Top Ten Things an ELBW Will Tell You

Mindy Morris, DNP, NNP-BC, CNS
engagegrowthrive@gmail.com

Objectives

- Describe one evidence-based nutritional intervention to prevent post-natal growth failure
- Identify two neuroprotective practice strategies to implement in the care of the ELBW Infant
- List two evidence-based respiratory practices to apply in the care of the ELBW Infant

Disclosures

- I have no financial disclosures or conflicts of interest pertinent to this presentation

Survival/Survival w/o Morbidity

1998-2002 (N = 9132)

GA	Survival	Survival w/o Morbidity
22	6%	<1%
23	26%	1%
24	56%	6%
25	76%	14%
26	85%	24%
27	89%	38%
28	91%	46%

2003-2007 (N = 9600)

GA	Survival	Survival w/o Morbidity
22	6%	0
23	26%	2%
24	55%	5%
25	72%	14%
26	84%	28%
27	88%	37%
28	92%	49%

2008-2012 (N = 8723)

GA	Survival	Survival w/o Morbidity
22	7%	0
23	32%	2%
24	62%	7%
25	77%	17%
26	85%	27%
27	90%	43%
28	94%	56%

Adapted from: Stoll et al *JAMA* 2015 (Neonatal Research Network Centers)

#10 Care for Us Using Evidence-based Practices

Adapted from: Melnyk & Fineout-Overholt, 2005

#10 Care for Us Using Evidence-based Practices

- Challenges of confounding factors
- Slow translation of research knowledge into practice
- Move forward with science **&** common sense

Stoll et al *JAMA* 2015 (Neonatal Research Network Centers); Balas & Boren, Clinical Knowledge for Healthcare, 2000

#9: Give Us A Great Start to Life!

Ante/Perinatal Care

- Antenatal steroids
- Prevention of complications: Chorioamnionitis

Prenatal Meeting

- Reduce variability in counseling
- Family Shared Decision Making
  - Personalize approach
  - Put information in context
    - Each family is different
  - Words are important
  - Do not take away HOPE

Raju, et al., AJOG, 2014; Staub et al., Acta Paediatrica, 2014; Kramer, et al., *Sem Fet Neo*, 2009

#9: Give Us A Great Start to Life!

Antenatal Practices

1993-1997 (N = 7027)

Practice	%
Steroids	57%
Antibiotics	62%
Cesarean	46%

1998-2002 (N = 9132)

Practice	%
Steroids	79%
Antibiotics	74%
Cesarean	52%

2003-2007 (N = 9600)

Practice	%
Steroids	80%
Antibiotics	67%
Cesarean	59%

2008-2012 (N = 8877)

Practice	%
Steroids	85%
Antibiotics	71%
Cesarean	63%

Adapted from: Stoll et al *JAMA* 2015 (Neonatal Research Network Centers)

#9: Give Us A Great Start to Life!

Delayed Cord Clamping

- 30-60 seconds
- Decreases perinatal & neonatal morbidity
  - Better hemodynamic stability
  - Auto-transfusion, < need for RBC
  - Decrease IVH (all grades)
  - Lower risk NEC
  - No maternal risks

Admission Labs

- Increases hgb & circulating volume
- Lower incidence
  - RBC transfusions
  - IVH
  - Painful procedures
- Greater blood culture sensitivity

Brocato et al., *Obstet Gynecol Surv* 2016; Bayer, K. *Adv Neonatal Care*, 2016; Perlman, et al., *Pediatrics*, 2015; Dongli, et al., *PLOS One*, 2015 ; Rabe et al., *Cochrane Database Syst Rev* 2012

Baer et al., *J Perinatol* 2013; Carroll et al., *J Perinatol* 2012; Chistensen et al., *Transfusion* 2011

#9: Give Us A Great Start to Life!

Delivery Room Practice

- Goal: stabilization without injury
- Teamwork - communication
- Golden Hour Checklist
- Respiratory Management
- Neuroprotective Focus
- Thermoregulation

Perlman, et al., *Pediatrics,* 2015; AAP/AHA Neonatal Resuscitation 5th ed 2006; CPQCC, www.cpqcc.org; Finer & Rich, 2004 *Current Opinion in Pediatrics;* Vohra, 1999; Bjorkland, 2000; Epicure Study Group, 2000; Vohra, 2004; Lyon, 2004; Knobel, 2005

#8 Keep the PEEP/CPAP

- Maintains/Increases Functional Residual Capacity
- Improves static lung compliance
- Reduces airway resistance
- Improves V/Q matching
- Decreases BPD

#8 Keep the PEEP/CPAP

- Meta-analysis: early use of CPAP with selective surfactant in ELBW results in lower BPD compared with prophylactic surfactant
- Early CPAP with delayed surfactant administration does not increase risk of adverse outcomes
- Early CPAP may reduce duration of mechanical ventilation & postnatal steroid administration
- Individualize care based on patient needs

COMMITTEE ON FETUS AND NEWBORN, *Pediatrics,* 2014

#8 Keep the PEEP

BPD by Gestational Age

1993-1997 (N = 5142)

Gestational Age	%
All	36%
22	41%
23	57%
24	54%
25	47%
26	40%
27	31%
28	22%

1998-2002 (N = 6807)

Gestational Age	%
All	43%
22	52%
23	71%
24	68%
25	58%
26	47%
27	33%
28	25%

2003-2007 (N = 7085)

Gestational Age	%
All	42%
22	85%
23	73%
24	69%
25	55%
26	44%
27	34%
28	24%

2008-2012 (N = 6909)

Gestational Age	%
All	45%
22	88%
23	79%
24	69%
25	57%
26	50%
27	36%
28	24%

Adapted from: Stoll et al *JAMA* 2015 (Neonatal Research Network Centers)

#8 Keep the PEEP

Respiratory Support 22-28 weeks

2003-2007 (N = 8546)

Support	%
Never ventilated	10%
Any HF	37%
Any CV	87%
Any Nasal IMV	18%
Any CPAP	78%
Only Nasal IMV	1%
Only CPAP	8%

2008-2012 (N = 8034)

Support	%
Never ventilated	13%
Any HF	38%
Any CV	83%
Any Nasal IMV	32%
Any CPAP	78%
Only Nasal IMV	2%
Only CPAP	9%

Adapted from: Stoll et al *JAMA* 2015 (Neonatal Research Network Centers)

#8 Keep the PEEP/CPAP

Summary

- Standardize Practice to maintain PEEP
  - System
  - Strategy
- Work as a Team
- Mindful Care
  - Appropriate Equipment
  - Position prone when possible
  - It takes TWO
- Assess practices

#7 We Love Caffeine

- The ELBW has poor control of breathing which results in
- Therapeutic strategies for apnea: NCPAP & methylxanthines (caffeine)
  - Reduces frequency of AOP, need for mechanical ventilation, failed extubation

	Caffeine	Placebo	P Value
*Death	5.2%	5.5%	0.73
*BPD	36.3%	46.9%	<0.001
PDA (Drug)	29.3%	38.1%	<0.001
PDA (Surg.)	4.5%	12.6%	<0.001

	Caffeine	Placebo	P Value
Death or Disability	40.2%	46.2%	0.008
Cerebral Palsy	4.4%	7.3%	0.009
Cognitive Delay	33.8%	38.3%	0.04
Severe ROP	5.1%	7.9%	0.01

Adapted from: Schmidt et al. *NEJM* 2006; Schmidt et al. *NEJM* 2007

- Early dosing (< 3 days) may be beneficial (No RCT)

Daly et al., *Pediatrics*, 1969; Miller, et al., *J Pediatr*, 1985; Henderson-Smart, *Aust Paediatr J*, 2003; Schmidt et al. *NEJM* 2006; Dobson, et al., *J Pediatr* 2014; Eichenwald & Committee on Fetus & Newborn, *Pediatrics*, 2016; Davis et al., *J Pediatr*, 2010; Patel, et al., *Pediatrics* 2013

#7 We Love Caffeine

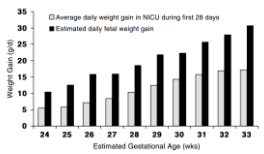
- AOP reflects immaturity of respiratory control
- *Generally* resolves by 37 weeks PMA
- Caffeine citrate is a safe & effective treatment

- No trials have addressed when to discontinue in preterm infants
  - Sole use of CGA not recommended
  - Consider caffeine may decrease intermittent hypoxemia
    - Sustain pro-inflammatory cascade
    - Treatment
      - O2 Saturation Targeting; CPAP; Caffeine

Eichenwald & COMMITTEE ON FETUS AND NEWBORN, *Pediatrics*, 2016

Eichenwald & COMMITTEE ON FETUS AND NEWBORN; Rhein et al., *JAMA Pediatr*, 2014; Doyle, et al., *J Perinatol*, 2016; Abdel-Hady, et al., *World J Clin Pediatr*, 2015; Poets, et al., *JAMA*, 2015; 2014 Martin, et al., *Neonatology*, 2011

#6 We Are What We EAT… or What We're Fed



From: Clark et al., *J Perinatol*, 2003

- Growth failure improved; still significant problem
- 30-40% still growth restricted at 18-22 months
- Predominant cause: Inadequate nutrition - Nutrient deficits
- Inadequate nutrition has significant consequences on ND outcomes

Ziegler et al, 2007; Bloom et al, 2003; Clark et al., *J Perinatol*, 2003; Neubauer et al, 2008; Cooke, 2006; Ehrenkranz, et al, *Pediatrics*, 2006; Bolduc & Shevell, 2005; Cooke & Foulder-Hughes, 2003; Gale et al, 2006; Ehrenkranz, R. *Sem Peinatol*, 2007; Ehrenkranz, R. *J Pediatr*, 2014

Growth Failure: Poor Neurodevelopmental Outcomes

Outcomes at 18-22 months

Outcome Weight gain	Q1 n = 124	Q2 n = 122	Q3 n = 123	Q4 n = 121	P value
g/kg/d	12	15.6	17.8	21.2	
CP (%)	21	13	13	6	<0.01
MDI < 70 (%)	39	37	34	21	<0.01
NDI (%)	55	49	41	29	<0.01
Rehosp.	63	60	50	45	<0.01

Outcome Head Circ.	Q1 n = 124	Q2 n = 122	Q3 n = 123	Q4 n = 121	P value
cm/week	0.67	0.87	0.98	1.17	
CP (%)	22	17	11	3	<0.01
MDI < 70 (%)	44	41	23	22	<0.01
NDI (%)	62	51	33	28	<0.01

cm/week length	0.82	0.91	1.00	1.11	
	47	43	29	28	<0.001

Adapted from: Ehrenkranz, et al., *Pediatrics* 2006

#6 We Are What We EAT… or What We're Fed

- Brain is the highest metabolic organ
- Brain processes affected by nutrition
  - Neurogenesis
  - Neuronal differentiation
  - Myelination
  - Synaptogenesis

Ghassan, et al., *Clin Med Insights: Ped*, 2015; Ramel, et al., *Curr Pediatr Rep*, 2014; Ramel & Georgieff, *World Rev Nutr Diet*, 2014

#6 We Are What We EAT… or What We're Fed

Summary:

- Support Lactation
  - **MOM**/DHM
- Reduce Practice Variation
- Make Nutritional Goals a Priority
  - Calculate daily caloric intake & Nutrient components
- Monitor all Anthropometric Measures
  - Linear growth indexes Organ growth

Ramel, et al., *Curr Pediatr Rep*, 2014; Pfister & Ramel, *Clin Perinatol*, 2014; Ramel et al., *Neonatology*, 2012

#5 & #4 Neuroprotection/Neurodevelopment

Impairment by Bayley	ELBW %
Unimpaired	16%
Mild Impairment	22%
Moderate/Severe Impairment	22%
Died	40%

Risk of NDI	ELBW
Neurosensory: Vision Hearing	9-25% 1-28%
Developmental: CP IQ < 2 sd/mean	15-23% 22-50%
Learning Disabilities	34-45%
Cognitive impairment	34-37%
Behavioral	15-40%

Adapted from: Gargus, et al., *Pediatrics*, 2009; Vanderbilt & Gleason, *Pediatr Clin N AM*, 2011 Review of Literature

	ELBW	Term
Cognitive	93.1	105.6*
Academic Reading Spelling Arithmetic	 98.0 96.8 90.0	 105.5* 104.2* 99.1*
Behavioral	11.0	7.9*

Behavioral Challenges	ELBW	Term
Hyperactivity	18%	9%
Conduct	11%	10%
Emotional	21%	9%
Peer	20%	12%

Adapted from: Hutchinson, et al., *Pediatrics*, 2013; Delobel-Ayoub, et al., *Pediatrics*, 2009

#5 Neuroprotection – Prevention of IVH

- Incidence
  - ~20% of neonates < 1500 g
  - 20-25% of ELBW
- Timing
  - 25% first 12 hours
  - 50% first 24 hours
  - 90% first 72 hours
- Pathogenesis: Fragile Germinal Matrix & no Auto Regulation
- Vascular Factors
- Extravascular Factors
- Intravascular Factors

- NICU factors associated with IVH
  - High CPAP; Pneumothorax; Asphyxia
  - Hypo/Hypercarbia
  - Rapid fluid administration
  - Rapid change in BP
  - Hyper/Hypotension
  - Hypernatremia
  - Hypothermia
  - Thrombocytopenia
  - PDA
  - Seizure
  - Routine Cares

Volpe, et al., *Neurology of the Newborn*, 2008; McCrea et al., *Clinics in Perinatology*, 2008; Shah, N. & Wusthoff, C. *Neo Network*, 2016

Shah, N. & Wusthoff, C. *Neo Network*, 2016 ; Malusky & Donze, *Neonatal Network*, 2011; Limperopoulos, et al., *Pediatrics*, 2008

#5 Neuroprotection

Neuroprotection Bundles

- Head midline/neutral
  - +/- HOB elevated
- Thermoregulation
- Minimizing pain/stress
- Avoid harmful medications

- ELGAN Study
  - 6% of those with "normal" CUS diagnosed with CP
  - 38% with CP had "normal" CUS
- EPIPAGE Study
  - 4% of those with "normal" CUS diagnosed with CP
  - 1/3 with CP had "normal" CUS

Shah & Wusthoff, *Neonatal Network*, 2016 Malusky & Donze, *Neonatal Network*, 2011; McLendon et al. *Pediatrics* 2003

Kuban et al *Pediatr Radiol*, 2007; Kuban et al *J Child Neurology*, 2009; Ancel et al *Pediatrics*, 2006; Marret et al *PLoS One* 2013; Hintz, et al *Pediatrics*, 2015

#4 Neurodevelopment: Balance Protection & Promotion

- Protect Sensory Development
  - Sleep
  - Vision
  - Sound
- Too early/prolonged exposure can cause adverse ND outcomes
- The preterm infant ≠ the fetus: ***Preterm infant also does ≠ the term infant***
- Excessive/prolonged minimization can also be harmful: sensory deprivation

Smith J & Pineda, R. *Neo Network*, 2016; White, R. *NAINR*, 2015 ; Jobe, A. *J Peds*, 2014; Fichel & Coughlin, 2007; Bertelle et al., 2005; McGrath 2004; Peirano et al. 2003; Bryant et al 2004; Graven 2006; Hun et al 2013; Duran et al 2012

Our Impact – Integrating Knowledge into Practice

Summary

- Respect developmental science
- Opportunities Every Day
- Personal Presence
- Care practices change over time
  - Maturational-driven

#3 Consistency/Standardization

- Potential to improve care/outcomes
- Reduce hospital stay
- Reduce healthcare expenditures
- Decreases morbidity/mortality
- Team & Family Partnership
- Tools: Communication, Guidelines, Checklists, & QI
- Regionalized care reduces mortality
- Specialized care using *EBP* improves outcomes
- Implementation of *practice guidelines* with staff education in a *dedicated group* can impact major morbidities

Hasibeder, W. R., *Curr Opin Crit Care*, 2010; Phibbs, et al *NEJM*, 2007; Geary, et al *Pediatrics*, 2008; Chow, et al *Pediatrics*, 2003; Morris et al., *Pediatrics*, 2015

#3 Standardization/QI - Checklists

- Checklists standardize processes & reduce ambiguity
- The structure & predictability facilitate:
  - Translation of evidence into practice
  - Careful & systematic delivery of care, which reduces variability
  - Same knowledge is available to entire team
- Decreased death & complications have been demonstrated
  - Checklists are suited for some problems; not others
  - Checklists work best with teams/culture change

Winters et al., *Critical Care* 2009; Bosk, et al., 2009 *The Lancet;* Hales et al., 2008 *Int J Qual Health Care;* Haynes, et al., *NEJM* 2009; Pronovost, et al., 2006 *NEJM;* Gawande & Lloyd, *The Checklist Manifesto: How to get things right, 2010*

#2 It Takes a Village ….. Team-Based Care

- "Poor teamwork contributes to most adverse events"
- Systematic reviews:
  - Team processes & team behavior training significantly improve patient safety, clinical performance, & outcomes
  - Team model of care for ICU reduces mortality, length of stay, & cost of care
- Team-based care endorsed by: Society of Critical Care Medicine & AACCN
- Greater staff satisfaction & reduced resource utilization with a team-based approach to care & training in the NICU

Pronovost & Freischlag *JAMA* 2010; Schmutz & Manser *BJA* 2013; Durbin, C.G. *Crit Care Med* 2006; Salas & Rosen, *Qual Saf Health Care* 2013; Kim, et al., *Health Care Reform* 2010; Weled et al, *Crit Care Med* 2015; Morris et al., *Pediatrics*, 2015; Brodsky, et al., *BMJ Qual Saf,* 2013

#2 It Takes a Village ….. Team-Based Care

- Move from non-integrated to an integrated approach
  - Shared mental model
  - Tools to support the team
- Team-based model of care requires ongoing team building/training
- "The single biggest problem in communication is the illusion that it has taken place." George Bernard Shaw

Schmutz & Manser *BJA* 2013; Durbin, C.G. *Crit Care Med* 2006; Salas & Rosen, *Qual Saf Health Care* 2013; Weled et al, *Crit Care Med* 2015; Morris et al., *Pediatrics*, 2015; Brodsky, et al., *BMJ Qual Saf,* 2013

#1 Family is EVERYTHING

Family-centered care is associated with:

- Enhanced parent-infant attachment & bonding
- Decrease length of stay
- Greater family satisfaction

Ortenstand, et al., *Pediatrics*, 2010; Ramezani, et al., *Int J Community Based Nurs Midwifery*, 2014

#1 Family is EVERYTHING

- We long for normalcy
- Help us celebrate small victories

#1 Family is EVERYTHING

ONGOING SUPPORT

- Support groups or meetings with previous families
- Interactions with other families sharing a similar experience
- Prepare for discharge follow-up & expectations