Infant Nutrition & Growth to Optimize Outcome

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Partnering to Improve Health Care Quality
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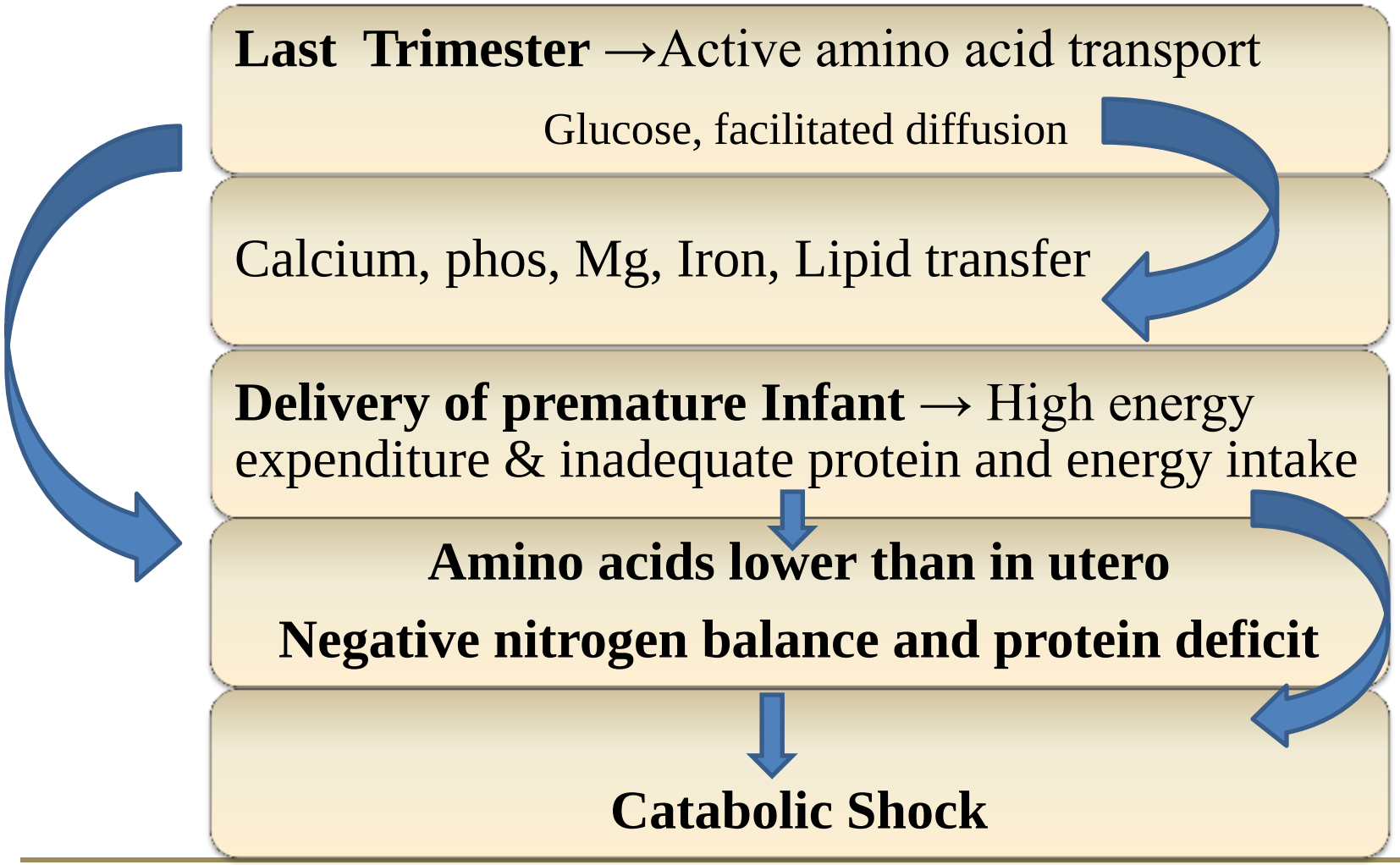
Objectives

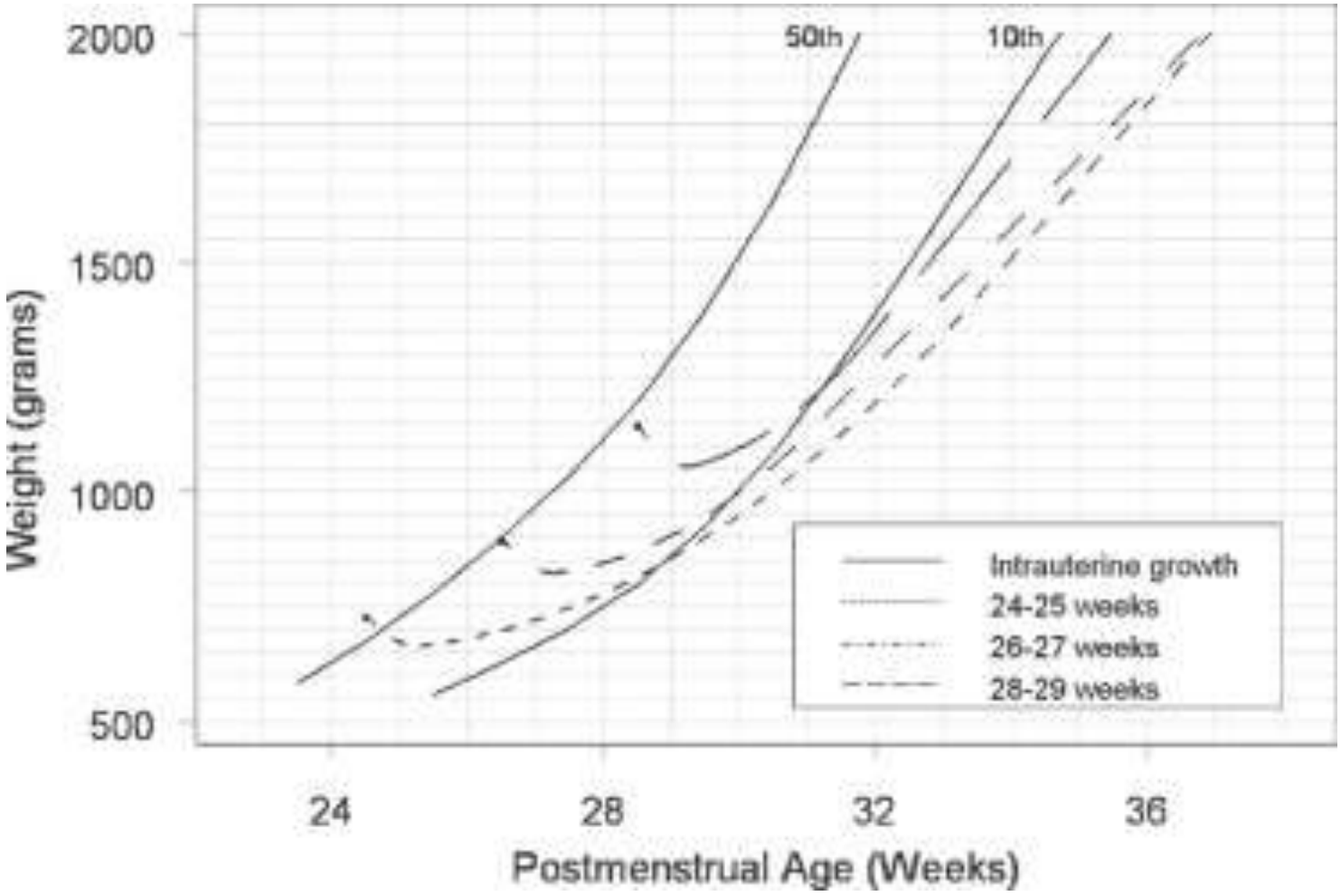
- Developing a standardized nutritional toolkit
- Early IV protein, lipid, & energy requirements
- Early initiation of enteral feeds
- Human milk diet

Rationale for Aggressive Nutrition



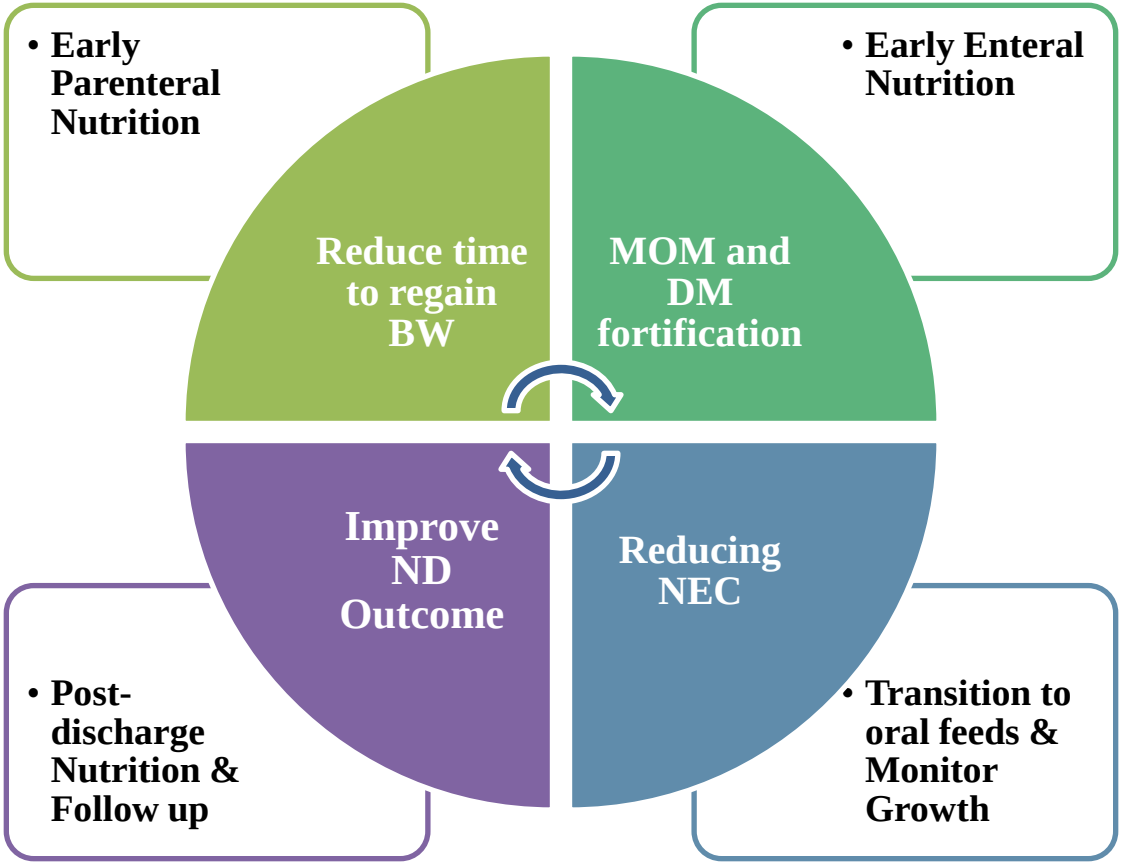
Prevent Extrauterine Growth Restriction

Postnatal growth = Intrauterine growth



Ehrenkranz RA. NICHD Growth Observational Study. Pediatrics 1999

Components of Neonatal Nutrition



Adopted from Bhatia,2013

Early Neonatal Nutrition is Important

- Better postnatal growth & less likelihood of length and head circumference <10%ile
- Neurodevelopment
- NEC
- Sepsis
- ROP
- Impacts long term morbidity

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Develop a Standardized Nutritional Toolkit

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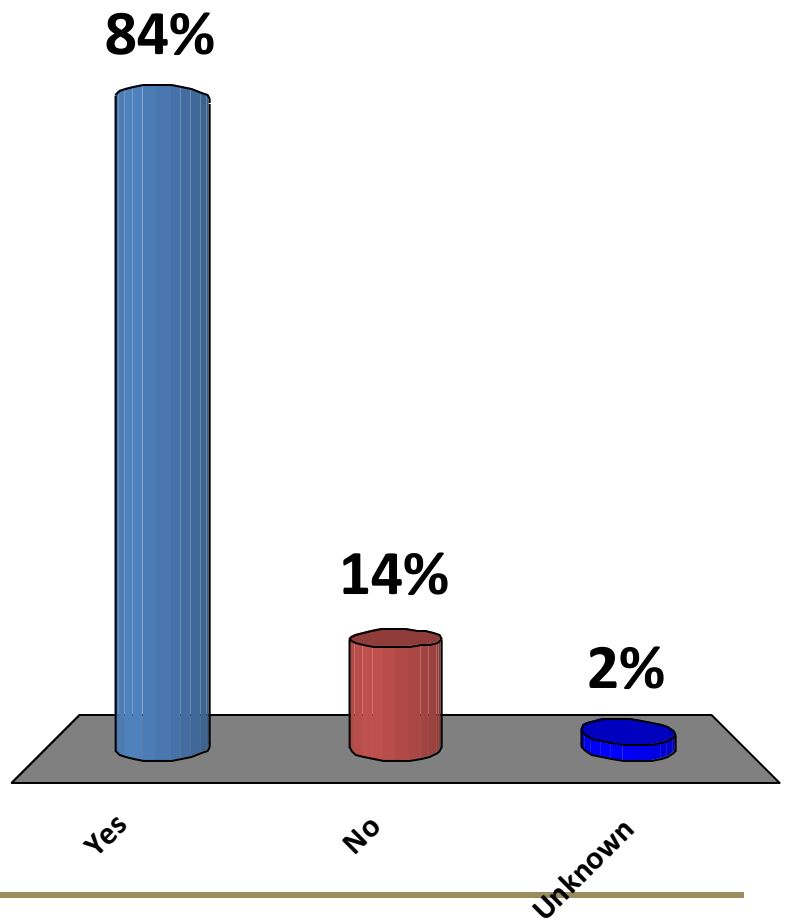
Does your NICU have a standardized nutrition guideline for VLBW?

A. Yes

B. No

C. Unknown



Standardized Guidelines Improve Clinical Outcomes

- 0 day of life
- Lowers morbidity & improves outcomes [1]
- Improves feeding tolerance & decreases TPN days[2]
- Less discharge weight <3rd%ile [2,3]
- Decreases variability of nutrition related outcomes[2,3]
  - NEC, late onset sepsis

[1]*Patole SK. Systemic reviews and meta-analysis,2005.*
[2]*McCallie KR .Improved outcomes with standardized feeding protocol in VLBW. Journal of Perinatology 2011.*
[3] *Street JL. Implementing feeding guidelines in NICU results in less variability in nutrition outcomes,2006*

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Early IV Protein, Lipid, & Energy Requirements

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In your NICU, when are IV **protein** initially started in VLBW infants?

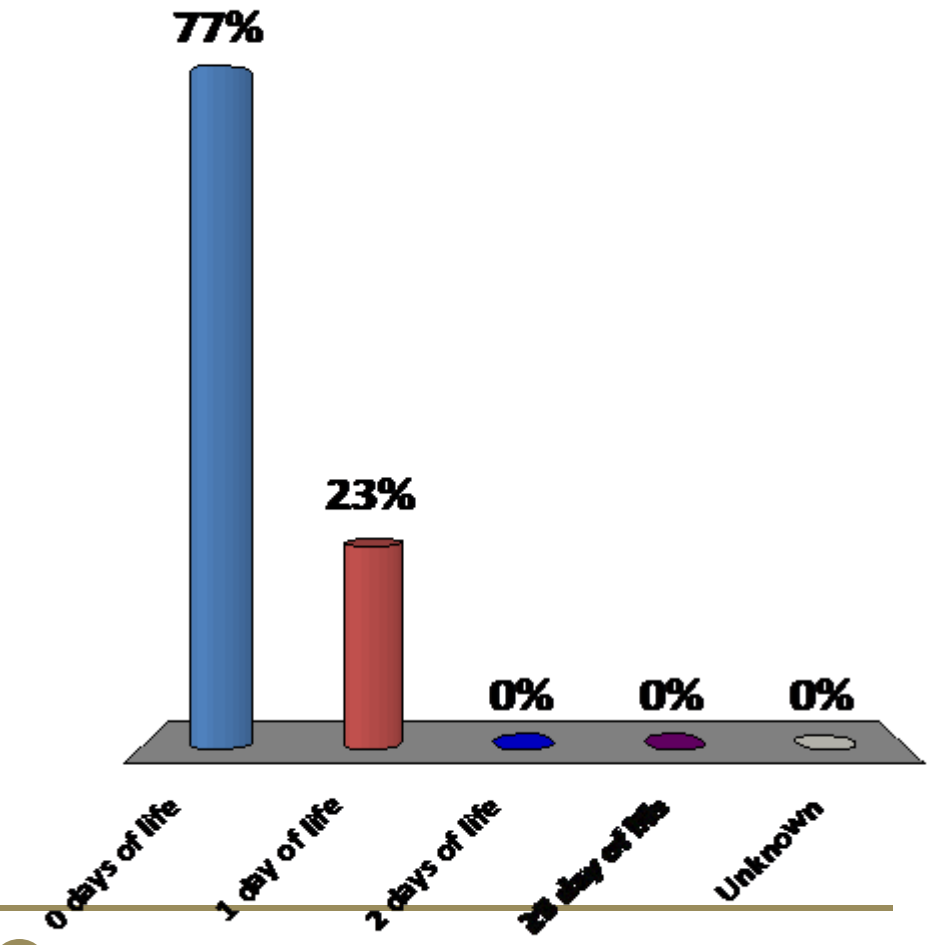
A. 0 days of life

B. 1 day of life

C. 2 days of life

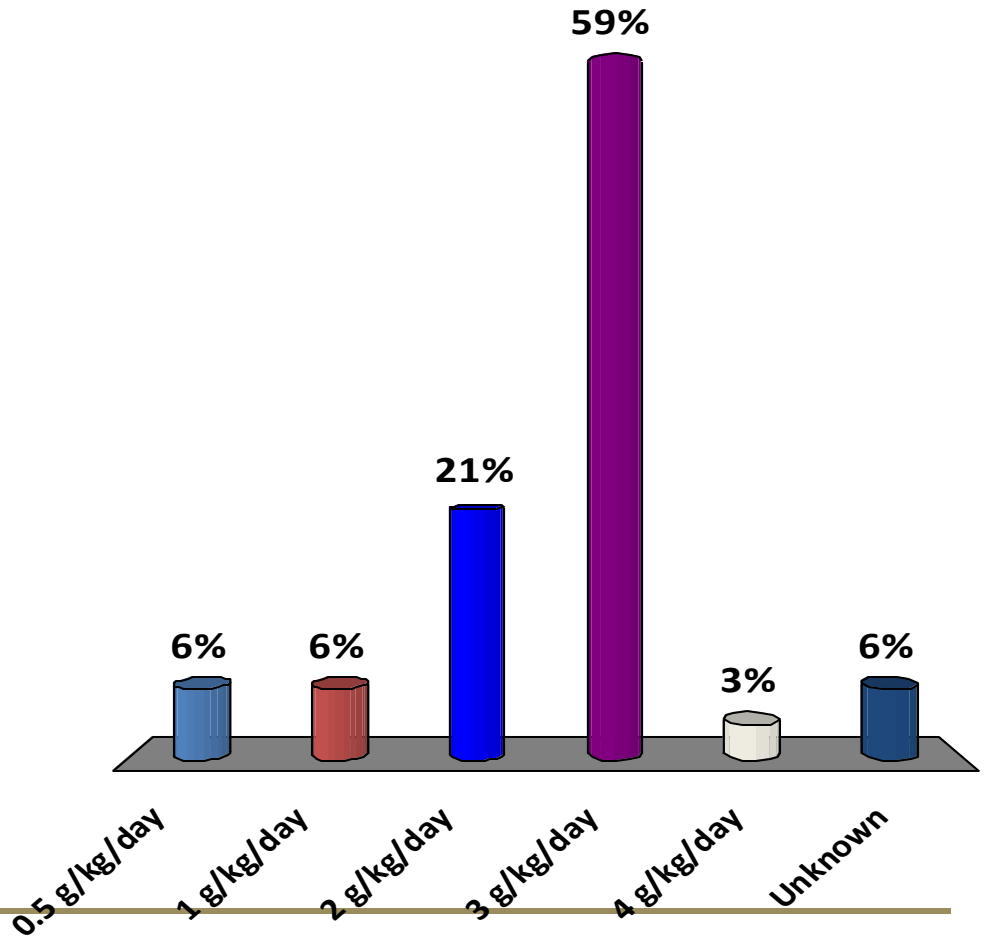
D. ≥3 day of life

E. Unknown



In your NICU, what is the initial IV **protein** administration for VLBW infants?

A. 0.5 g/kg/day
B. 1 g/kg/day
C. 2 g/kg/day
D. 3 g/kg/day
E. 4 g/kg/day
F. Unknown



In your NICU, when are **lipids** initially started in VLBW Infants?

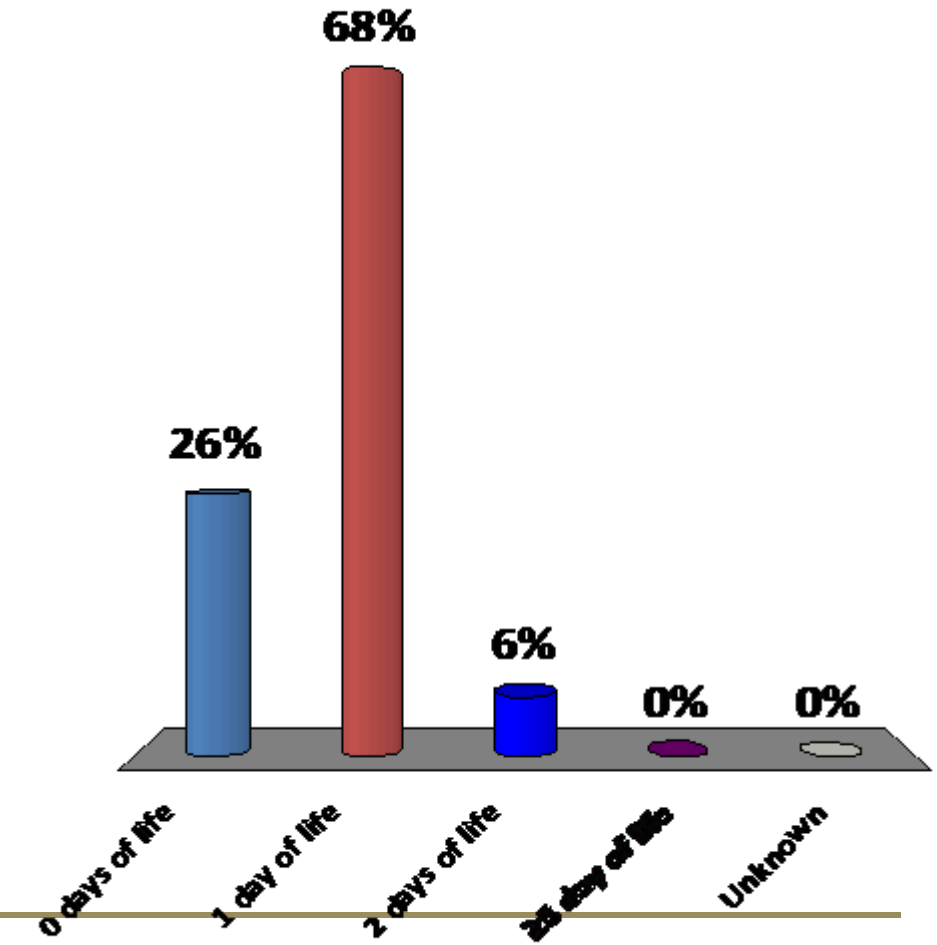
A. 0 days of life

B. 1 day of life

C. 2 days of life

D. ≥3 day of life

E. Unknown



In your NICU, what is the initial IV **lipids** administration for VLBWs?

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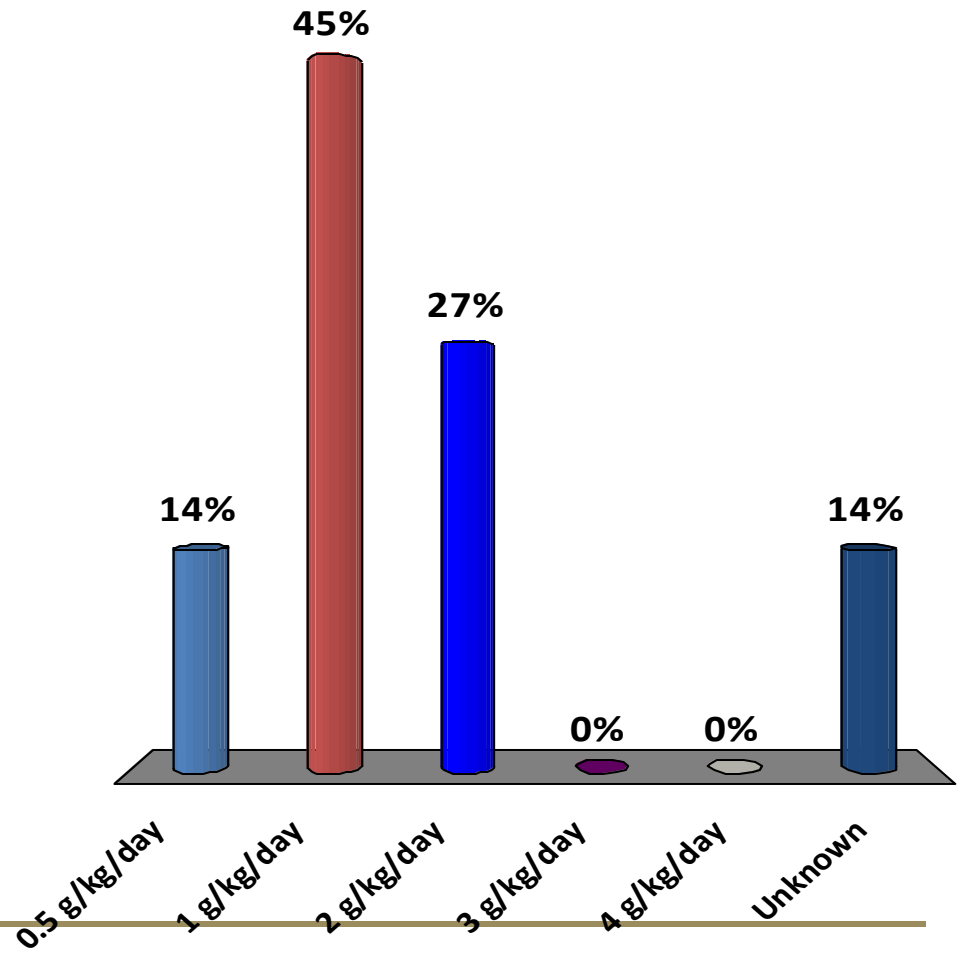
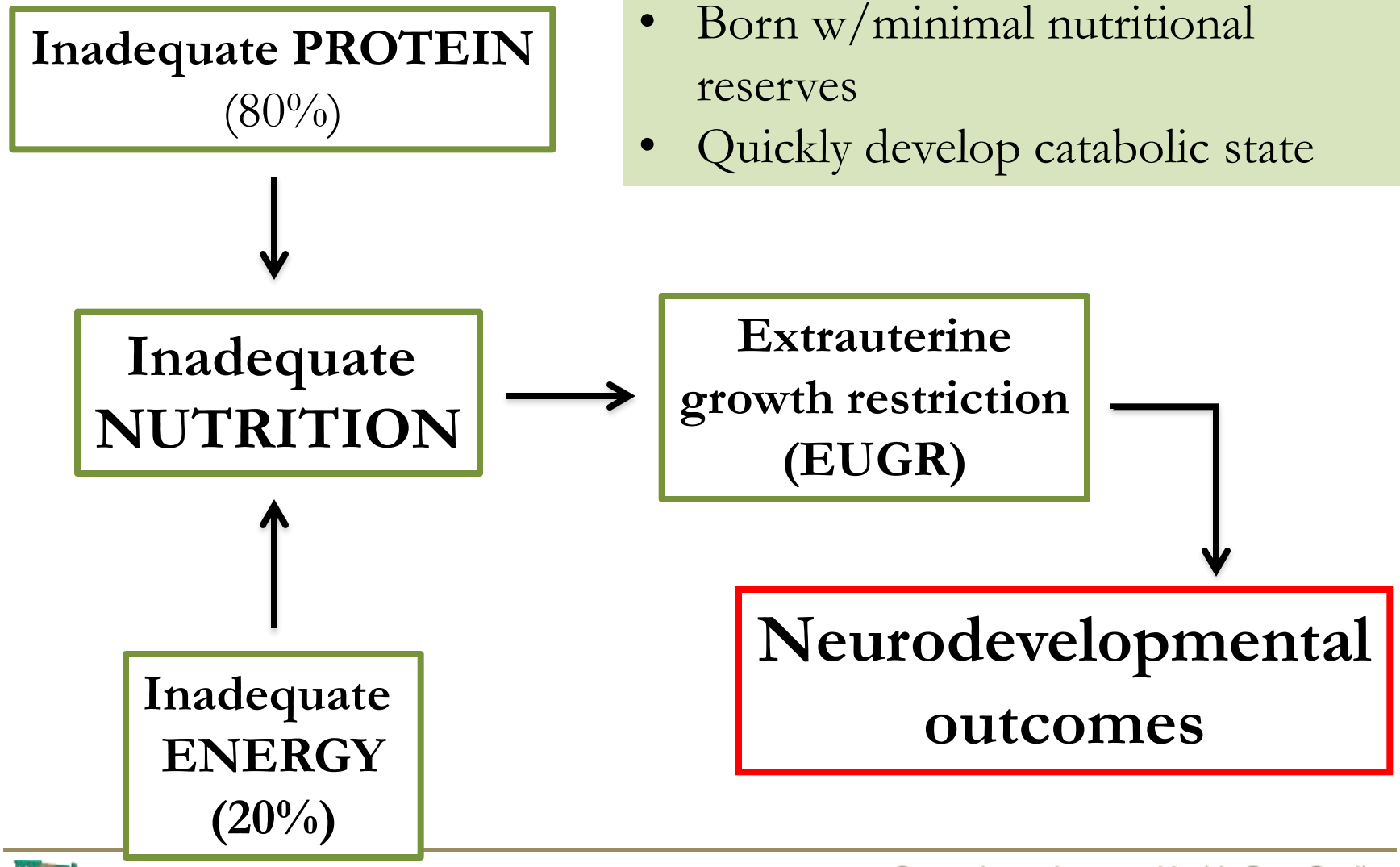


Nutrition Challenges in VLBW Infants

- Born w/minimal nutritional reserves
- Quickly develop catabolic state

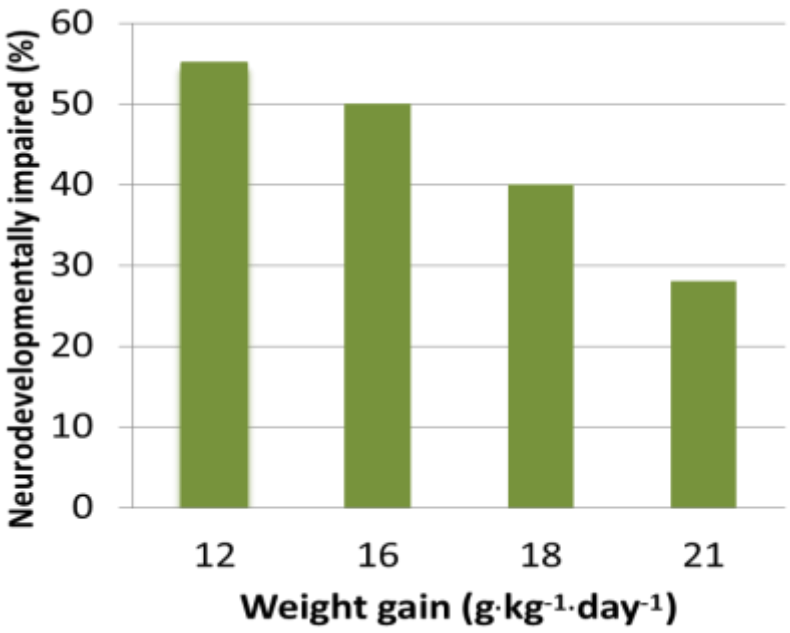


Ziegler E. J Pediatr .Gastroenterol. Nutr 2007.

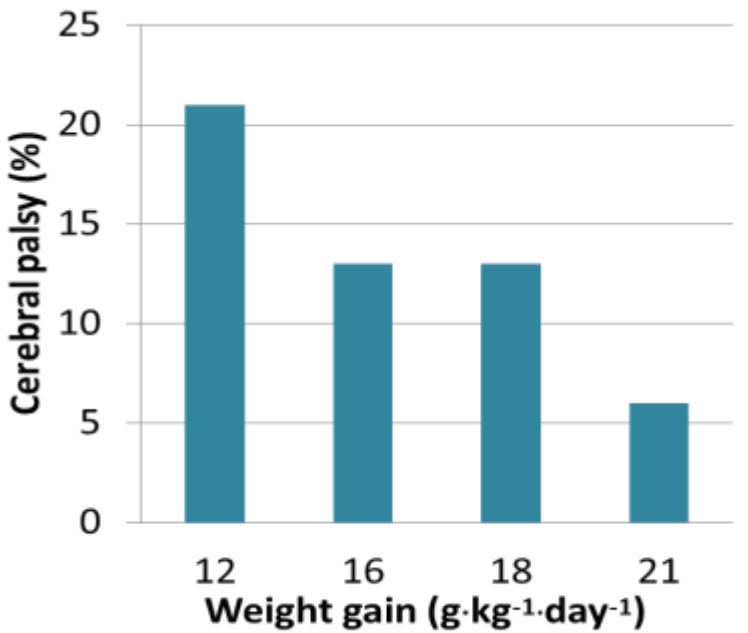
Nutrition & Neurodevelopmental outcomes

Bayley II at 18 mo. CGA[1]	n=148
Every 1 g/kg/day PROTEIN	Increase MDI by 8.2 points
Every 10 kcal/kg/day ENERGY	Increase MDI by 4.6 points

[2]



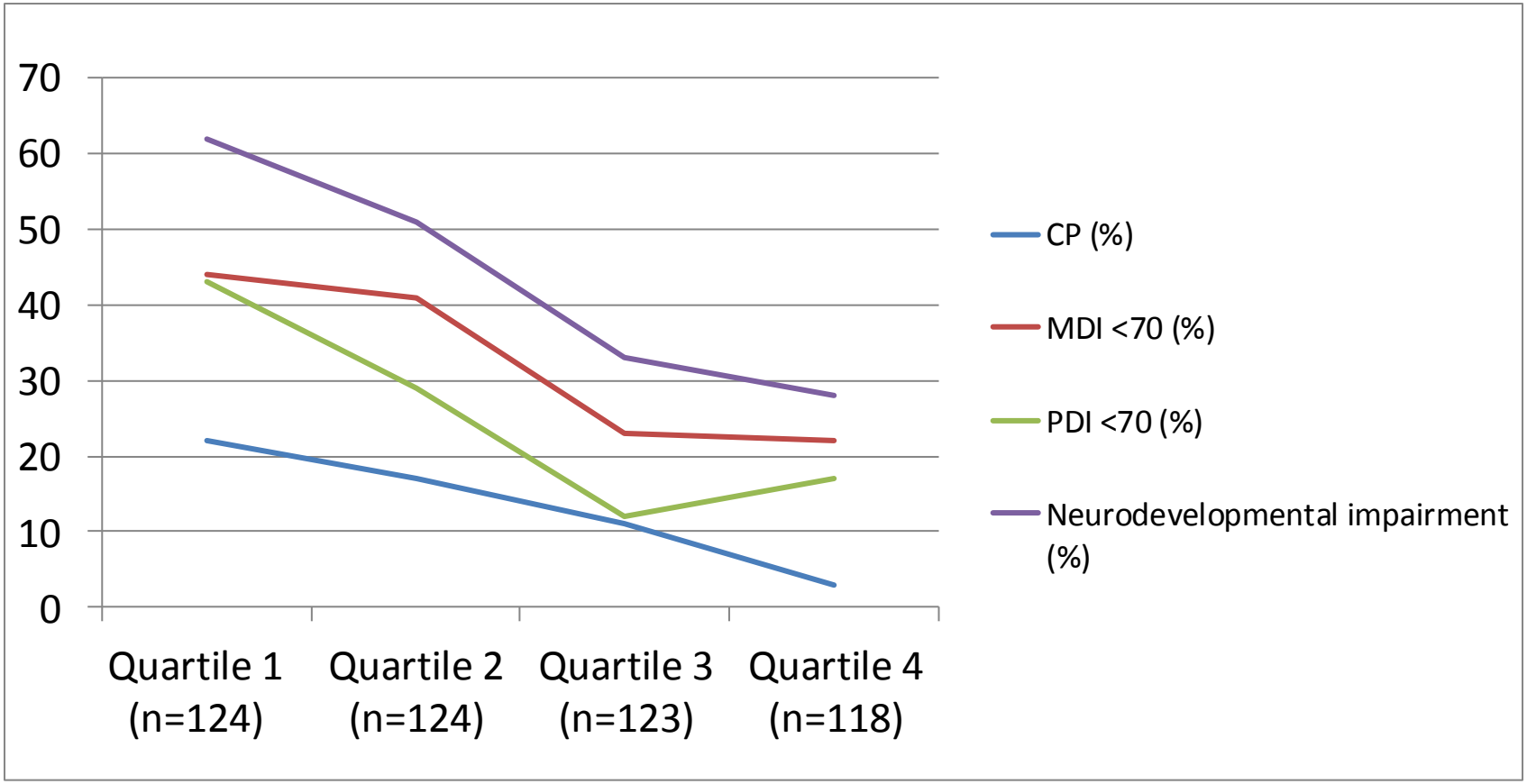
[2]



[1]*Stephens BE, et al. First week protein and energy intakes are associated with 18 month developmental outcomes in ELBW infants. Pediatrics. 2009.*

[2]*Ehrenkranz, et al. Growth in NICU influences neurodevelopmental & growth outcomes of ELBW. Pediatrics 2006.*

Outcomes at 18 to 22 Months' Corrected Age According to Head Circumference Growth Quartile



Ehrenkranz, et al. Growth in NICU influences neurodevelopmental & growth outcomes of ELBW. Pediatrics 2006.

Early IV Protein Intake Associations

- Less hyperglycemia & hyperkalemia and ↑ Nitrogen retention[1]
- Less ROP[2]
- Better postnatal growth[3,4,5, 6]
  - lean tissue growth
  - organ development
- Less discharge length < 10th % ile & better 18-month developmental outcomes[4,5,6,7]

[1]Ibrahim HM, 2004. [2] Can E.2013, [5]Ehrenkraz RA, 2006. [4]Pointdexter BB 2006. [5]Stephens BE , 2009. [6]Isaacs EB, 2009. [7]Hay WW, Thureen P. Pediatr Neonatol. 2010.

Early IV lipid Intake

- Positive effect on nitrogen balance & improves energy intake[1]
- Growth[2]
  - Less discharge weight for age <10th%ile[1,2]
  - Less EUGR[2]
- Neurodevelopmental outcomes
- Less ROP[1]
- Less NEC[1]

Safe & tolerated in VLBWs

(2 g/kg/day on day 1)

[1]D.Drenvkpohl. Randomized trial of VLBW infants receiving high IVFE during first week of life. Pediatrics 2008. [2]A.Dinerstein.Early and aggressive nutrition in VLBW infants. Journal of perinatology 2006

Early, aggressive Nutritional Strategy in VLBW

	Aggressive (n = 117)	Conventional (n = 65)	p
EUGR at 40 wks PMA, number (%)	62 (53)	50 (77)	0.005
Wt (kg) at 40 wks PMA, median (range)	2.95 (2.08-4.83)	2.7 (1.68-3.66)	0.002
Length (cm) at 40 wks PMA, mean (SD)	46.6 (2.6)	45.6 (2.7)	0.009
Head circumference(cm) at 40 wks PMA, mean (SD)	35.2 (0.17)	34.3 (0.21)	0.002
Days to regain birth weight, median (range)	10 (1–21)	16 (1–29)	<0.001
Maximum weight loss, mean (SD)	9 (4.9)	13.3 (6.1)	<0.001
Day of life at max weight loss, mean (SD)	4.7 (2.1)	12.7 (2.3)	0.005

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A Dinerstein et al. Early & aggressive nutritional strategy decreases postnatal growth failure in VLBW infants. Journal of perinatology 2006

Recommended Early IV Nutrition in first week

Nutrient	Day 0[a]	Day 1-2	Day 3
Amino acids g/kg/day*	≥2	≥3.5	3.5- 4
Lipid g/kg/day	≥2	3-4	3-4
Total Energy Kcal/kg/day	60-80	80-100	≥100

***For optimal lean tissue growth: 3-3.3 g protein per 100 kcal**

[a] First 24hours of life

B Koletzko et al. Nutritional care of preterm Infants. Scientific basis & practical guidelines. 2014

FPQC vs. VON (2013)
Weight Gain at Discharge

	FPQC		VON	
	%	n	%	n
Discharge weight gain <10th%ile, mean (IQR)	48.6 (41.7-54.4)	1,851	51.7 (41.0-65.3)	48,134
Discharge head growth <10th%ile, mean (IQR)	23.3 (16.7-30.7)	1,837	29.0 (18.8-37.0)	46,164

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Early Initiation of Feeds
(≤ 5 days of life)

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In your NICU, when are first enteral feeds initiated in clinically stable VLBW infants?

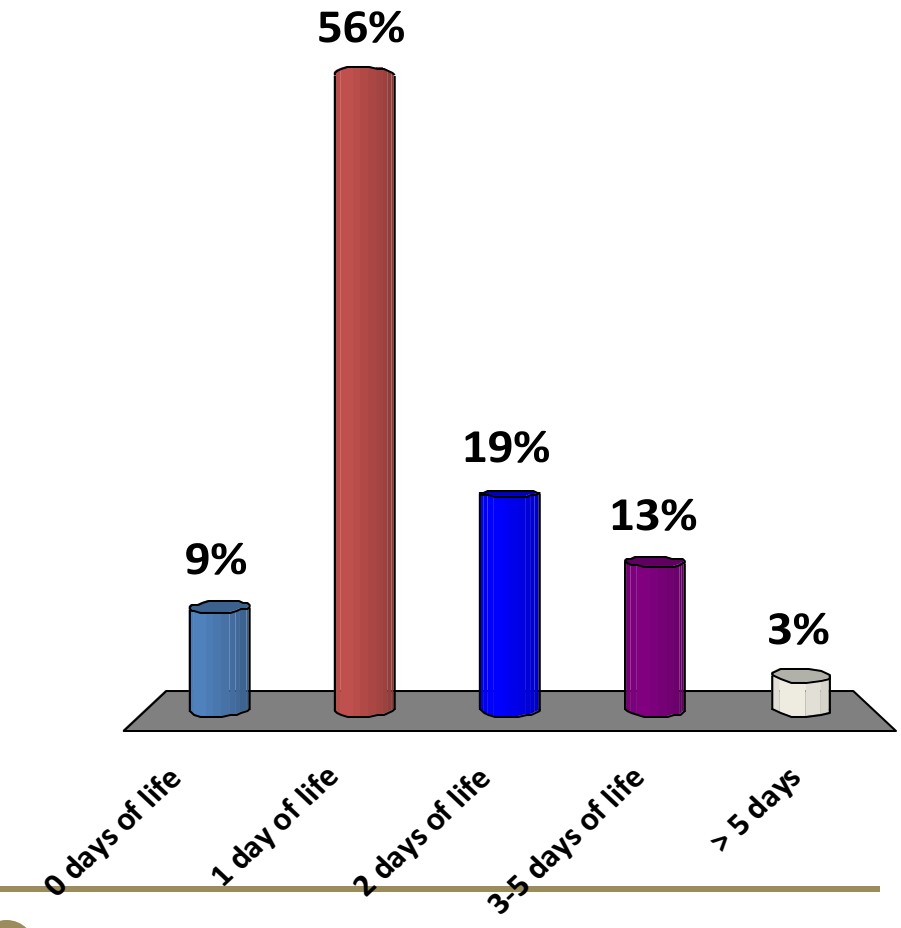
A. 0 days of life

B. 1 day of life

C. 2 days of life

D. 3-5 days of life

E. > 5 days



Early Initiation of Enteral Feeds

- Hormonal stimulation of intestine growth[1]
- Improves feeding tolerance[1]
- Decreases TPN days → Decreases cholestasis[1]
- Decreases NEC[1,2]

ASPEN clinical guidelines (2012)	
Initiate feeds	≤ 2 days of life
Advance feeds	~30 ml/kg/day*
Type of feed	Exclusive human milk
*For infants >1 kg	

[1] *Evidence based guidelines for optimization of Nutrition for VLBW, NeoReviews, 2013*
[2] *Fallon et al; ASPEN clinical guidelines: nutrition support of neonatal patients, JPEN 2012*

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Human Milk Diet

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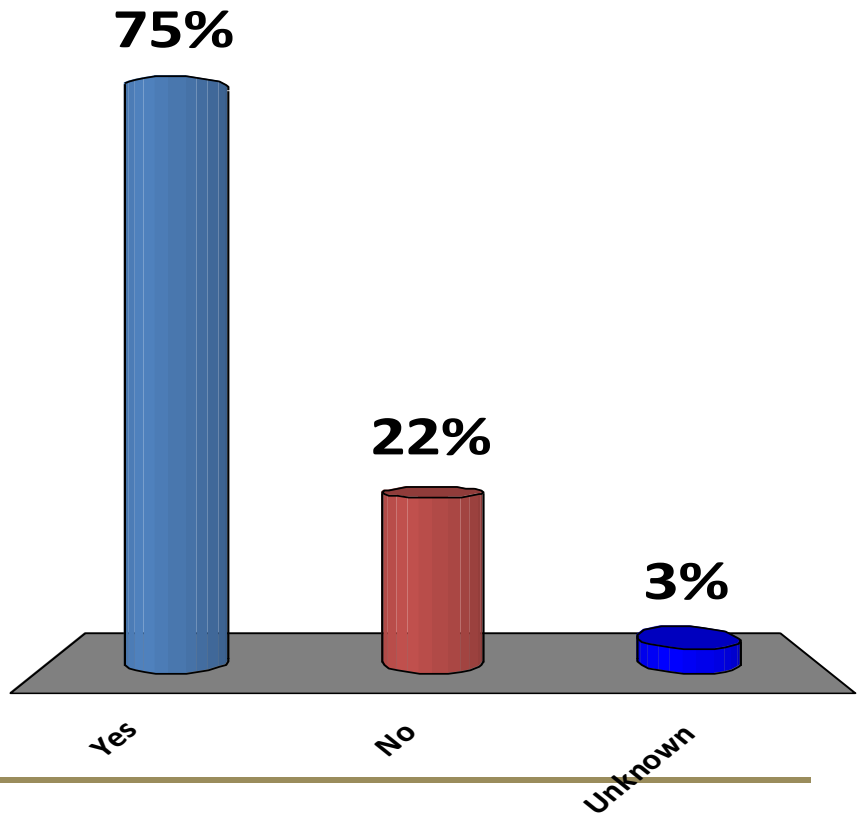
Does your NICU use an **exclusive** human milk (mother's own milk or donor breast milk) in VLBW infants during the first month of life?

A. Yes

B. No

C. Unknown

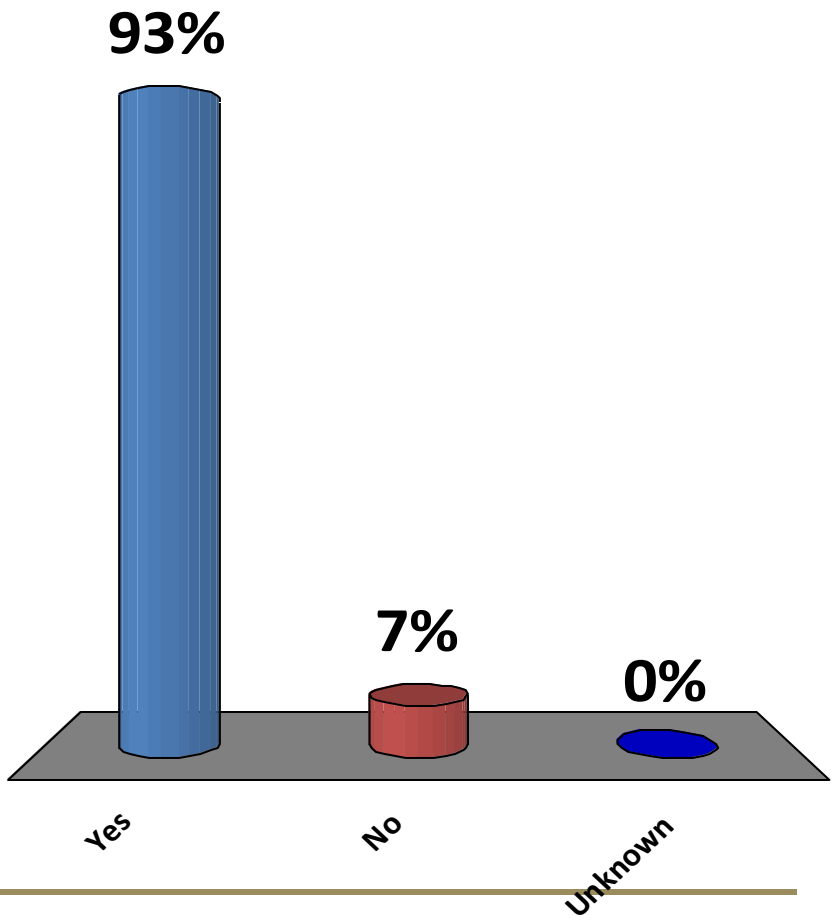


Does your NICU support the use of donor human milk?

A. Yes

B. No

C. Unknown



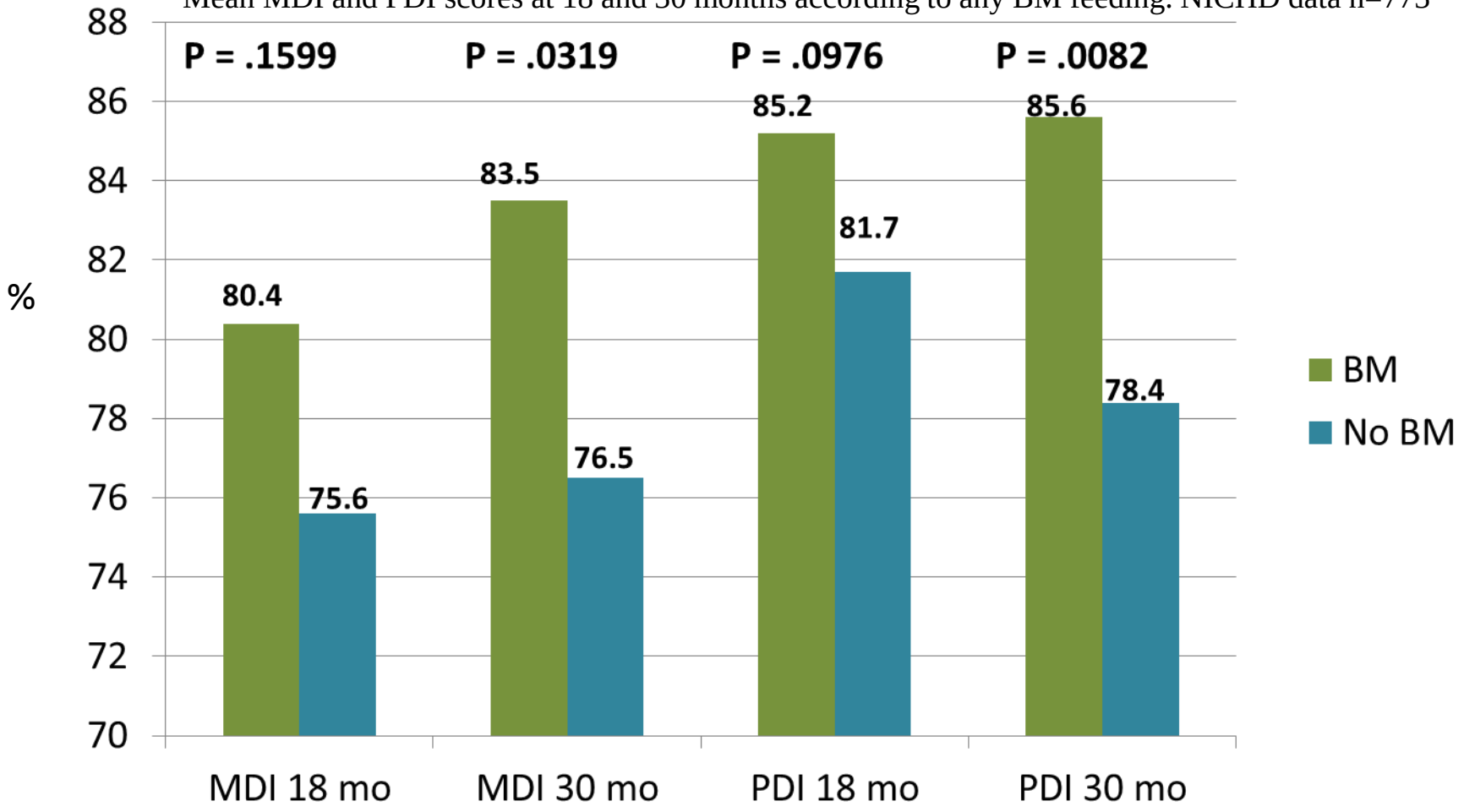
Human milk - Best Diet for VLBW Infants

- AAP recommends breastfeeding for all infants regardless of birth weight[1]
  - Premature: mothers own milk or donor human milk
- Improved neurodevelopmental outcomes[2,3]
- Decreased NEC[2,3]

[1]AAP section on breastfeeding and the use of human milk. Pediatrics 2012
[2]Vohr BR, Poindexter BB, Beneficial effects of breast milk in the neonatal intensive care unit on developmental outcomes of extremely low birth weight infants at 18 months of age. Pediatrics. 2006
[3]Maayan-Metzger . Human milk versus formula feeding among preterm infants: short-term outcomes. Am J Perinatol. 2012.

Neurodevelopmental Outcomes Associated with Human milk use

Mean MDI and PDI scores at 18 and 30 months according to any BM feeding. NICHD data n=773



Vohr BR, Poindexter BB. et al. Persistent beneficial effects of breast milk ingested in NICU on outcomes of ELBW at 30 months of age. Pediatrics, 2007

Donor Human Milk

- Similar to term milk (energy, fat, & lactose)[1]
- Insufficient protein for preterm infant[1]
- Effects of pasteurization (IgA, lactoferrin, lipase)[1]
- Slower postnatal growth in early neonatal period (vs. formula)

POTENTIAL BENEFITS[2]
NEC[2,3]
Feeding tolerance[2]
Long term health outcomes, ↓BP & LDH:HDL[2]
Enhanced Immunity (short &long term)[2]

[1]May J. Human Milk- Tables of the antimicrobial factors and microbiological contaminants relevant to human milk banking. La Trobe University. Available at:http://www.latrobe.edu.au/microbiology/milk.html.2013
[2]Arslanoglu S . Donor human milk in preterm infant feeding. Evidence and recommendations. Journal of Perinat. Med 2010 [3]Boyd CA. Donor breast milk versus formula for preterm infants: Systemic review and meta-analysis .Arch Dis Child Fetal Neonatal.2007

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FPQC vs. VON (2013)

- Infants at Discharge on any Human Milk
- NEC
- Late onset sepsis

FPQC vs. VON (2013)

	FPQC		VON	
	%	n	%	n
All infants: Any human milk, mean (IQR)	41.8 (33.3-48.7)	2,252	50.5 (36.7-64.1)	58,548
All infants: Human milk only, mean (IQR)	9.7 (3.9-18.4)	2,252	11.2 (1.5-15.8)	58,548
All infants: Formula only, mean (IQR)	47.1 (41.7-55.6)	2,252	36.9 (19.8-46.1)	58,548
NEC	4.4 (2-5.5)	2,251	5.1 (0-7)	58,516
Any late Infection	14.5 (10.8-18.3)	2,165	12.3% (4.8-15.9)	55,990

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Are we interested in pursuing a nutrition project?

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What should our project scope include?

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What evidence-based measures do we want to address?

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What measures should be evaluated for each of the goals?

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THANK YOU

FPQC leadership

Dr. Tony Napolitano

Dr. Maya Balakrishnan