Scientific Year in Review: Implications for Neonatal Brain-Shapers

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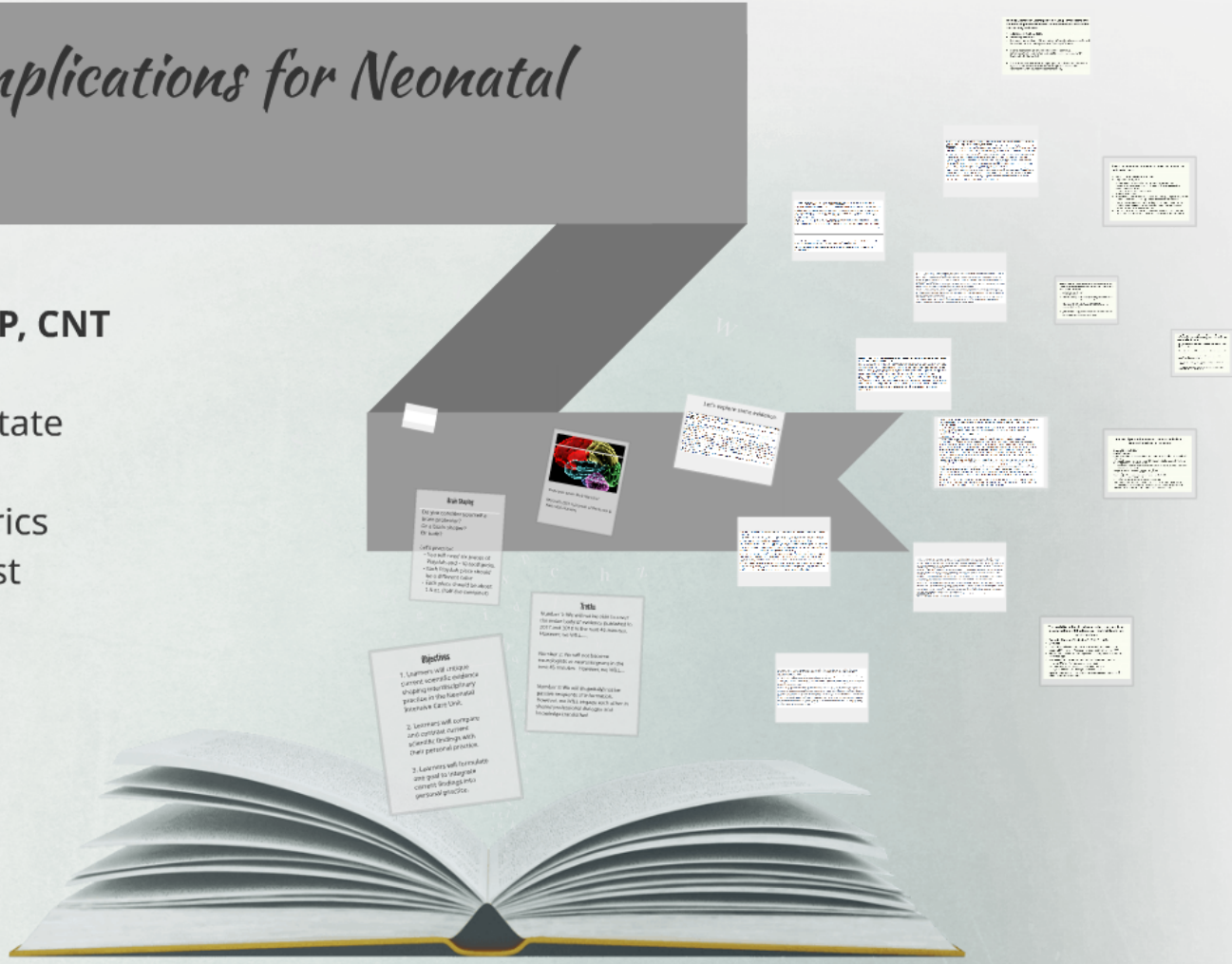

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Objectives

1. Learners will critique current scientific evidence shaping interdisciplinary practice in the Neonatal Intensive Care Unit.

2. Learners will compare and contrast current scientific findings with their personal practice.

3. Learners will formulate one goal to integrate current findings into personal practice.

Truths

Number 1: We will not be able to cover the entire body of evidence published in 2017 and 2018 in the next 45 minutes. However, we WILL.....

Number 2: We will not become neurologists or neurosurgeons in the next 45 minutes. However, we WILL...

Number 3: We will (hopefully) not be passive recipients of information. However, we WILL engage each other in shared professional dialogue and knowledge translation!

Brain Shaping

Do you consider yourself a brain protector?
Or a brain shaper?
Or both?

Let's practice:

- You will need six pieces of Playdoh and ~10 toothpicks.
- Each Playdoh piece should be a different color
- Each piece should be about 1.5 oz. (half the container)

Does you brain look like this?

McGrath (2013) Journal of Perinatal & Neonatal Nursing

Let's explore some evidence.

Bashir, R. A., et al. (2017). "Survival, Short-Term, and Long-Term Morbidities of Neonates with Birth Weight < 500 g. American Journal of Perinatology 34(13): 1333-1339.

OBJECTIVES: The objective of this study was to describe survival, short-term, and long-term morbidities of neonates w birth weight < 500 g.

STUDY DESIGN: Retrospective cohort studies to calculate survival, short-term, and long-term morbidity rates of neonates born weighing < 500 g from 1993 to 2012 and neurodevelopmental impairment rates at 4.5 years for births 1993 to 2008 in one center.

RESULTS: Of 549 inborn neonates with birth weight < 500 g, 4% survived. For live births and neonatal intensive care ur (NICU) admissions, 10 and 55% survived, respectively. Of 28 NICU (inborn and outborn) survivors (median birth weight 460 g and gestation 25.9 weeks [range: 22.6–30.3 weeks]), 71% were inborn, 50% male, and 75% were small for gestational age. One in five neonates was a twin or multiple. Short-term morbidities noted were bronchopulmonary dysplasia (91%), culture proven sepsis (50%), retinopathy of prematurity (41%), and severe brain injury (22%); 27% ha no long-term impairment, 23% one, 23% two, 18% three, and 9% four impairments in motor, cognitive, vision, and/or hearing domains. At 4.5 years, 29% had visual impairment, 10% wore hearing aids, 50% had IQ < 70, 18% cerebral pals and 68% had low motor scores.

CONCLUSION: Only 4% of births < 500 g survived. All survivors had short-term morbidities; 27% neonates survived without long-term major impairments.

Jabbour, J., et al. (2017). "Vocal fold paralysis in preterm infants: prevalence and analysis of risk factors." Journal of Perinatology 37(5): 585-590.

OBJECTIVE: To calculate the prevalence of vocal fold paralysis (VFP) in preterm (<37 weeks of gestation) infants at a single neonatal intensive care unit (NICU) and identify risk factors for the development of VFP.

STUDY DESIGN:

This is a case control study of all surviving preterm infants admitted to the NICU at Children's Hospital of Wisconsin from 2006 to 2012, comparing those with and without VFP. Multivariate analysis was performed to identify significant risk factors for VFP.

RESULTS: Of the 2083 patients included, 73 (3.5%) had VFP, including 18% of those at <26 weeks of gestation. On multivariate analyses, VFP was associated with patent ductus arteriosus (PDA) ligation (P<0.001, odds ratio (OR) 15.9, 95% confidence interval (CI) 8.9 to 28.1), history of invasive ventilation (P=0.008, OR 4.5, 95% CI 1.5 to 13.6) and black vs non-black race (P=0.001, OR 2.5, 95% CI 1.5 to 4.3).

CONCLUSION: Given the prevalence of VFP and its associated morbidity, efforts to decrease PDA ligation and invasive ventilation in preterm infants are warranted.

Ostfeld, B. M., et al. (2017). "Prematurity and Sudden Unexpected Infant Deaths in the United States." Pediatrics 140(1): 1-8.

BACKGROUND AND OBJECTIVES: Prematurity, a strong risk factor for sudden unexpected infant death (SUID), was addressed in recommendations by the American Academy of Pediatrics in 2011 for safe sleep education in NICUs. We documented associations between gestational age (GA) and SUID subsequent to these guidelines.

METHODS: Using the 2012-2013 US linked infant birth and death certificate period files, we documented rates per live births of sudden infant death syndrome, ill-defined and unspecified causes, accidental suffocation and strangulation in bed, and overall SUID by GA in post-neonatal, out-of-hospital, and autopsied cases; compared survivors and cases; and estimated logistic regression models of associations between GA and SUID.

RESULTS: SUID cases were more likely than survivors to be <37 weeks' GA (22.61% vs 10.79%; $P < .0001$). SUID rates were 2.68, 1.94, 1.46, 1.16, 0.73, and 0.51 per 1000 live births for 24 to 27, 28 to 31, 32 to 33, 34 to 36, 37 to 38, and 39 to 42 weeks' GA, respectively. Logistic regression models additionally indicated declines in the risk for SUID as GA increased. Prenatal smoking, inadequate prenatal care, and demographics associated with poverty were strongly associated with SUID.

CONCLUSIONS: Despite the 2011 American Academy of Pediatrics recommendations for increased safe sleep education in the NICUs, SUID rates were inversely associated with GA in 2012 to 2013, suggesting that risk of SUID associated with prematurity has multiple etiologies requiring continued investigation, including biological vulnerabilities and the efficacy of NICU education programs, and that strategies to reduce SUID should be multifaceted.

Putnick, D. L., Bornstein, M. H., Eryigit-Madzwamuse, S., & Wolke, D. (2017). Long-Term Stability of Language Performance in Very Preterm, Moderate-Late Preterm, and Term Children. Journal of Pediatrics, 18174-79.e3. doi:10.1016/j.jpeds.2016.09.006

OBJECTIVE: To investigate whether children born very preterm, moderate-late preterm, and term differ in their average level and individual-difference stability in language performance over time.

STUDY DESIGN: Language was assessed at 5 and 20 months and 4, 6, and 8 years of age in 204 very preterm (<32 weeks' gestation), 276 moderate-late preterm (32-36 weeks' gestation), and 268 term (37-41 weeks' gestation) children from the Bavarian Longitudinal Study.

RESULTS: Very preterm children consistently performed worse than term-born children, and moderate-late preterm children scored in between. Language performance was stable from 5 months through 8 years in all gestation groups combined, and stability increased between each succeeding wave. Stability was stronger between 5 months and 4 years in very preterm than moderate-late preterm and term groups, but this differential stability attenuated when covariates (child nonverbal intelligence and family socioeconomic status) were controlled.

CONCLUSIONS: Preterm children, even moderate-late preterm, are at risk for poorer language performance than term-born children. Because individual differences in language performance are increasingly stable from 20 months to 8 years in all gestation groups, pediatricians who attend to preterm children and observe language delays should refer them to language intervention at the earliest age seen.

Walsh, M. C., Bell, E. F., Kandefer, S., Saha, S., Carlo, W. A., T D'angio, C., ... & Van Meurs, K. P. (2017). Neonatal outcomes of moderately preterm infants compared to extremely preterm infants. Pediatric research, 82(2), 297.

BACKGROUND: Extremely preterm infants (EPT, <29 weeks' gestation) represent only 0.9% of births in the United States; yet these infants are the focus of most published research. Moderately preterm neonates (MPT, 29-33$^{6/7}$ weeks) are an understudied group of high-risk infants.

METHODS: To determine the neonatal outcomes of MPT infants across the gestational age spectrum, and to compare these with EPT infants. A prospective observational cohort was formed in 18 level 3-4 neonatal intensive care units (NICUs) in the Eunice Kennedy Shriver NICHD Neonatal Research Network. Participants included all MPT infants admitted to NICUs and all EPT infants born at sites between January 2012 and November 2013. Antenatal characteristics and neonatal morbidities were abstracted from records using pre-specified definitions by trained neonatal research nurses.

RESULTS: MPT infants experienced morbidities similar to, although at lower rates than, those of EPT infants. The main cause of mortality was congenital malformation, accounting for 43% of deaths. Central Nervous System injury occurred, including intraventricular hemorrhage. Most MPT infants required respiratory support, but sequelae such as bronchopulmonary dysplasia were rare. The primary contributors to hospitalization beyond 36 weeks' gestation were inability to achieve adequate oral intake and persistent apnea.

CONCLUSIONS: MPT infants experience morbidity and prolonged hospitalization. Such morbidity deserves focused research to improve therapeutic and prevention strategies.

Bembich, S., et al. (2017). "Longitudinal Responses to Weighing and Bathing Procedures in Preterm Infants." Journal of Perinatal & Neonatal Nursing 31(1): 67-74.

Knowledge of the effects of nursing-induced stress on short-term outcomes in preterm infants is limited. Effects of 2 standard nursing procedures-weighing and bathing-on autonomic and motor stability of preterm infants were studied during their hospitalization. Outcomes were evaluated during and after the procedures. Eleven preterm infants were observed between 32 and 35 weeks' postmenstrual age (PMA) (postnatal days range: 4-63). Neonatal responses were assessed according to the Synactive Theory of Development and nursing was performed taking into account Newborn Individualized Developmental Care and Assessment Program (NIDCAP) principles. Effects of the studied nursing procedures on infants' stability during and after their execution were evaluated by nonparametric statistics. During monitored procedures, stress responses in autonomic and motor systems were observed at all PMAs. However, after 32 weeks' PMA, preterm infants also showed an autonomic and motor stability recovery 5 minutes after procedure completion. Contrary to our hypothesis, preterm infants showed to be stressed by weighing and bathing procedures up to 35 weeks' PMA. However, if facilitated and supported after nursing conclusion by interventions such as swaddling and nesting, according to NIDCAP principles, they recovered autonomic and motor stability by 5 minutes after ending procedures.

Chen, K. L., et al. (2017). "Magnetic noninvasive acupuncture for infant comfort (MAGNIFIC) - a single-blinded randomised controlled pilot trial." Acta Paediatr 106(11): 1780-1786.

AIM: To determine the safety and feasibility of auricular noninvasive magnetic acupuncture (MA) to decrease infant pain during heel pricks.

METHODS: Infants requiring heel pricks for blood collection were randomised to either MA (n = 21) or placebo (P) (n = 19) after parental informed consent. MA or placebo stickers were placed on both ears according to the Battlefield Protocol by an unblinded investigator and left on for 3 days. Pain was assessed with the Premature Infant Pain Profile (PIPP) by blinded clinicians.

RESULTS: Mean gestation (MA:34.1, P:34.4 weeks) and age of infants (MA:5.3, P:4.5 days) were similar as were mean (SD) pre (MA:1.7(1.4), P:2.1(1.9)) and post (MA:1.6(1.4), P: 2.1(1.7)) heel prick PIPP scores. PIPP scores were significantly lower in MA infants during heel pricks (MA:5.9(3.7), P: 8.3(4.7), p = 0.04). One-way ANCOVA modelling showed that MA

was significantly associated with lower PIPP scores after controlling for analgesic use (p = 0.043). No differences in heart rate, oxygen saturation, analgesic use or adverse effects (e.g. local skin reactions) noted.

CONCLUSION: This pilot study shows that auricular MA is feasible in neonates and may reduce PIPP scores during heel pricks. Further study is required to determine the impact of MA on other painful or stressful conditions and on neurodevelopment.

Feeding Methods at Discharge Predict Long-Term Feeding and Neurodevelopmental Outcomes in Preterm Infants Referred for Gastrostomy Evaluation

- **Jadcherla, S. R. et al., 2017.**
- ***Journal of Pediatrics***
- Retrospective study of 194 neonates <37 weeks who were referred for evaluation and management of feeding difficulties

- Infants discharged on a G-tube had lower cognitive , communication , and motor composite scores (assessed with Bayley at 18-24 months)

- The presence of a G-tube, younger gestation, bronchopulmonary dysplasia, or intraventricular hemorrhage was associated significantly with neurodevelopmental delay

Evereklian, M., & Posmontier, B. (2017). The Impact of Kangaroo Care on Premature Infant Weight Gain. Journal of Pediatric Nursing, 34e10-e16. doi:10.1016/j.pedn.2017.02.006

Background: Preterm births occur among 11.4% of all live infant births. Without steady weight gain, premature infants may experience lengthy hospitalizations, neurodevelopmental deficits and hospital readmissions, which can increase the financial burden on the health care system and their families. The total U.S. health-related costs linked to preterm infant deliveries are estimated at $4.33 billion. Kangaroo care is a feasible practice that can improve preterm infant weight gain. However, this intervention is utilized less often throughout the U.S. due to numerous barriers including a lack of consistent protocols, inadequate knowledge, and decreased level of confidence in demonstrating the proper kangarooing technique. An integrative review was conducted to evaluate the impact of kangaroo care on premature infant weight gain in order to educate nurses about its efficacy among preterm infants.

Data Sources: A literature search was conducted using CINAHL, PubMed, Cochrane Reviews, ClinicalKey and Google Scholar. Large volume searches were restricted using appropriate filters and limiters.

Conclusions: Most of the evaluated studies determined that weight gain was greater among the kangarooing premature infants. Kangaroo care is a low-tech low-cost modality that can facilitate improved preterm infant weight gain even in low-resource settings. Despite its current efficacy, kangaroo care is not widely utilized due to several barriers including an absence of standardized protocols and a lack of knowledge about its benefits. Kangaroo care can become a widespread formalized practice after nurses and parents learn about the technique and its numerous benefits for premature infants, including its association with improved weight gain.

Boss, R. D., et al. (2017). "Communicating prognosis with parents of critically ill infants: Direct observation of clinician behaviors." Journal of Perinatology 37(11): 1224-1229.

OBJECTIVE: Delivering prognostic information to families requires clinicians to forecast an infant's illness course and future. We lack robust empirical data about how prognosis is shared and how that affects clinician-family concordance regarding infant outcomes.

STUDY DESIGN: Prospective audio recording of neonatal intensive care unit family conferences, immediately followed by parent/clinician surveys. Existing qualitative analysis frameworks were applied.

RESULTS: We analyzed 19 conferences. Most prognostic discussion targeted predicted infant functional needs, for example, medications or feeding. There was little discussion of how infant prognosis would affect infant/family quality of life. Prognostic framing was typically optimistic. Most parents left the conference believing their infant's prognosis to be more optimistic than did clinicians.

CONCLUSIONS: Clinician approach to prognostic disclosure in these audiotaped family conferences tended to be broad and optimistic, without detail regarding implications of infant health for infant/family quality of life. Families and clinicians left these conversations with little consensus about infant prognosis.

Álvarez, M. J., Fernández, D., Gómez-Salgado, J., Rodríguez-González, D., Rosón, M., & Lapeña, S. (2017). The effects of massage therapy in hospitalized preterm neonates: A systematic review. *International journal of nursing studies*, *69*, 119-136.

OBJECTIVE: The aim of this study was to perform a systematic review to identify, evaluate and summarise studies on the administration of therapeutic massage to preterm neonates during their stay in the NICU, and to assess their methodological quality.

DESIGN: systematic review following PRISMA statements guidelines.

DATA SOURCES: A comprehensive search was performed including relevant articles between January 2004 and December 2013, using the following electronic databases: Medline, PEDro, Web of Science and Scopus.

REVIEW METHODS: Two reviewers conducted a review of the selected articles: one evaluated the methodological quality of the studies and performed data extraction and the other performed a cross-check. Divergences of opinion were resolved by discussion with a third reviewer. The studies reviewed implemented a wide variety of interventions and evaluation methods, and therefore it was not possible to perform a meta-analysis. The following data were extracted from each article: year of publication, study design, participants and main measurements of outcomes obtained through the intervention. A non-quantitative synthesis of the extracted data was performed. Level of evidence was graded using the Jadad Scale.

RESULTS: A total of 23 articles met the inclusion criteria and were thus included in the review; these presented a methodological quality ranging from 1 to 5 points (with a mean of 3 points). Most studies reported that the administration of various forms of therapeutic massage exerted a beneficial effect on factors related to the growth of preterm infants. The causes indicated by the researchers for these anthropometric benefits included increased vagal activity, increased gastric activity and increased serum insulin levels. Other demonstrated benefits of massage therapy when administered to hospitalised preterm infants included better neurodevelopment, a positive effect on brain development, a reduced risk of neonatal sepsis, a reduction in length of hospital stay and reduced neonatal stress.

CONCLUSIONS: Although based on a qualitative analysis of heterogeneous data, the present review suggests that a clear benefit is obtained from the administration of massage therapy in hospitalised preterm infants, a finding which should encourage the more generalised use of massotherapy in NICU clinical practice.

How to improve sleep in a neonatal intensive care unit: A systematic review

- **Teunis, C, Van Den Hoogen, A., et al., 2017.**
- ***Early Human Development***
- To systematically review the literature to determine interventions promoting neonatal sleep on the NICU, in order to develop key guidelines to improve neonatal sleep.
  - September 2016 and again on 28 January 2017.
- 14 studies were included
- Interventions to promote sleep: NIDCAP, Massage therapy, Kangaroo care, Yakson & Gentle Human Touch, Cycled Light, different sleep surfaces, and music.
- Many of the studies reported a positive effect on sleep wake cycles. Overall, insufficient support/evidence to recommend or support one intervention or protocol over another for sleep promotion.
- Importance of promoting sleep as a keystone of treatment, incorporate sleep measurements, have regulations on elective care procedures and their timing.

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Using fiberoptic endoscopic evaluation of swallowing to detect laryngeal penetration and aspiration in infants in the neonatal intensive care unit

- **Suterwala, M., Reynolds, J., Carroll, S., Sturdivant, C., & Armstrong, E.S. 2017.**
- ***Journal of Perinatology***

- 25 infants >= 37 weeks PMA suspected of aspirating were assessed with FEES and VFSS

- No major complications or significant differences between FEES prefeeding and postfeeding vital signs

- FEES interrater reliablity was 80% for both penetration and aspiration, compared with 87 and 90%, respectively, for VFSS.

- Conclusion: FEES is a safe and reliable in assessing laryngeal penteration and tracheal aspiration in NICU infants.

Impact of parental presence at infants' bedside on Neonatal Abstinence Syndrome

- **Howard, M. B. et al., 2017.**
- ***Hospital Pediatrics***
- Aimed to examine the association between rates of parental presence and NAS outcomes.
- Retrospective, single-center cohort of 86 infants treated pharmacologically for NAS using a rooming-in model of care
  - After mother's discharge, infant hospitalized in pediatric inpatient unit for 5-7 days where one parent can stay overnight
- Parental presence was documented every 4 hours
  - Mean parental presence was 54.4% of the infant's hospitalization
- Maximum (100%) parental presence was associated with:
  - 9 day shorter LOS ($r = -0.31$; $P < .01$)
  - 8 fewer days of infant opioid therapy ($r = -0.34$; $P < .001$)
- 1 point lower mean Finnegan score ($r = -0.35$; $P < .01$) when parent present
- After adjusting for breastfeeding, parental presence remained significantly associated with reduced NAS score and opioid treatment days

The predictive value of early oral motor assessments for neurodevelopmental outcomes of moderately and late preterm infants

- **Zhang, X., Zhou, M., Yin, H., Dai, Y., & Li, Y. (2017)**
- ***Medicine***
- 118 moderately and late preterm infants (32-36 weeks EGA)
- Neonatal Oral-Motor Assessment Scale at 36-37 weeks PMA
- Bayley Scales of Infant Development-CR completed at 6 months corrected age
- Infants with abnormal sucking pattern in neonatal period:
  - Lower Mental Development Index (p=.003)
  - Lower Psychomotor Development Index (p=.029)
  - Higher rate of below average scores (p = .022)
- Incoordination of suck-swallow-respiration was a risk factor for adverse neurodevelopment

What Does All This Tell Us?

- Some experiences in the NICU can be stressful but there are interventions to help
- Interventions can also aid sleep
- Standardized neurobehavioral and feeding assessments are available for the neonatal period and do not impose more stress than clustered cares do
- Early NICU factors impact long-term outcomes
- While cognition and behavior may differ in previous high-risk infants, early feeding and neurobehavioral interventions starting in the NICU and continuing after discharge can optimize sensory, motor, and cognitive outcomes and allow high risk infants to thrive
- Parents need kid gloves at discharge-support is needed for ensuring maternal mental health and access to services

My question from earlier:
Are you a brain protector? Or a brain shaper?

What you can do to help improve neurodevelopmental outcomes:

- Use the evidence. Identify the gaps.
- Use structured and consistent documentation
- Explore standardized assessments
- Remember the three key elements of evidence-based medicine:
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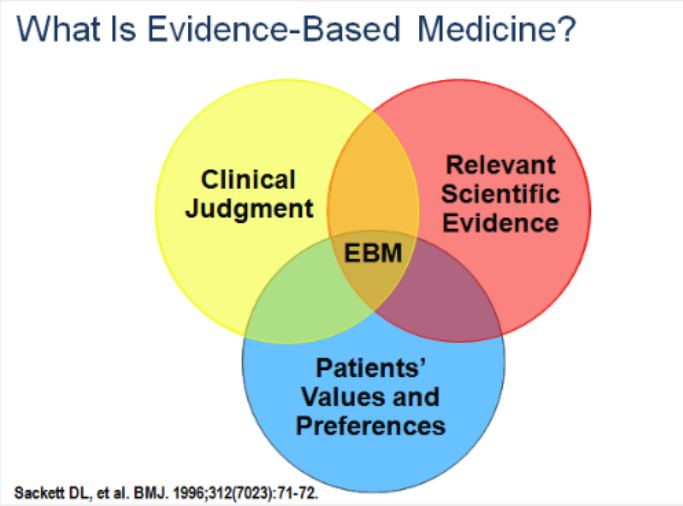

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Thank you!

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McGrath, J. M. (2013). Important reminder: All neonatal caregivers are brain shapers. J*ournal of Perinatal and Neonatal Nursing, 27*(3), 199-200. doi:10.1097/JPN.0b013e31829ea0b5

Pineda, R., & Poskey, G.A. (April, 2017). *2017 Neonatal therapy science: The year in review.* [Presentation] NANT 8. Charlotte, NC.