Sweet Child of Mine

Use of Dextrose Gel for Neonatal hypoglycemia

Petruska Maak, M.D

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- Prevalence is increasing : pre-terms & maternal factors

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  - Target > 50 mg/dL

Current Guidelines

AAP Committee on fetus and Newborn 2011

Screening and Management of Postnatal Glucose Homeostasis in Late Preterm and Term SGA, IDM/LGA Infants

[(LPT) Infants 34 – $36^{6/7}$ weeks and SGA (screen 0-24 hrs); IDM and LGA ≥34 weeks (screen 0-12 hrs)]

Symptomatic and <40 mg/dL ⟶ IV glucose

ASYMPTOMATIC

Birth to 4 hours of age		4 to 24 hours of age	
INITIAL FEED WITHIN 1 hour Screen glucose 30 minutes after 1st feed		Continue feeds q 2-3 hours Screen glucose prior to each feed	
Initial screen <25 mg/dL		Screen <35 mg/dL	
Feed and check in 1 hour		Feed and check in 1 hour	
<25 mg/dL ↓ IV glucose*	25–40 mg/dL ↓ Refeed/IV glucose* as needed	<35 mg/dL ↓ IV glucose*	35 – 45 mg/dL ↓ Refeed/IV glucose* as needed

Target glucose screen ≥45 mg/dL prior to routine feeds

* Glucose dose = 200 mg/kg (dextrose 10% at 2 mL/kg) and/or IV infusion at 5–8 mg/kg per min (80–100 mL/kg per d). Achieve plasma glucose level of 40-50 mg/dL.

Symptoms of hypoglycemia include: Irritability, tremors, jitteriness, exaggerated Moro reflex, high-pitched cry, seizures, lethargy, floppiness, cyanosis, apnea, poor feeding.

YEAR	AUTHOR	METHODS	FINDINGS
2006	**What is the neurodevelopmental outcome after neonatal HG in the first week of life?**	- 5225 references (1966 to 2005). - 46 potentially relevant articles - - 18 studies included: 1583 infants.	- 2 with high methodological quality
1988	**Lucas**	661 preterm infants. 5 centers Infant formula vs preterm formula or supplements added to maternal milk . 92% assessed at 18 months. Retrospective study;	- Deficits if > 3 days HG < 45 mg/dL on > 5 days. - Low mental/motor skills, > delays & CP. - Screening for ICH not uniformly done, - Causal relationship vs adjustment
2005	**Brand**	5 healthy term LGA, HG in 60 (80%); -Assessed at 4 years. Retrospective study, Tool (DDS) no Bayley	HG 60 (80%); NO significant differences between neonates with and without hypoglycemia
1988	**Koh**	- 5 newborns evaluated by (BAER), 7 infants/children evaluated by BAER; 5 children evaluated by somatosensory evoked potentials (electric current stimulation).	- BG < 47 ->Evoked potentials abnormal in 10 of 11. - Abnormal sensory EP w/ BG 13 to 45 - Suggested different susceptibility to HG
2012	**Kjerstens**	- 832 preemies: 32-35-6/7 wks - HG: 1 BG < 30 within 72 hours of birth - 67 (8%) had HG. 42 w/BG 20-30 - 25 w/glucose < 20 - 90% of these infants were NOT admitted to NICU	- Assessed ~43-49 mos - Parents report/ charts - 12 of 67w/BG < 30 w/abnormal ASQ - HG was associated with higher risk of DD in preterms 32- 35-6/7 wks
2015	**Kaiser**	-1943 born at Arkansas center 23-42 wks 1395 newborn-student pairs (72%) 440 (31.5%) preterm - Universal BG screen policy Eval infants with BG < 45, < 40, < 35 11 children w/ cognitive disability Retrospective population-based	Early transient NB hypoglycemia was associated with decreased probability of proficiency on literacy and math test scores at age 10 years
2015	**McKinlay**	- Studies: Lucas (1988), Kjerstens (2012), Kaiser (2015)	All 3 studies raised concerns of poorer neurodevelopmental outcomes when preterm infants were hypoglycemic
2012	**Tin**	- BG drawn with labs at same time each day for 10 days 566 preterm NICU infants 47(8%) w/ BG <45 on > 3D 11 had BG < 36 on 3 days 38 (6.7%) f/u up at age 15	- Study population - studies were designed to eval care unrelated to HG - "Found no evidence to support the belief that recurrent low BG (<45 mg/dl) in the first 10 days of life pose a hazard to preterm infants"
2005	**Burns** **"Symptomatic hypoglycemia may be associated with neurodevelopmental impairment – What do MRI scans show?**	- 84 infants with > 1 episode early NH - 35 term, 37 to 42 weeks - Excluded: HIE, cong infection, brain anomalies dysmorphic features, genetics - 10 excluded because MRI at > 6 weeks - 22 (63%) had transient NH that resolved with glucose administration and without recurrence - 27 (61%) symptomatic w/seizures	- 30 (86%) had severe HG< 27 on >1x - 5 had mild HG > 27 to < 47 - More prevalent IUGR & c-section - MRI ~ 9 days (1-42 d) - 33 (94%) : white matter abnormalities - No differences MRI transient vs prolonged/recurrent - Neurodevelopmental outcomes ~18 mos: 8 –normal, 15 w/mild impairment, 8 w/moderate impairment, 3 w/ severe impairment

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- Sublingual absorption rate is equal to IV dextrose
- Promotes continued breast feeding and maternal bonding.

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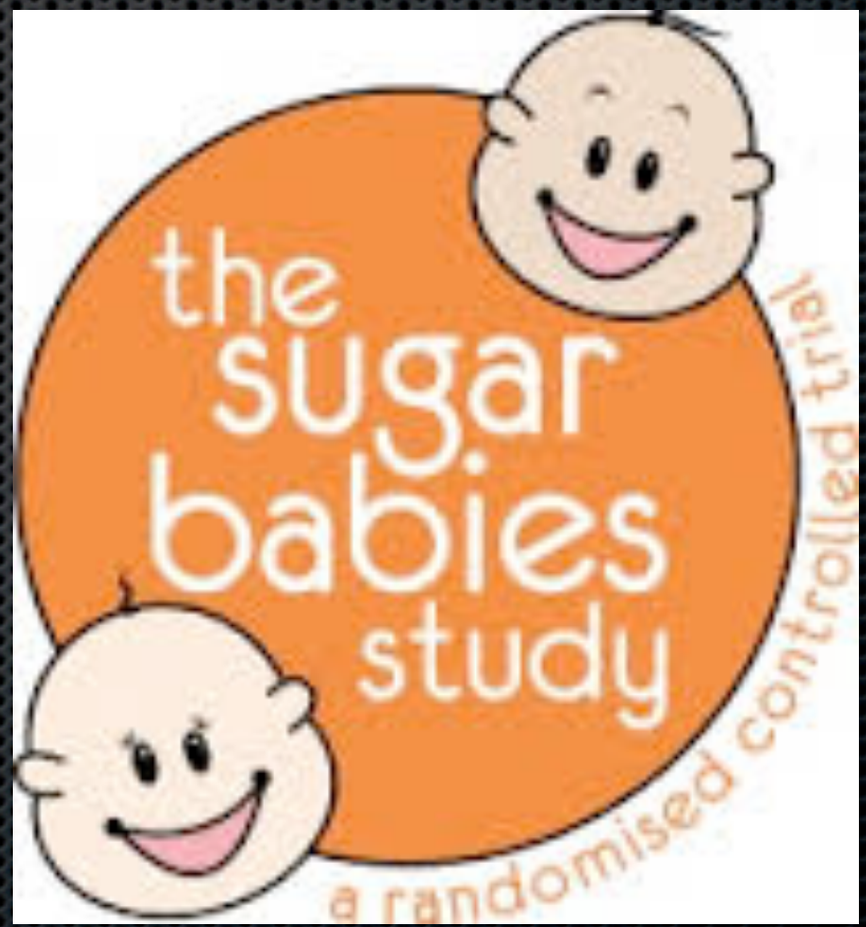

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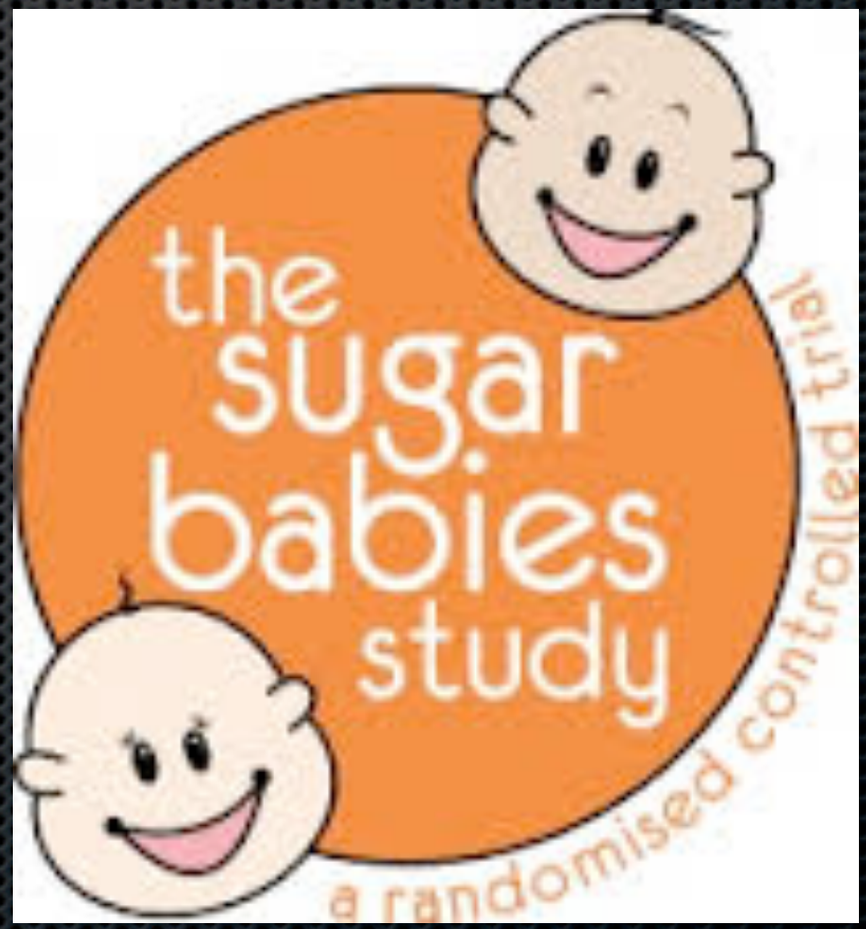

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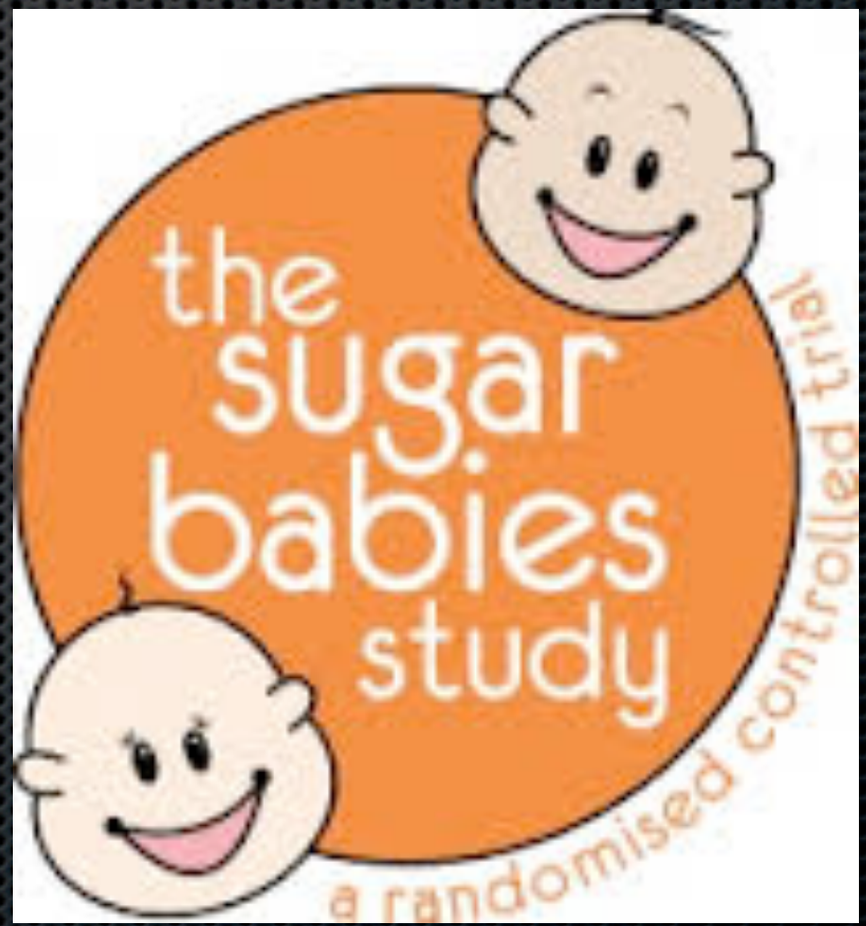

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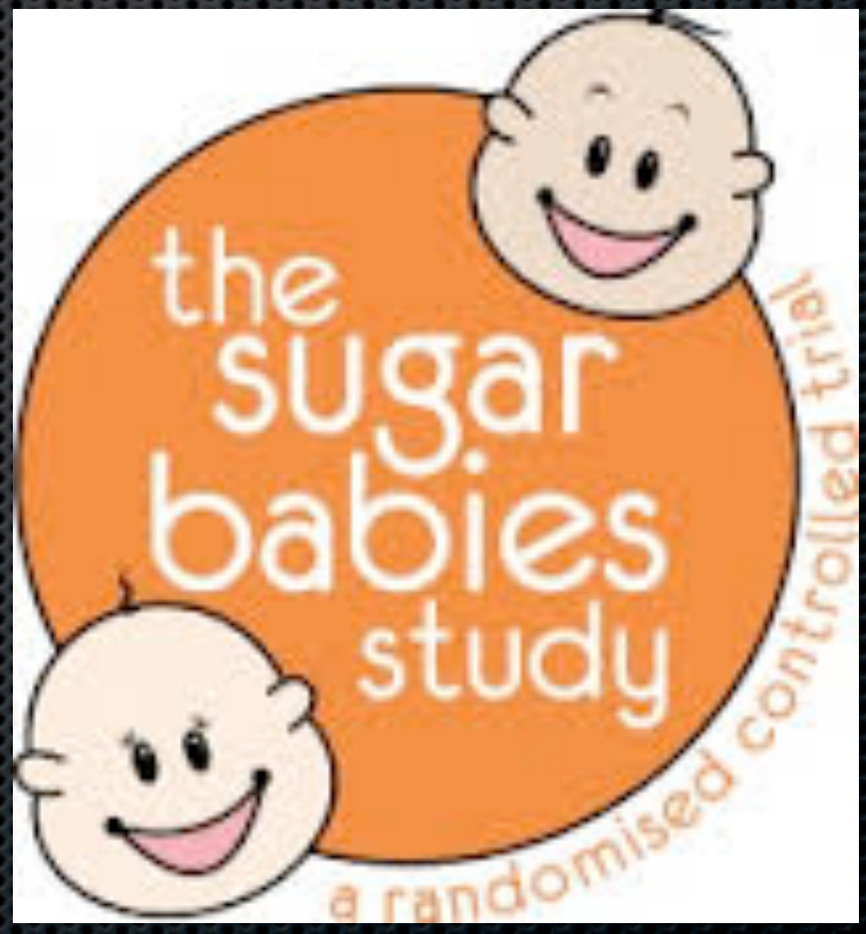

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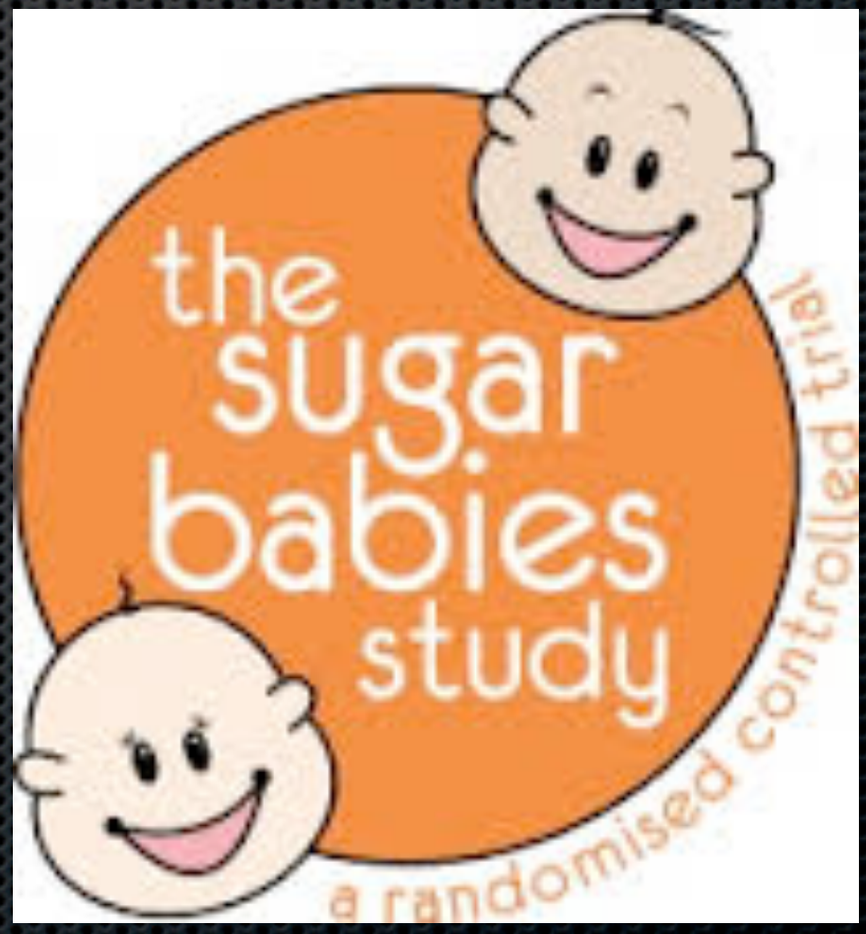

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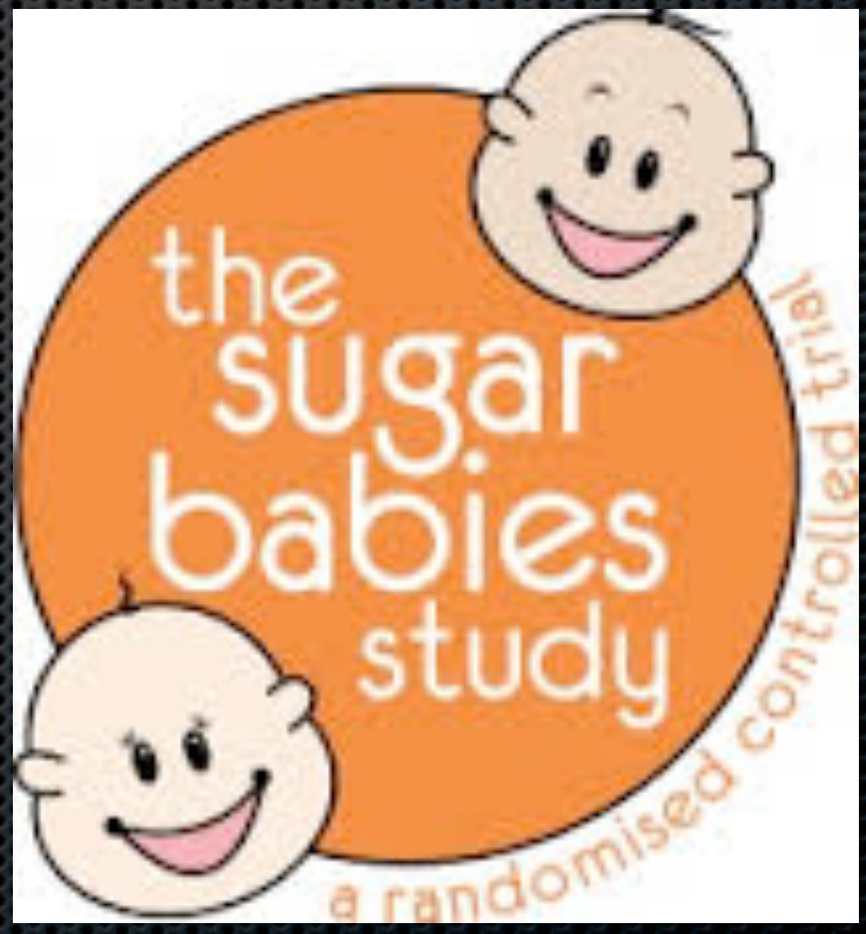

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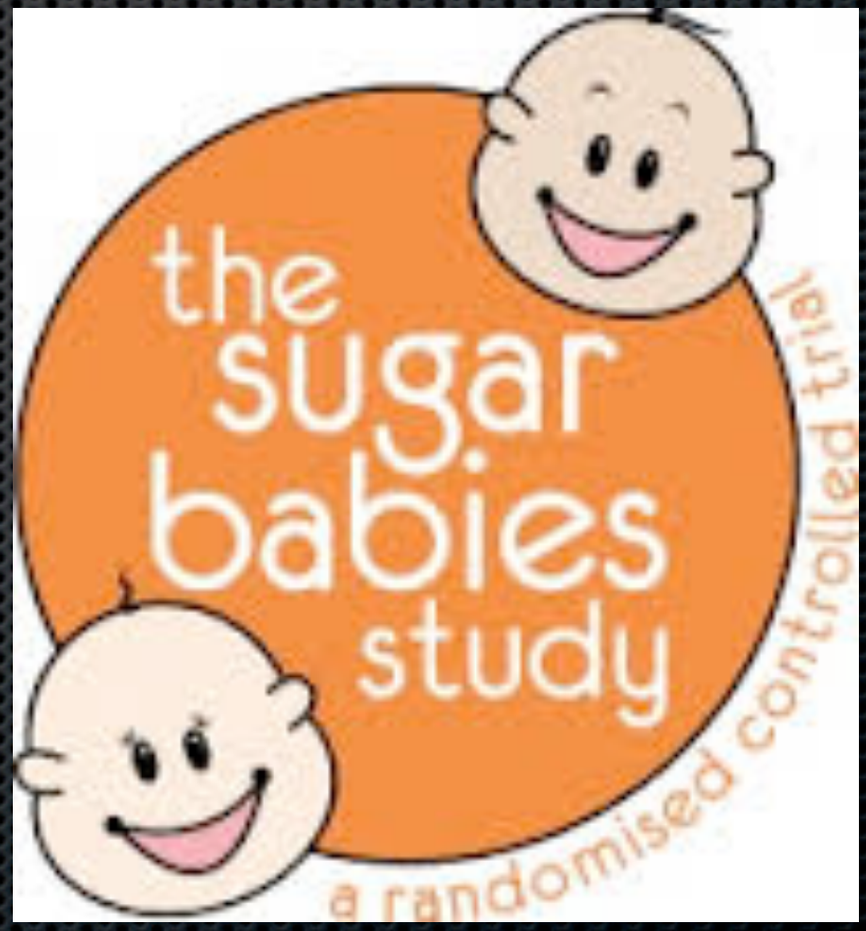

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- Primary Outcomes: Treatment failure with BG < 47mg/dl x 2
- No adverse events

	Dextrose gel (n=118)	Placebo gel (n=119)	Relative risk or median difference (95% CI)	p value
Volume of study gel (mL/kg)	0·84 (0·43–2·44)	0·97 (0·47–2·49)	0·005 (–0·01 to 0·02)	0·45
Treatment failure	16 (14%)	29 (24%)	0·57 (0·33 to 0·98)	0·04
Dextrose administered as:				
Study gel				
Babies	118 (100%)	119 (100%)	..	..
Dose (g/kg)	0·3 (0·2–1·0)	0	..	..
Open-label gel*				
Babies	6 (5%)	13 (11%)	0·47 (0·18 to 1·18)	0·15
Dose (g/kg)	0·2 (0·1–0·4)	0·4 (0·2–0·6)	0·14 (0·00 to 0·20)	0·10
Intravenous bolus				
Babies	7 (6%)	13 (11%)	0·54 (0·23 to 1·31)	0·24
Dose (g/kg)	0·2 (0·2–0·2)	0·2 (0·1–1·0)	0·0001 (–0·004 to 0·20)	0·96
Intravenous infusion				
Babies	8 (7%)	17 (14%)	0·47 (0·21 to 1·06)	0·09
Dose (g/kg)	6·7 (2·0–10·6)	7·7 (3·7–14·6)	2·12 (–0·42 to 5·58)	0·10
Total intravenous dextrose (g/kg)	7·1 (2·5–10·8)	8·3 (4·2–16·2)	2·55 (0·50 to 5·84)	0·09
Total dextrose from sources other than study gel†				
Babies	12 (10%)	28 (24%)	0·43 (0·23 to 0·81)	0·01
Dose (g/kg)	4·5 (0·2–10·8)	6·6 (0·2–16·2)	0·20 (–2·1 to 5·5)	0·51
Total dextrose from all sources				
Babies	118 (100%)	119 (100%)	..	..
Dose (g/kg)	0·3 (0·2–11·4)	0·0 (0·0–16·2)	0·20 (0·19 to 0·23)	<0·0001
Feeding				
Breastfed babies	112 (95%)	113 (95%)	1·00 (0·94 to 1·06)	0·99
Feeds per baby	13 (1–29)	11 (1–24)	–1·00 (–3·00 to 0·00)	0·16
Babies receiving expressed breastmilk	100 (85%)	97 (82%)	1·04 (0·93 to 1·17)	0·60
Feeds per baby	4 (1–15)	6 (1–16)	1·00 (0·00 to 2·00)	0·02
Volume (mL/kg)	2·4 (0·1–96·1)	4·7 (0·0–43·6)	1·07 (0·14 to 2·37)	0·03
Babies receiving infant formula	68 (58%)	72 (60%)	0·95 (0·77 to 1·18)	0·69
Feeds per baby	7 (1–21)	10 (1–24)	2·00 (0·00 to 4·00)	0·04
Volume (mL/kg)	41 (1–162)	58 (2–208)	11·06 (–3·01 to 26·89)	0·14
Admitted to NICU				
Babies (n)	45 (38%)	55 (46%)	0·83 (0·61 to 1·11)	0·24
For hypoglycaemia (n)	16 (14%)	30 (25%)	0·54 (0·31 to 0·93)	0·03

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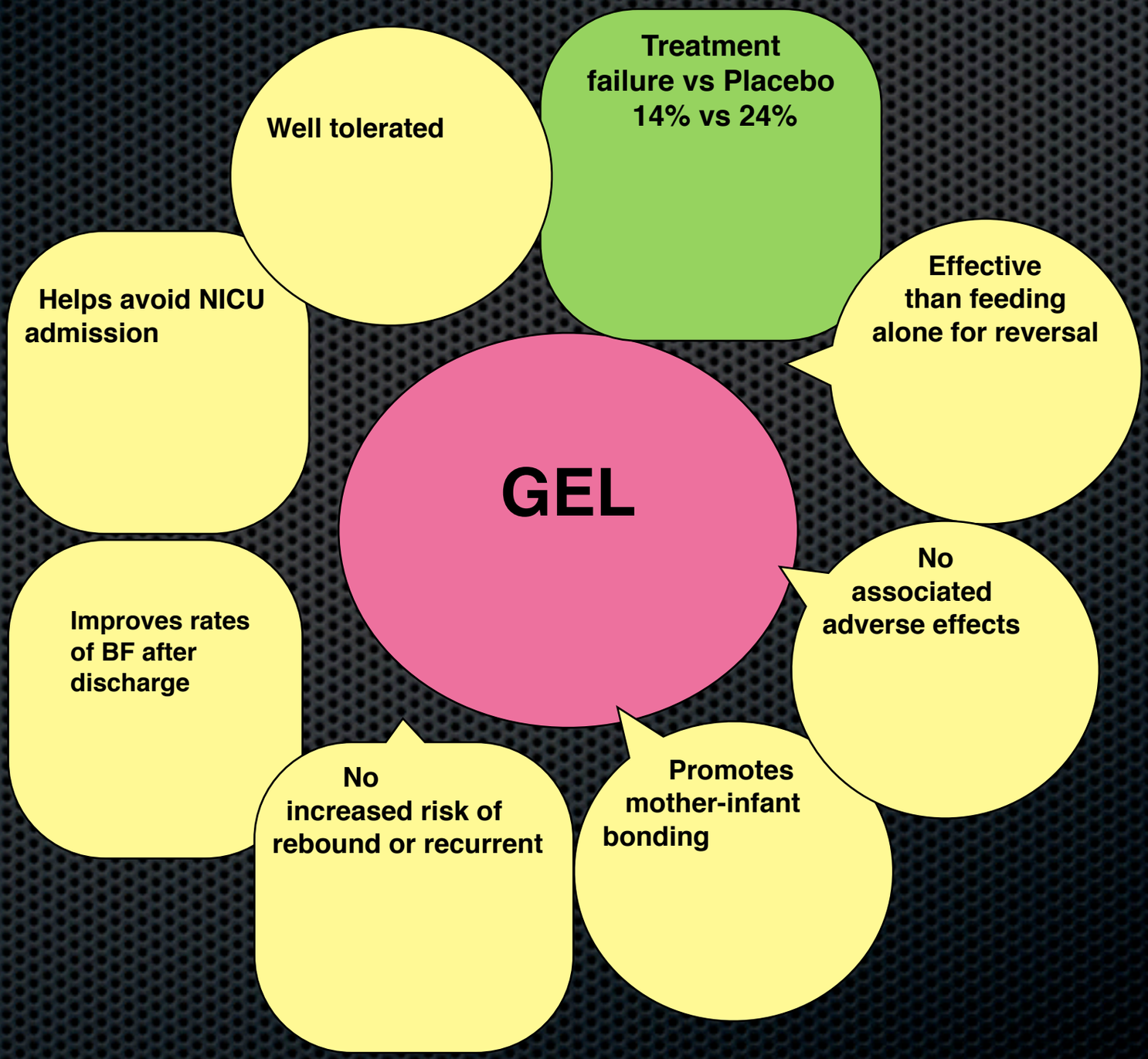

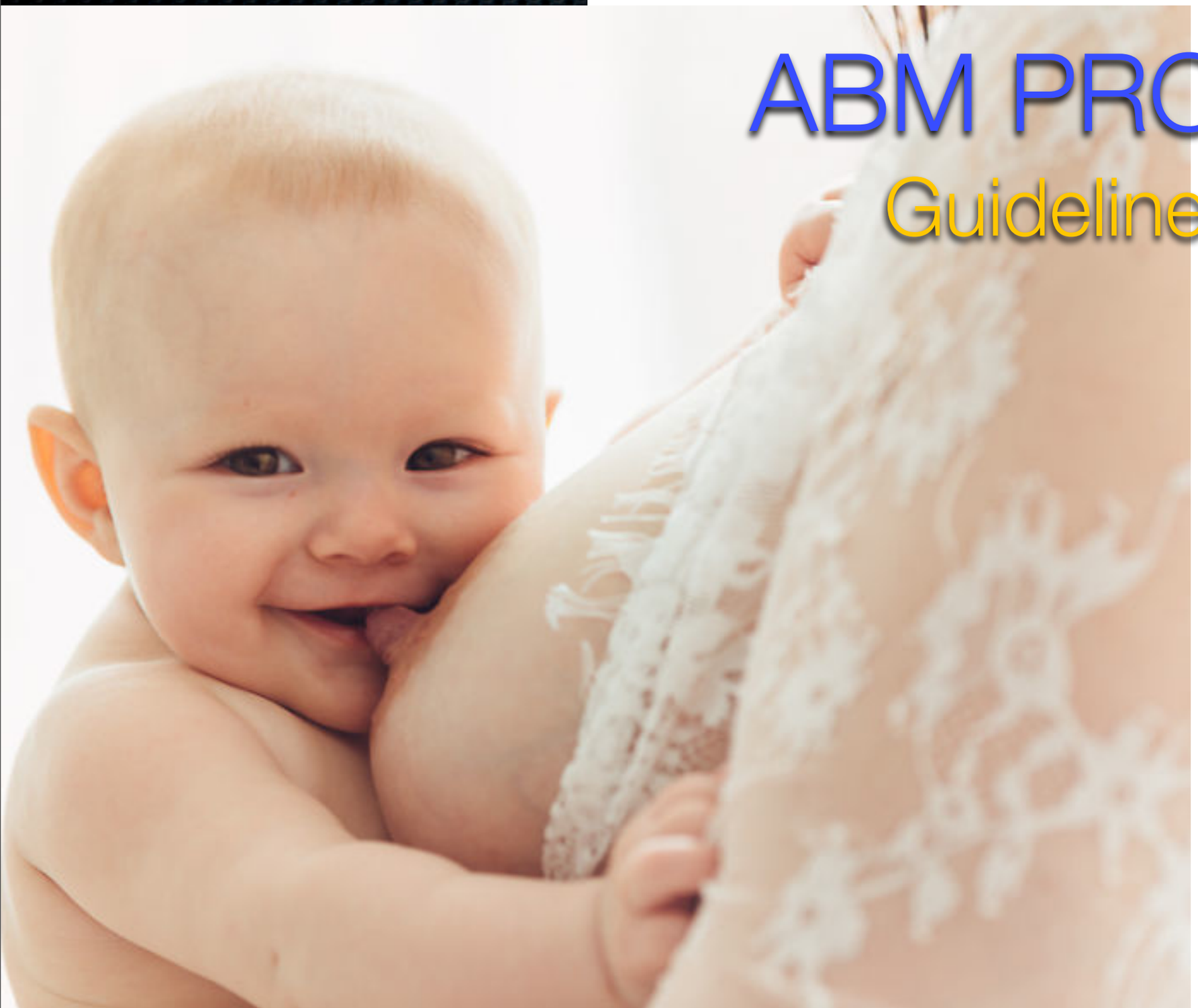

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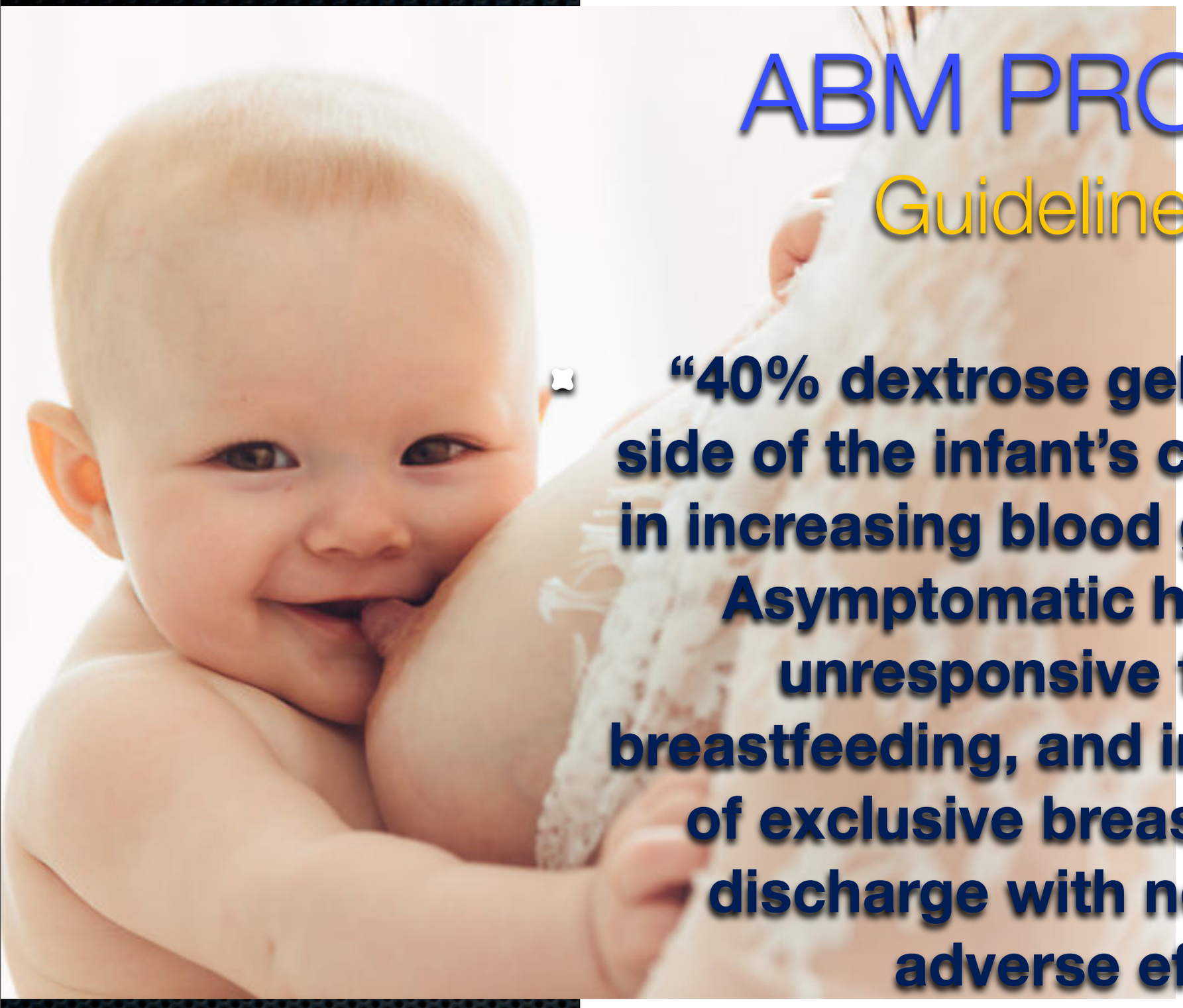
Guidelines 2017



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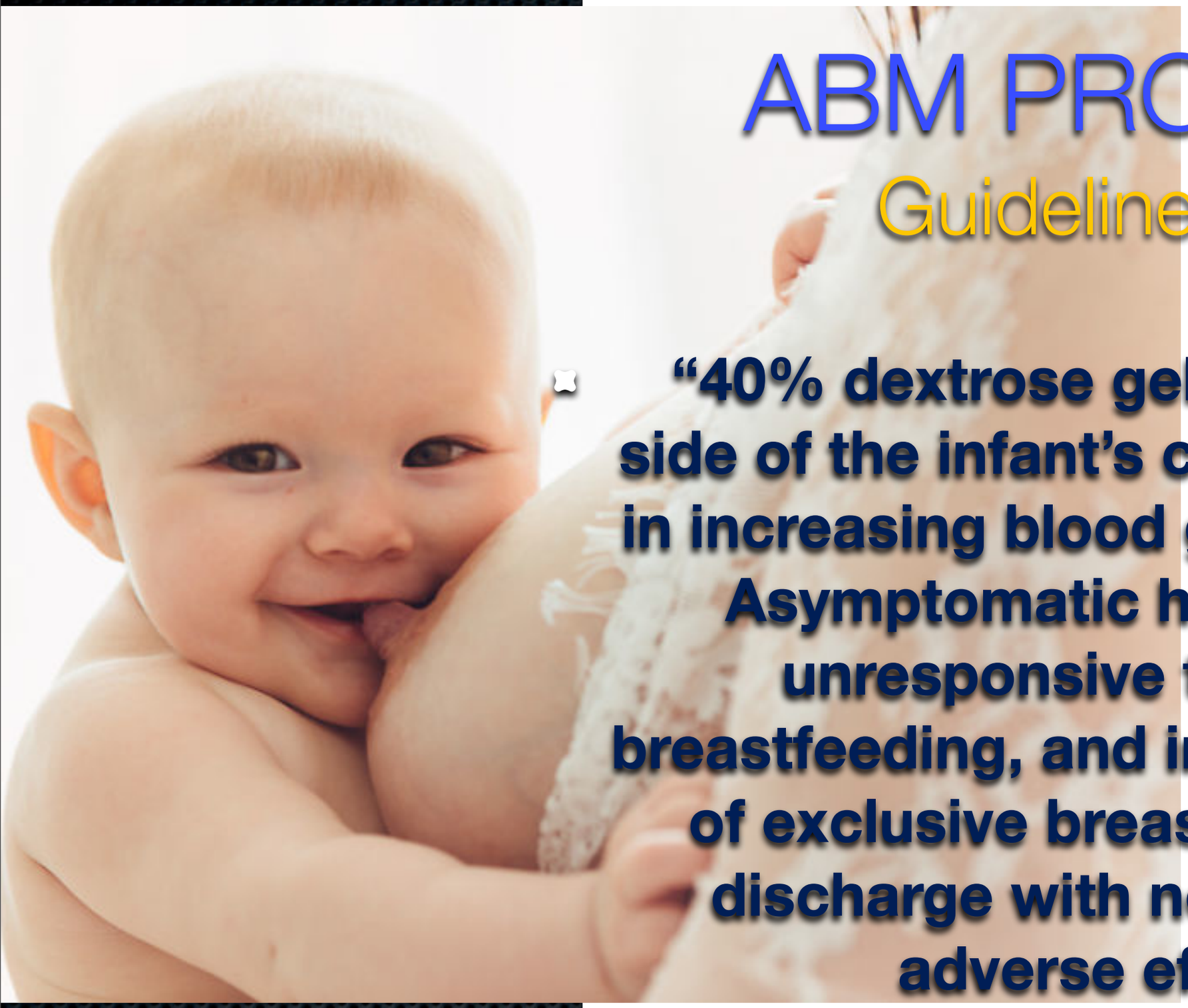

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- Children with Hypoglycemia and Later Development (CHYLD)
- Sugar Babies Study (n=514, >35 wks) & Babies and Blood Sugar's Influence on EEG study (n=102, >32 wks)
- Assess effects of transitional hypoglycemia

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2015:

- 528 (86%) eligible for follow-up at 2 years (> 35 weeks)
- 76% of eligible infants assessed
- 53% had HG: 1 BG< 47; severe episode < 36; or recurrent (> 3 episodes)

Conclusion at age 2:

No risk of neurosensory impairment or processing difficulty

JAMA Pediatrics | Original Investigation

Association of Neonatal Glycemia With Neurodevelopmental Outcomes at 4.5 Years

Christopher J. D. McKinlay, PhD; Jane M. Alsweiler, PhD; Nicola S. Anstice, PhD; Nataliia Burakevych, PhD; Arijit Chakraborty, PhD; J. Geoffrey Chase, PhD; Gregory D. Gamble, MSc; Deborah L. Harris, PhD; Robert J. Jacobs, PhD; Yannan Jiang, PhD; Nabin Paudel, PhD; Ryan J. San Diego, MSc; Benjamin Thompson, DPhil; Trecia A. Wouldes, PhD; Jane E. Harding, DPhil; for the Children With Hypoglycemia and Their Later Development (CHYLD) Study Team

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McKinlay et al.

- Assessed 477/604 eligible children from CHYLD (sugar babies) + 102 BABIES
- 38 were 32 to 34 weeks; rest > 35 weeks

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- Conclusions: Factors that increased risk of low EF/visual motor scores
Severe hypoglycemia < 36 - >3 episodes

Original Investigation

Association Between Transient Newborn Hypoglycemia and Fourth-Grade Achievement Test Proficiency
A Population-Based Study

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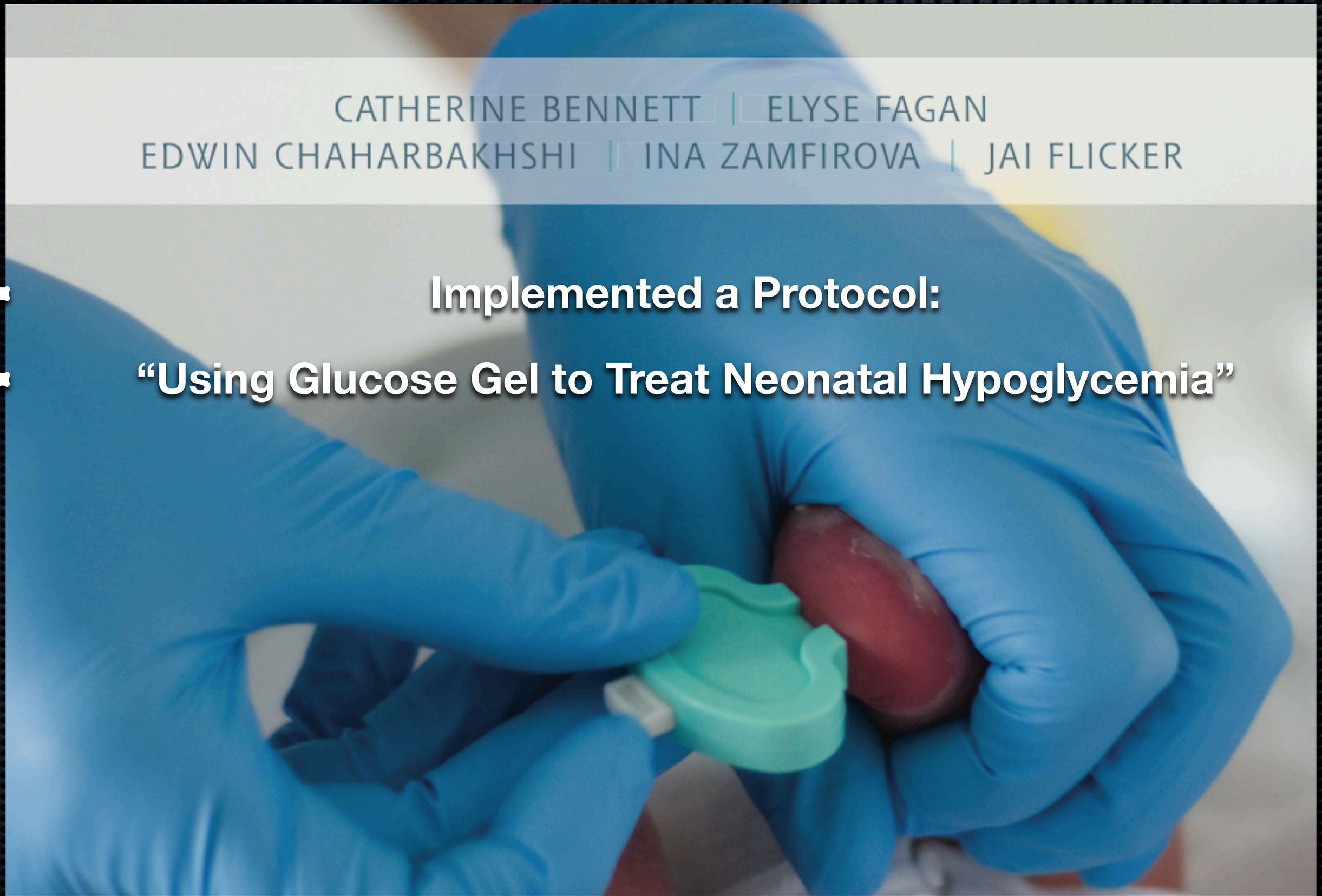

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- First-line treatment if BG < 35 mg/dl at 30 minutes after first feeding.

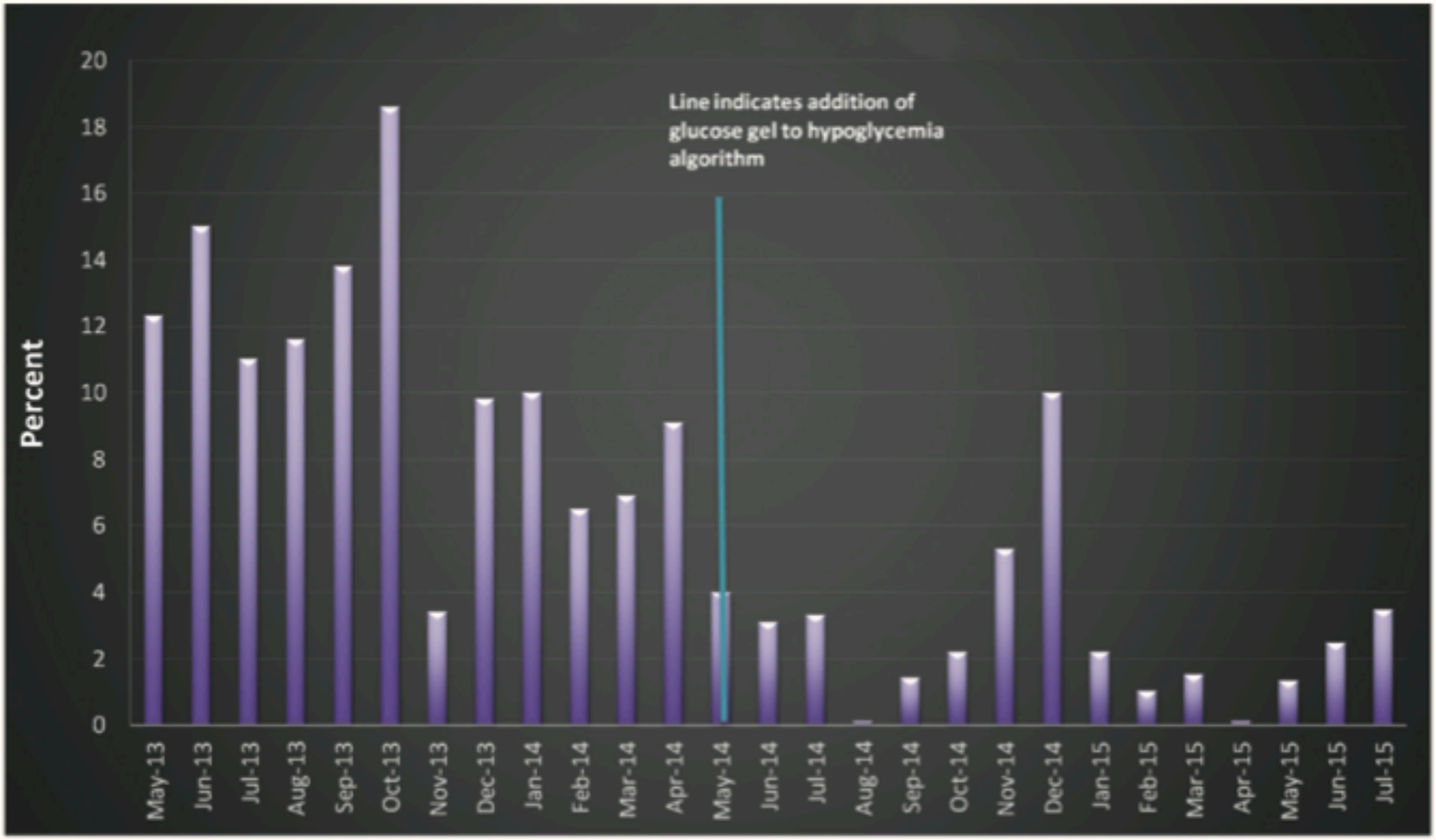
BOX 3
Basic Steps in Our Glucose Gel Algorithm

- Neonates are placed skin to skin and breastfed within the first hour of life.
- A BG level is obtained 30 minutes after this feeding is completed.
- If the BG level is <35 mg/dl, the nurse administers a weight-based dose of 40% glucose gel by syringe to the neonate's buccal cavity and then places the neonate with the mother to feed.
- A BG level is then repeated 1 hour after gel administration.
- If this BG level is >35 mg/dl, the neonate's BG levels are assessed before feedings until two consecutive readings are >45 mg/dl.
- If the neonate's BG level is <35 mg/dl, a second dose of the gel is administered, and the neonate is again placed with the mother to feed.
- In the event that a second dose is needed, a BG level is obtained 1 hour after gel administration.
- If hypoglycemia is not reversed after the second dose of 40% glucose, the physician is contacted for further orders.

Note. BG = bedside glucose.

FIGURE 1

Percentage of Infants Admitted to NICU for Neonatal Hypoglycemia



"This safe and effective intervention resulted in a 73% decrease in NICU admissions for the diagnosis of neonatal hypoglycemia over a 14-month period"

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Kaiser WCR & SSC

Dextrose Gel PILOT (July 2017-)

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POCT HYPOGLYCEMIA SCREENING PILOT PROTOCOL WITH USE OF DEXTROSE GEL

=== Protocol is only for asymptomatic infants at risk of hypoglycemia===

Infants at risk of hypoglycemia s are:
1) Infants of diabetic mothers
2) Late preterm infants (GA less than 37weeks)
3) **Infants with birth weights less than 10th percentile OR greater than 90th percentile per Fenton growth curves.**

Screening 0 until 4 Hrs of Life:
If initial AC/PC glucose >/= to 40 continue AC checks next feeding.
If initial AC/PC glucose less than 25-394, feed1 baby and re-check glucose in 1 hr2.
If initial AC/PC glucose less than 254, give **dextrose gel3 (0.5mL/kg)** then feed1 and re-check glucose in 1hr2.
If repeat glucose in 1 hr >/= to 40, continue AC checks at next feed.
If repeat glucose 25-39, give **dextrose gel3 (0.5mL/kg)** then feed and re-check glucose in 1 hr
If repeat glucose <25, notify MD.

Screening 4-24 Hrs of Life:
If AC glucose >/= to **45,** continue AC checks with next feeding.
If AC glucose <**45**4, give dextrose gel (0.5mL/kg) then feed1, re-check glucose in 1 hr2.
If repeat glucose in 1 hr >/= to 45, continue AC checks at next feed.
If repeat glucose 35-44, **give dextrose gel (0.5mL/kg)** then feed1 and re-check glucose in 1 hr
If repeat glucose less than 35, notify MD.


Lindsay Alise
PHOTOGRAPHY


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KAISER WCR RESULTS

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- 5 Weeks of Implementation

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- Most babies: LPIs & IDM
- **NO adverse events**

KAISER PERMANENTE HEALTHCONNECT™

Hypoglycemia screening Guidelines for Asymptomatic At Risk Newborns

Check Glucose on any infant who has symptoms of hypoglycemia (irritability, tremors, jitteriness, exaggerated Moro reflex, high pitched cry, lethargy, floppiness, cyanosis, seizures, apnea or poor feeding)

NOTIFY MD ABOUT SYMPTOMATIC INFANTS AFTER CHECKING SUGARS, REGARDLESS OF THE RESULT.

Patients Requiring 12 hour Screening

- All Infants of diabetic mothers
- Infants > 4 Kg

Screen every 3 hours AC for 12 hours (4 screens)

Patients requiring 24 hour screening

- Late preterm infants (GA less than 37weeks)
- Infants < 2.5 Kg

Screen every 3 hours AC for 12 hours and also at 15-18 hrs and at 21-24 hrs old (6 screens)

SCREENING 0-4 HOURS OF LIFE

Feed within 1 hour of life. First screen 30 min after feeding. If unable to feed check at 1 hour.

Feeds are either ad lib breastfeedings OR syringe feeding of EBM if available OR a combination of both. Only a baby who is exclusively formula feeding due to medical reasons or due to maternal choice or per physician orders, will get formula feeding.

Re-checks for glucose are to be done 1 hour after the end of the feeding.

If initial AC/PC glucose greater than or equal to 40 continue AC checks next feeding.
If initial AC/PC glucose between 25-39, feed baby and re-check glucose in 1 hr.
If initial AC/PC glucose less than 25, give **Dextrose gel 2 ml** then feed and re-check glucose in 1hr.

If repeat glucose in 1 hr >/= to 40, continue AC checks at next feed.
If repeat glucose 25-39, give **Dextrose gel 2ml** then feed and re-check glucose in 1 hr.
If repeat glucose <25, notify MD: Consider 3rd dose of gel, if formula feeding increase volume.
Consider introduction of formula feeding. If these actions ineffective, IV therapy.

SCREENING 4-24 HOURS OF LIFE

Continue screening before feeding every 3 hours for 12 or 24 hours

Feeds are either ad lib breastfeedings OR syringe feeding of EBM if available OR a combination of both. Only a baby who is exclusively formula feeding due to medical reasons or due to maternal choice or per physician orders, will get formula feeding.

If AC glucose >/= to 45, continue AC checks with next feeding.
If AC glucose <45, give **Dextrose gel 2ml** then feed, re-check glucose in 1 hr.

If repeat glucose in 1 hr >/= to 45, continue AC checks at next feed.
If repeat glucose 35-44, give **Dextrose gel 2ml** then feed and re-check glucose in 1 hr
If repeat glucose less than 35, notify MD for consideration of IV therapy.

If discharged at </= 24 hours, the last 2 consecutive blood sugars must be >45 mg/dl.
If discharged at >24 hours patient must have one documented blood sugar > 55 mg/dl.

FUTURE DIRECTIONS

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★Follow closely emerging OUTCOME DATA

FUTURE DIRECTIONS

THANK YOU!

KEEP YOUR
BABIES SWEET!