Improved survival needs early and FREQUENT Breastfeeding.

Dr Nils Bergman

MB ChB, DCH, MPH, MD

Cape Town, RSA

www.skintoskincontact.com

www.kangaroomothercare.com

Improved survival needs early and FREQUENT Breastfeeding.

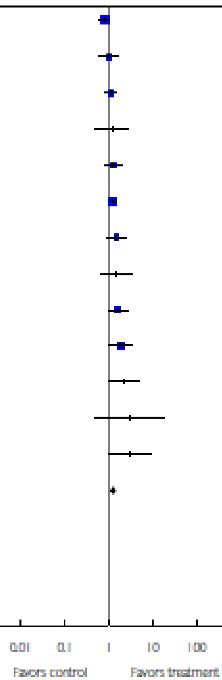
SKIN-TO-SKIN causes →BREASTFEEDING

Early skin-to-skin contact for mothers and their healthy newborn infants (Review)

2012, Issue 5

Moore ER, Anderson GC, Bergman N, Dowswell T

THE COCHRANE COLLABORATION®



Analysis 1.1. Comparison 1 Skin-to-skin versus standard contact healthy infants, Outcome 1 Breastfeeding 1 month to 4 months postbirth.

Review: Early skin-to-skin contact for mothers and their healthy newborn infants

Comparison: 1 Skin-to-skin versus standard contact healthy infants

Outcome: 1 Breastfeeding 1 month to 4 months postbirth

Study or subgroup	Treatment n/N	Control n/N	Weight	Risk Ratio M-H,Random,95% CI
Sosa 1976a	22/30	27/30	15.0 %	0.81 [0.64, 1.04]
Carlsson 1978	12/17	10/14	9.1 %	0.99 [0.63, 1.55]
Carfoot 2005	42/97	40/100	12.3 %	1.08 [0.78, 1.51]
Carfoot 2004	7/14	5/12	3.8 %	1.20 [0.51, 2.81]
Sosa 1976b	19/32	15/32	8.8 %	1.27 [0.79, 2.02]
Vaidya 2005	42/44	36/48	17.4 %	1.27 [1.07, 1.52]
Nolan 2009	16/20	8/15	7.7 %	1.50 [0.89, 2.53]
Anderson 2003	7/11	5/12	4.1 %	1.53 [0.68, 3.42]
Shiau 1997	19/28	12/28	8.1 %	1.58 [0.96, 2.61]
Sosa 1976c	15/20	8/20	6.5 %	1.88 [1.04, 3.39]
De Chateau 1977	12/21	5/19	3.8 %	2.17 [0.94, 5.02]
Syfrett 1996	3/4	1/4	1.0 %	3.00 [0.50, 17.95]
Thomson 1979	9/15	3/15	2.4 %	3.00 [1.01, 8.95]
Total (95% CI)	**353**	**349**	**100.0 %**	**1.27 [1.06, 1.53]**

Total events: 225 (Treatment), 175 (Control)

Heterogeneity: $Tau^2 = 0.04$; $Chi^2 = 22.47$, df = 12 (P = 0.03); $I^2 = 47\%$

Test for overall effect: Z = 2.60 (P = 0.0093)

Test for subgroup differences: Not applicable

Analysis 1.1. Comparison 1 Skin-to-skin versus standard contact healthy infants, Outcome 1 Breastfeeding 1 month to 4 months postbirth.

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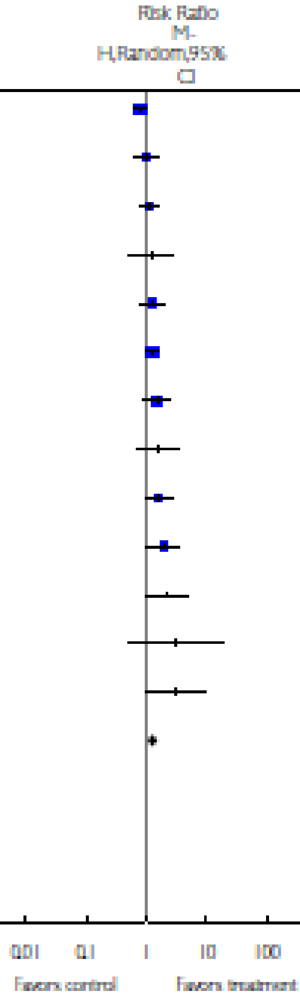
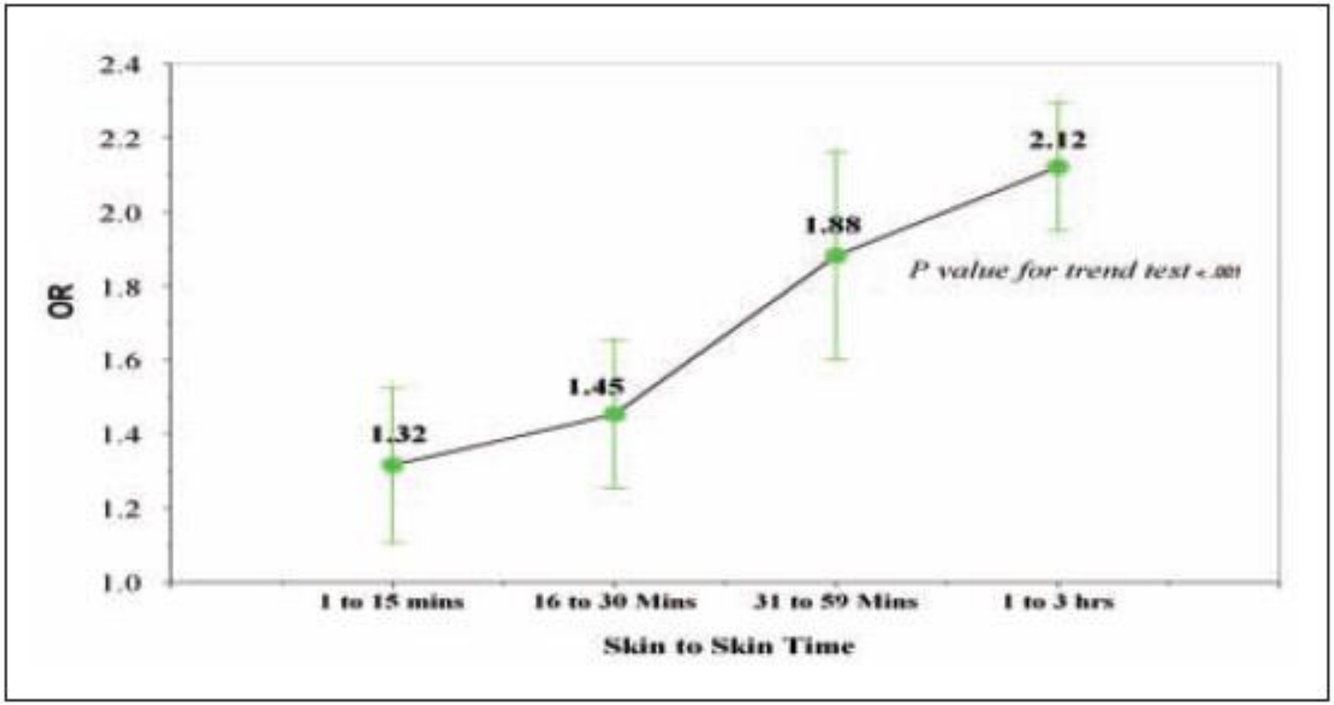


Journal of Human Lactation

http://jhl.sagepub.com

Effect of Early Skin-to-Skin Mother Infant Contact During the First 3 Hours Following Birth on Exclusive Breastfeeding During the Maternity Hospital Stay

Leslie Bramson, Jerry W. Lee, Elizabeth Moore, Susanne Montgomery, Christine Neish, Khaled Bahjri and Carolyn Lopez



More skin-to-skin → more breastfeeding

Improved survival needs early and FREQUENT Breastfeeding.

SKIN-TO-SKIN

causes →BREASTFEEDING

physiological

regulation

STABILITY


From Kim Luong Chi
(Vietnam)


From Kim Luong Chi (Vietnam)
29 week GA – zero separation
& skin-to-skin contact
→ suckling at 60 minutes.

Positive effect on breastfeeding

Photo: Karolinska Institute, Stockholm

Shirt becomes "sling",
feed frequently …

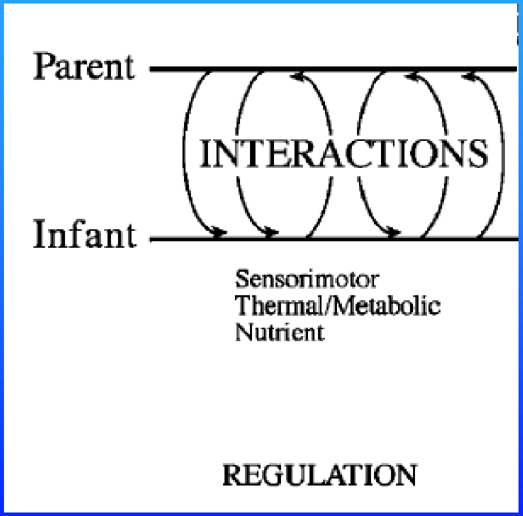

127
20
89
CLEAN
30

Improved survival needs early and FREQUENT Breastfeeding.

SKIN-TO-SKIN

causes →BREASTFEEDING

physiological regulation STABILITY



Improved survival needs early and FREQUENT Breastfeeding.

HOW OFTEN SHOULD A NEONATE FEED?

Karen Edmond, MBBS, MSc (Epidemiology), PhD
London School of Hygiene and Tropical Medicine, London, U.K.

Rajiv Bahl, MD, PhD
Department of Child and Ad
and Development, WHO, Ge

EVIDENCE FOR FEEDING FREQUENCY ????

Edmond 2006

FEED FREQUENCIES AND INTERVALS

Results

Effects on mortality, serious morbidity, neurodevelopment or malnutrition

No RCTs or observational studies were located which examined the impact of feeding frequencies or intervals on mortality, serious

Effects on other important outcomes

Only case series and descriptive studies were located which examined outcomes such as *feed tolerance* and *biochemical measures* (Level IV evidence) (*270*, *282*). These studies indicated

Conclusions and implications

Only case series and descriptive studies were located in this section. These describe the

about the safest or most effective regimens. No implications can be drawn for infants of particular gestational ages or birth weights.

Recommendations

No policy statements from international or national organizations were located which examined the frequency of feeding in LBW infants. Standard practice in many neonatal units is to commence feeding 4-hourly for infants >2000 g, 3-hourly for infants 1500–2000 g, 2-hourly for infants 1000–1500 g, and hourly in infants <1000 g. Feeding intervals are then extended on an individual basis depending on feed tolerance, gastric aspirates and physiological stability. It was not possible to provide additional recommendations due to insufficient evidence.

Only case series … Insufficient evidence

No mention of stomach capacity

Karen Edmond, MBBS, MSc (Epidemiology), PhD
London School of Hygiene and Tropical Medicine, London, U.K.

Rajiv Bahl, MD, PhD
Department of Child and A
and Development, WHO, (

EVIDENCE FOR STOMACH CAPACITY ????

Edmond 2006

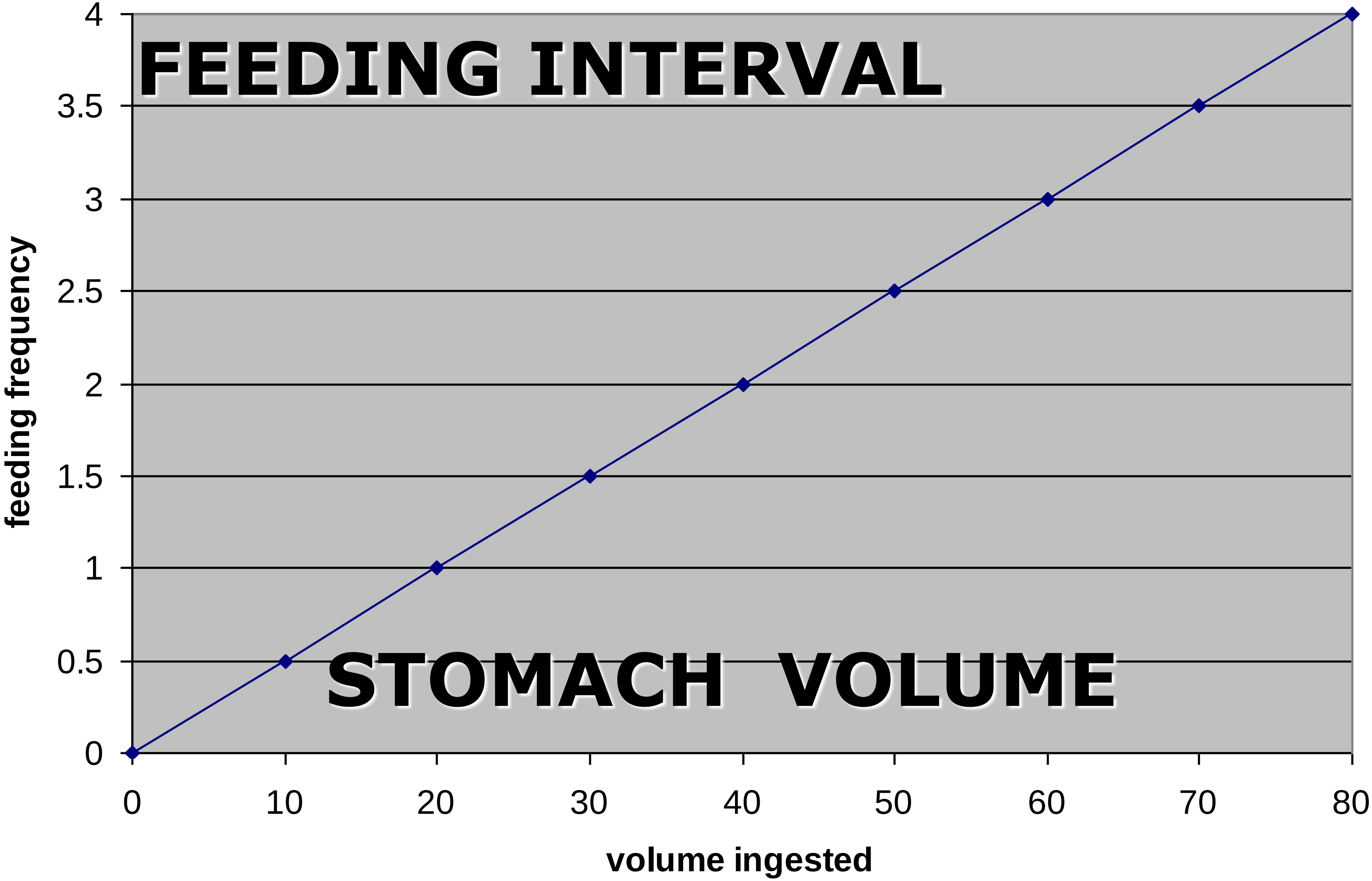
FEEDING FREQUENCY

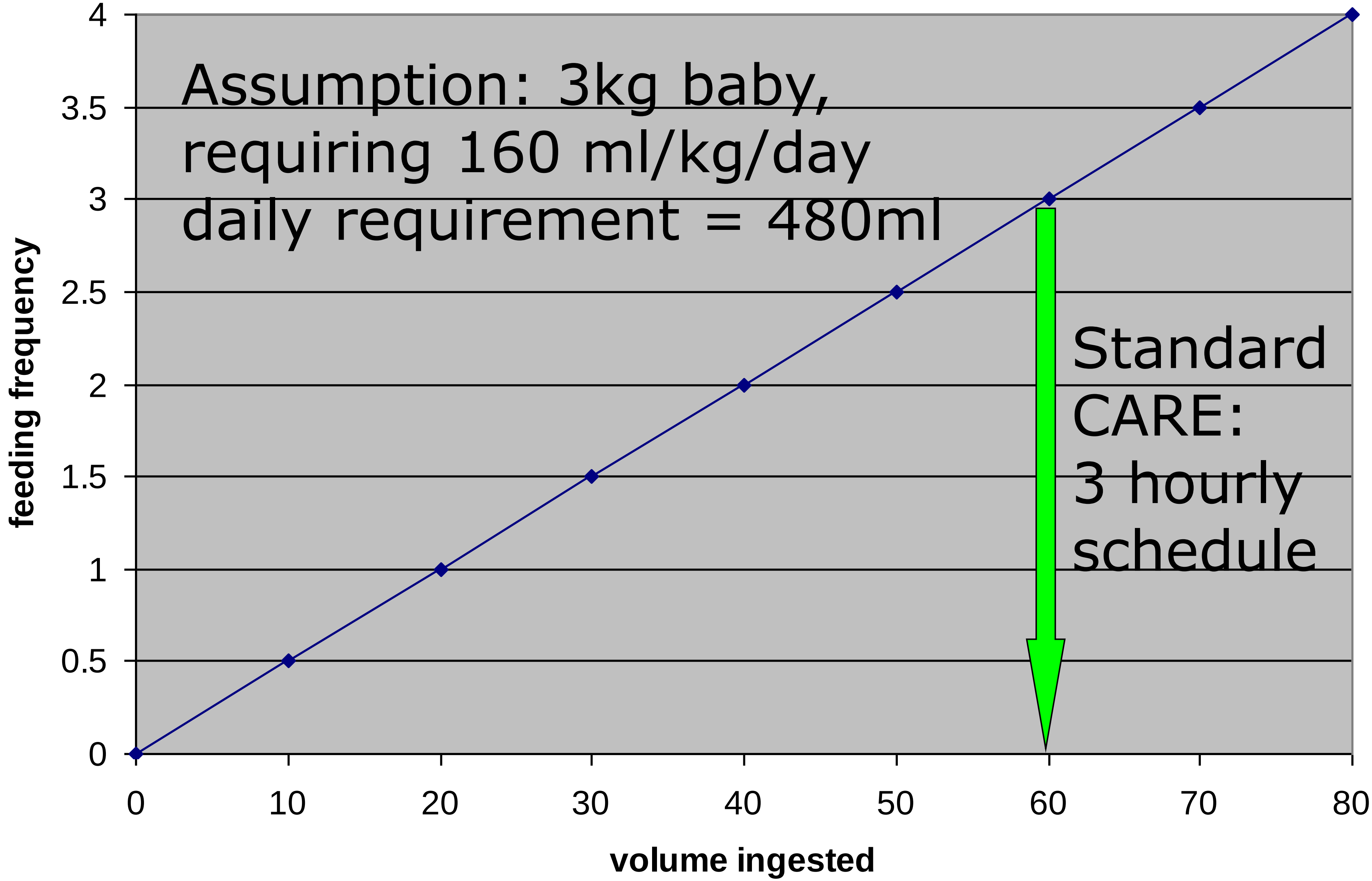
↕

1 / FEEDING INTERVAL → FEEDING VOLUME

↕

STOMACH VOLUME


FEEDING INTERVAL
STOMACH VOLUME
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80


Assumption: 3kg baby,
requiring 160 ml/kg/day
daily requirement = 480ml
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80

KEY QUESTION:

WHAT IS THE STOMACH VOLUME OF THE NEONATE ???

“Ontogeny of gastric emptying patterns in the human fetus”

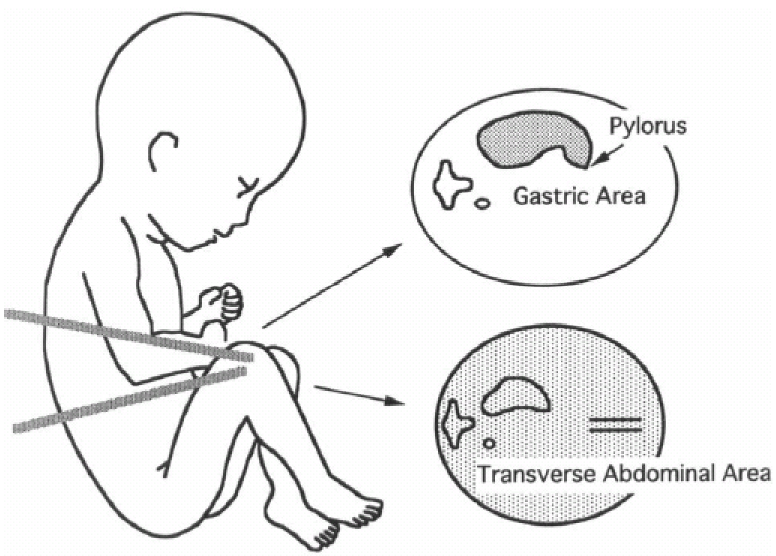


Figure 1. The schema of the fetal stomach, which is defined as the largest gastric area, inclusive of the pylorus, in relation to the transverse abdominal area [27].

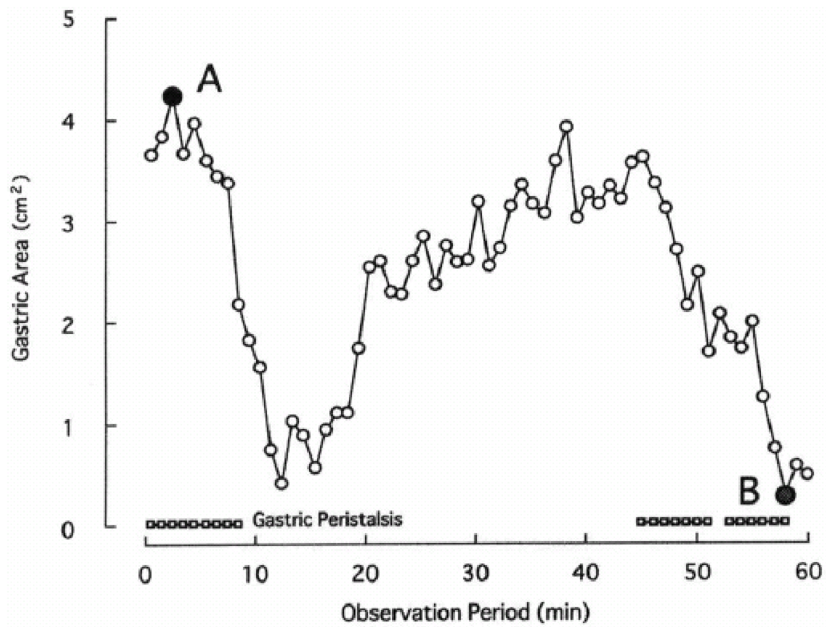


Figure 2. Changes of gastric area in a representative fetus at 33 weeks of gestation, in association with gastric peristalsis. The maximum gastric area (A) and the minimum gastric area (B) [27].

Sase 2005

BRADSHAW formula

Formula for calculation of stomach capacity (Charles Bradshaw, UCT)
Assumptions: the stomach can be approximated by dividing into three sections, namely a ellipsoidal hemisphere, an ellipsoidal cylinder, and a skewed ellipsoidal cone.
Variables: a = anteroposterior radius, t = transverse radius, l = length stomach
Relations: the height of the cone and the hemisphere are both the same as 'a'.

Ellipsoid = 4/3 * Pi* r1*r2*r3 = 4/3 *Pi * a * a * t;
therefore volume of hemisphere = 2/3 Pi * a *a * t
Cylinder = Area of base * height = (Pi * a * t) * (l - 2a)
Skewed cone = 1/3 * base *height = 1/3 * Pi * a * t * a
Total volume = <u>2/3 * Pi *a*a*t</u> + <u>Pi * a * t * (l- 2a)</u> + <u>1/3 * Pi * a * t * a</u>
=Pi a*t*l -Pi * a *a*t
<u>= Pi * a * t*(l-a)</u>

Goldstein and Sase data:
Stomach capacity at term 10 - 15 ml

Newborn stomach volume.

Gastric volumes at birth Correlated with gastric pH, gastrin and somatostatin →

"fetus drinks 10 ml portions of amniotic fluid …"

Widstrom 1988

"An Autopsy Study of Relationship between Perinatal Stomach Capacity and Birth Weight."

Infants above 2500g only:

	Ave	Range
Stillborn (n 11)	19.6 ml	(10-35)
Early death (n 9)	17.8 ml	(10-25)
All cases (n 20)	**18.8 ml**	

Naveed 1992

KERNESSUK 1997 (Russian)

Postmortem: in situ measures

(applied Bradshaw formula)

	Ave
Newborn (n 11)	15 ml
2 months (n 11)	35 ml
2-4 m (n 10)	50 ml
4-6 m (n 8)	100 ml

"Observations of the capacity of the stomach in the first ten days of post natal life."

Anatomic capacity was determined in post-mortem studies

Main data set → Alliot 1905 (n 25)

Scammon own cases ? (n 13)

30 – 35 ml at birth – almost regardless of birth weight

Scammon 1920

Zangen S et al

Rapid maturation of gastric relaxation in newborns

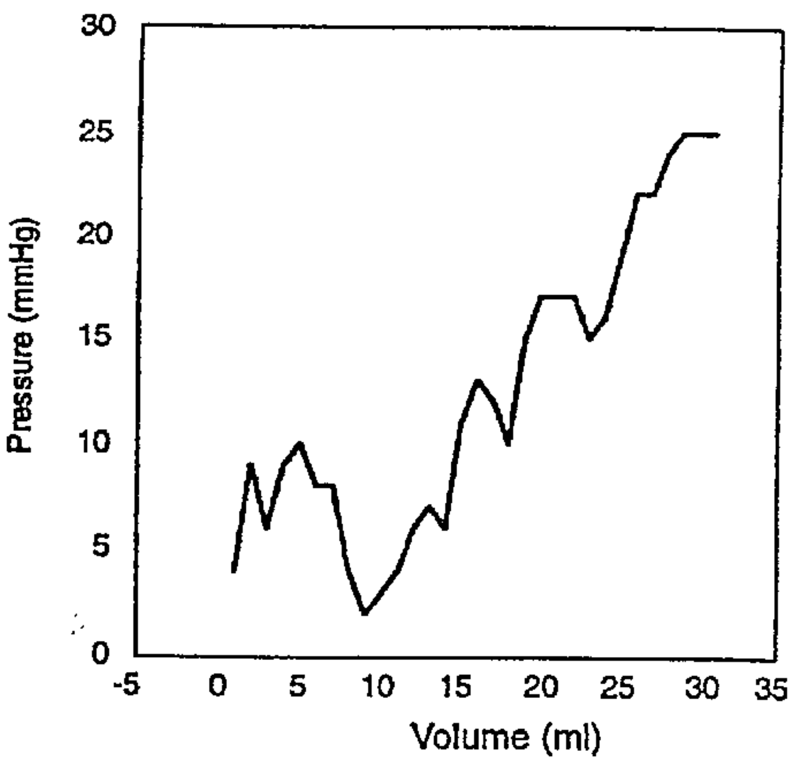


Figure 1. An intragastric pressure–volume plot from a single distention in one newborn. The flat portion of the curve between 0 and 15 mL is an artifact caused by the volume required to open the balloon. Note the linear pressure–volume relationship from 5 mm Hg to the maximal pressure tested, 30 mm Hg. There is no plateau with a 0 slope, as expected in adults.

Pressures (mmHg)

Balloon inflates to

15 ml no increase

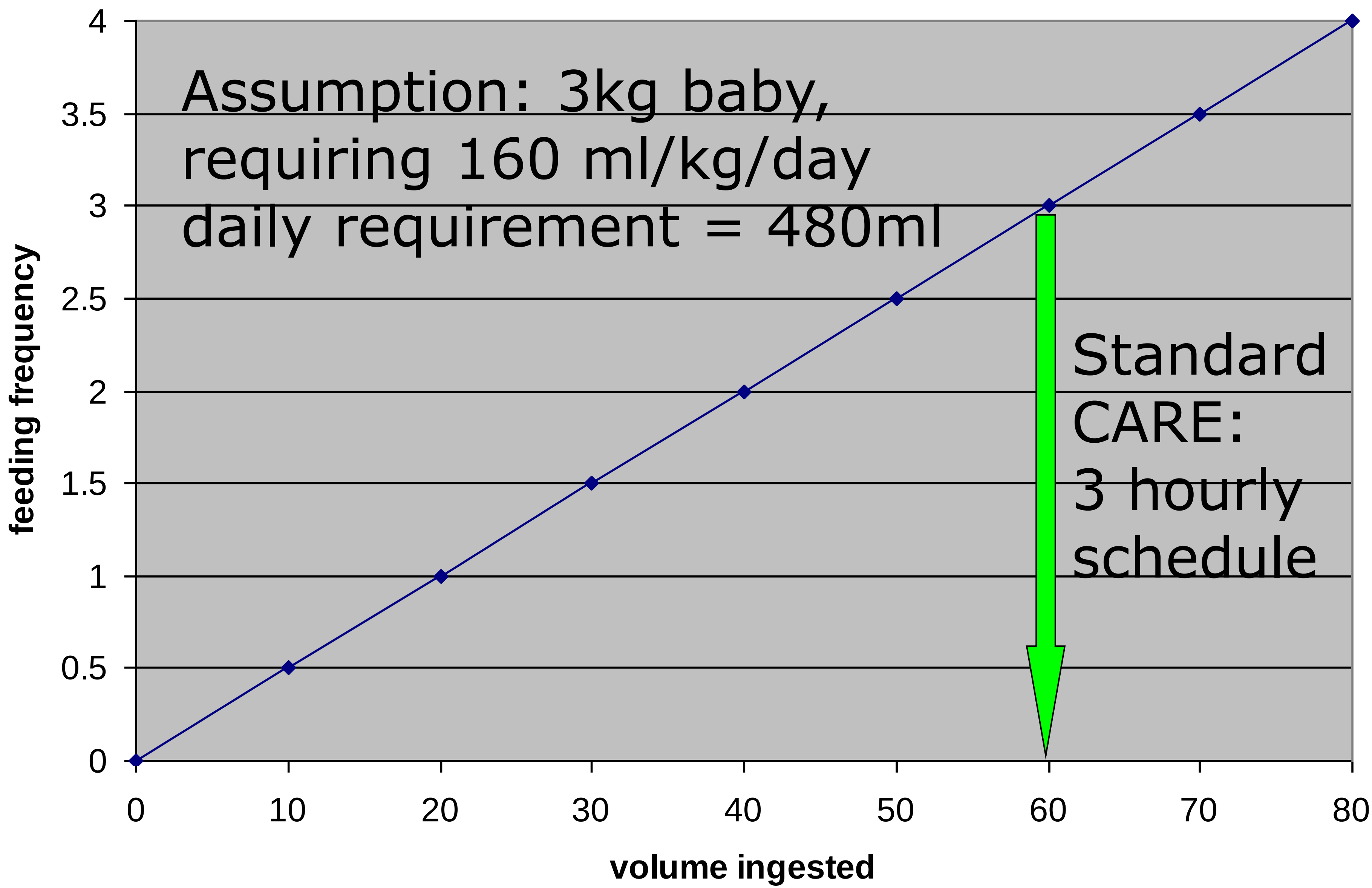
20 ml pressure OK

EVIDENCE: (NBn 111009)

Author	Capacity	Note:
Sase	10-15 ml	Live, term fetus
Goldstein	10-15 ml	Live, term fetus
Widstrom	10 mls	Live, newborn
Zangen	20 mls	Live, (pressure)
Naveed	20 mls	Autopsy (SB)
	20 mls	Autopsy (ENND)
Kernessuk	15 mls	Autopsy (in situ)
Scammon (Alliot)	30-35 ml	Autopsy (water pressure)

PROPOSAL:

The CAPACITY of a week old baby's stomach is approx **<u>20 ml.</u>**


Assumption: 3kg baby,
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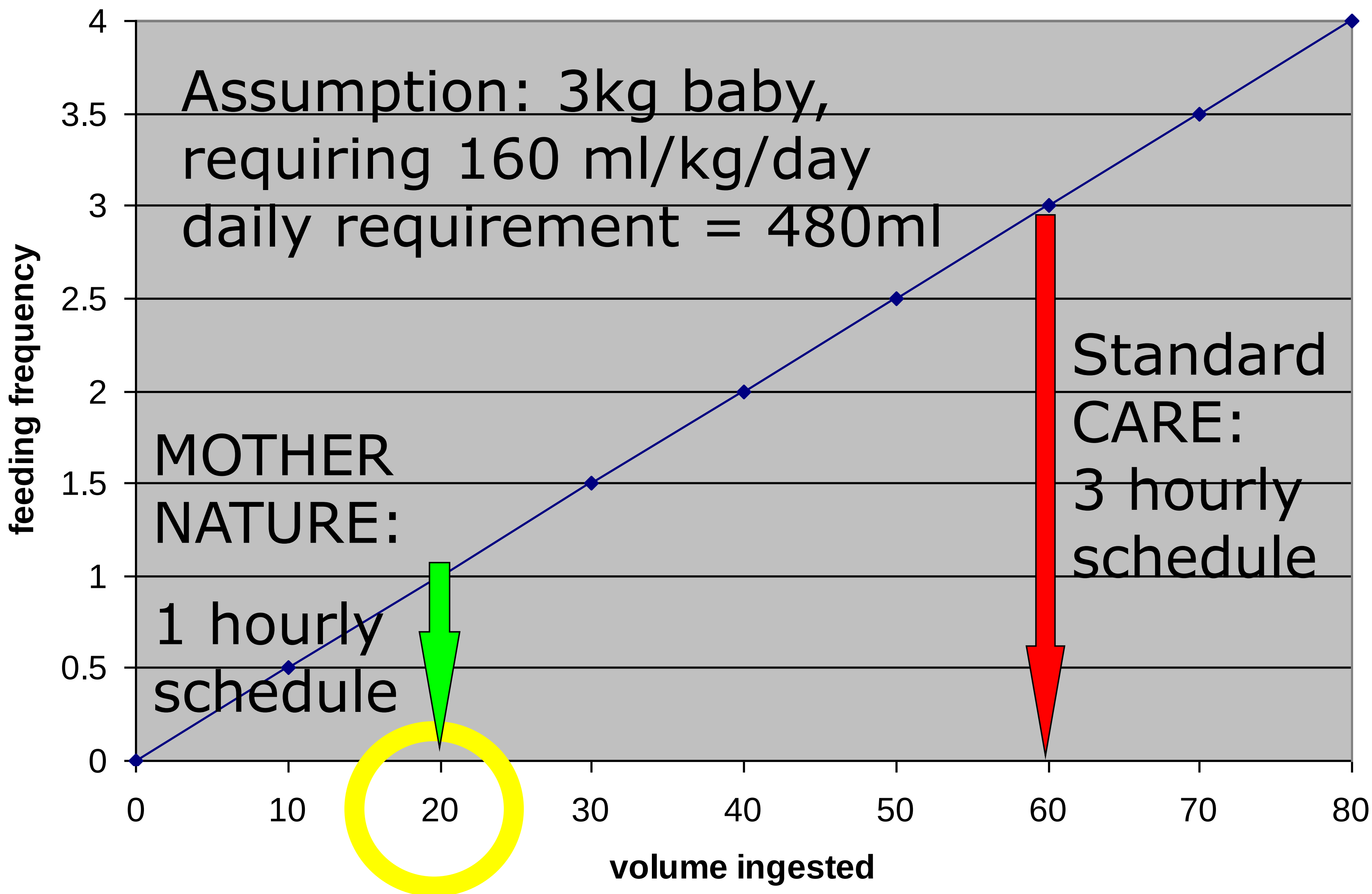
daily requirement = 480ml
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
4
3.5
3
2.5
2
1.5
1
0.5
0
0
10
20
30
40
50
60
70
80



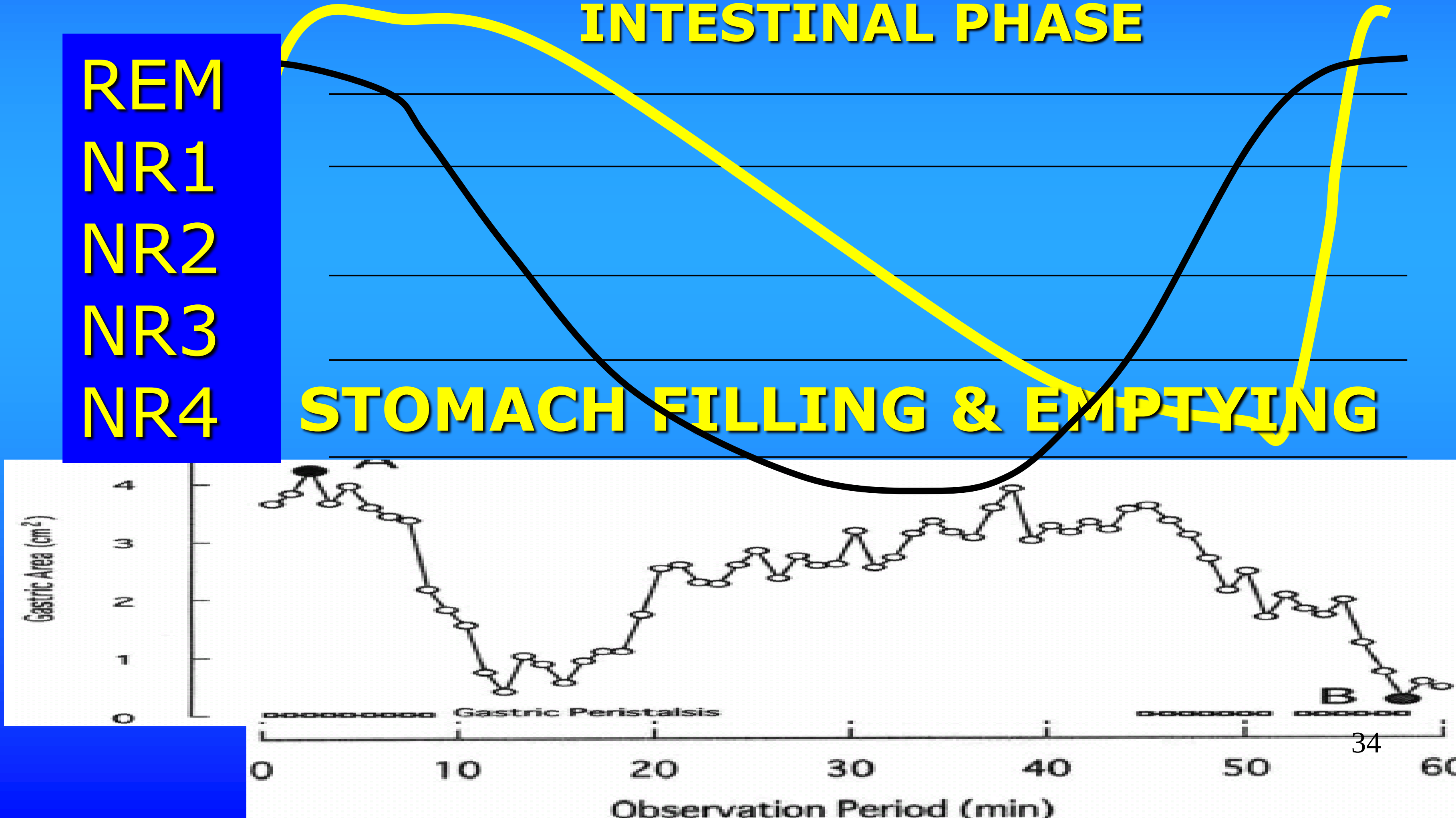
Assumption: 3kg baby,
requiring 160 ml/kg/day
daily requirement = 480ml
MOTHER
NATURE:
1 hourly
schedule
Standard
CARE:
3 hourly
schedule
feeding frequency
volume ingested
0
0.5
1
1.5
2
2.5
3
3.5
4
0
10
20
30
40
50
60
70
80

BRAIN CYCLING

CEPHALIC PHASE

GASTRIC PHASE

INTESTINAL PHASE



Improved quality survival needs support for SLEEP CYCLING, which needs skin-to-skin contact

SKIN-TO-SKIN

causes → SLEEP CYCLING

Enhances brain maturation

→ Brain wiring

→ Connectome

→ Quality survival

Improved survival needs early and FREQUENT Breastfeeding.

SKIN-TO-SKIN
causes →BREASTFEEDING
physiological →ANS same as
regulation for sleep!
STABILITY →Stomach small!
→ approx hourly

WHAT IS THE STOMACH VOLUME OF THE PREMATURE ??

Assume low resilience

Assume proportionality →

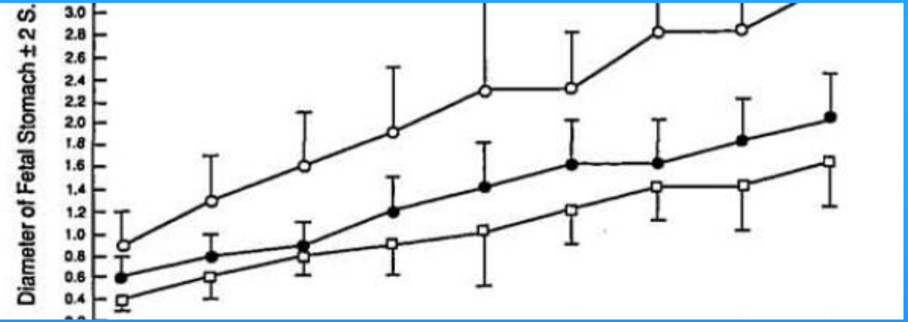


Figure 3. Mean ± 2 SD of the longitudinal (*open circles*), the transverse (*solid circles*), and the anteroposterior (*open squares*) diameters of the stomach against the gestational age, demonstrating linear relationships.

The CAPACITY of a low birthweight prem from 20ml / 3000g

= 0.007 x BWt (g)

1kg x 0.007 = 7mls

2kg x 0.007 = 14mls

FEEDING VOLUME

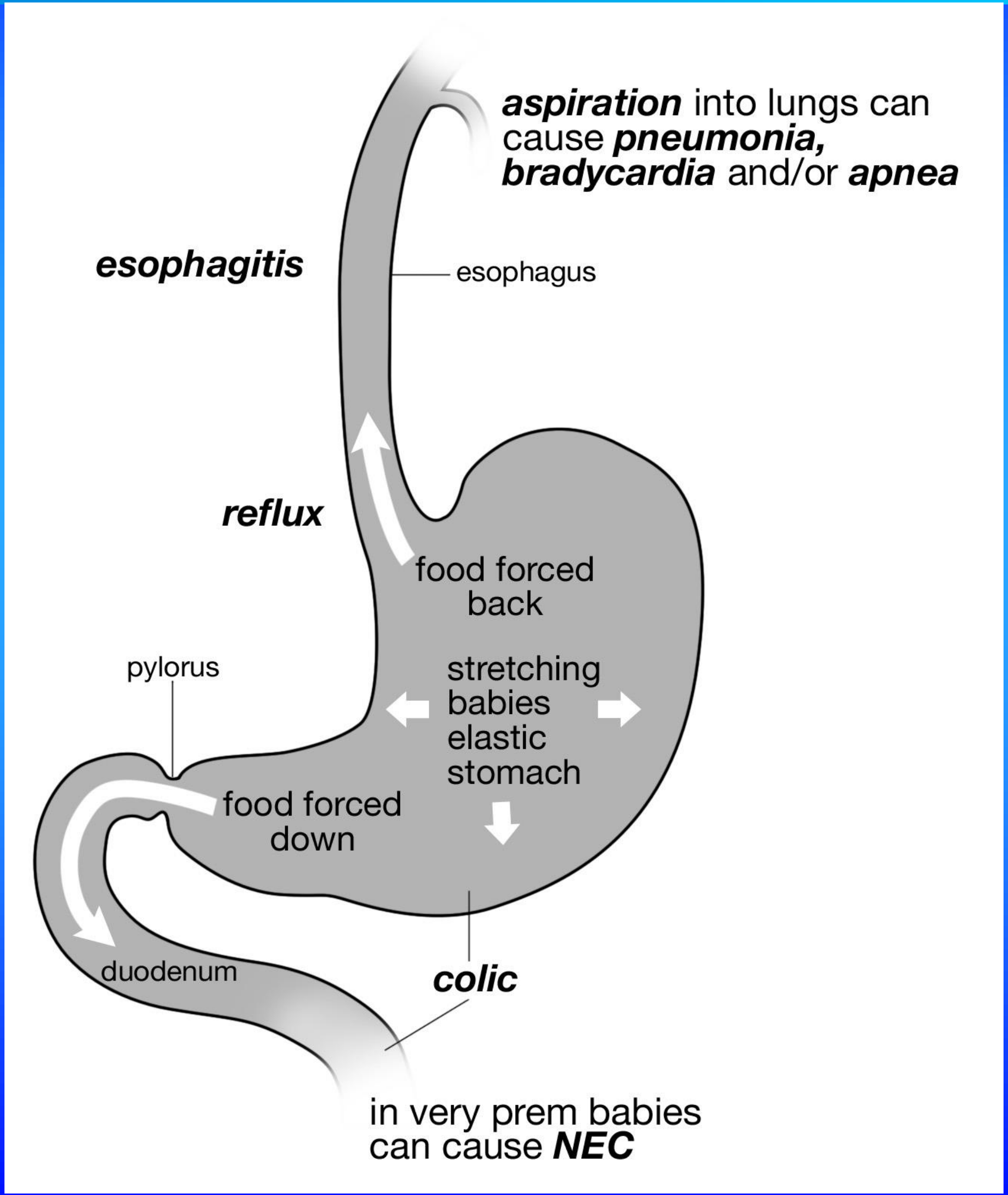
Alexis 1700g
daily requirement
160ml x 1.7 = 272 ml

3 hrly feed = 34 ml

2 hrly feed = 22ml
= ping pong ball

1 hrly feed = 11ml
= stomach capacity

Gastric overfilling syndrome?



Zangen S et al
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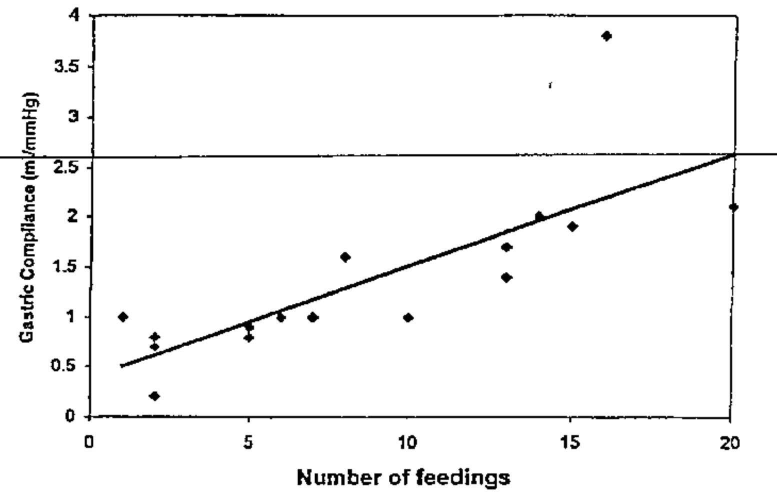


Figure 2. Relationship between gastric compliance and the number of feedings in neonates. Each neonate had a fixed compliance value (the slope of the volume–pressure relationship was linear) up to 30 mm Hg. There was a positive correlation between number of feedings and gastric compliance (r = 0.80; $p < 0.001$).

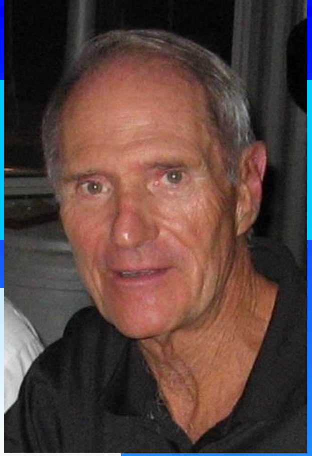
A balloon in stomach can fill to 76 mls

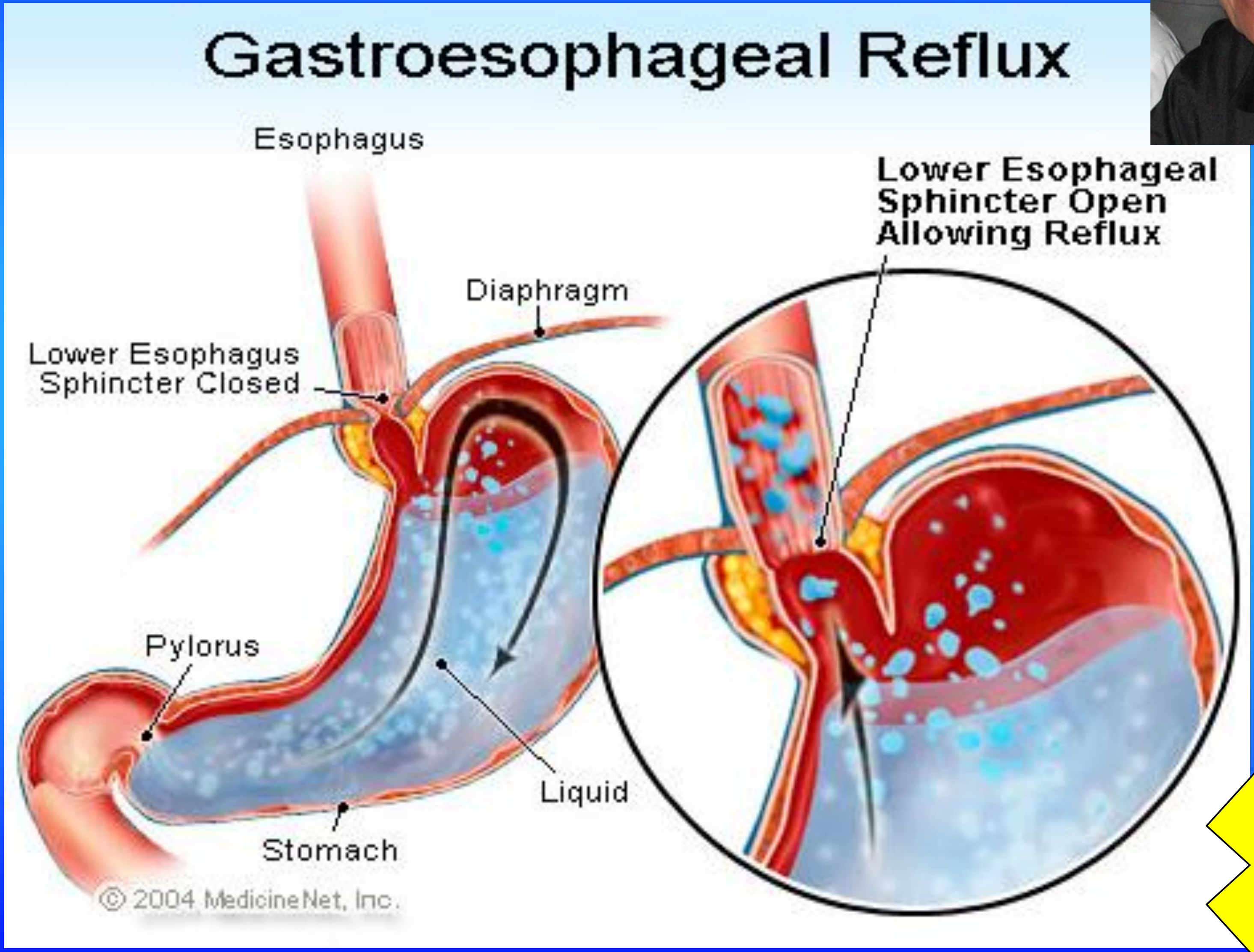
What does the stomach – without a balloon – do to 76 mls?

PRESUME: each feed approximately 75 mls

REFLUX !!!

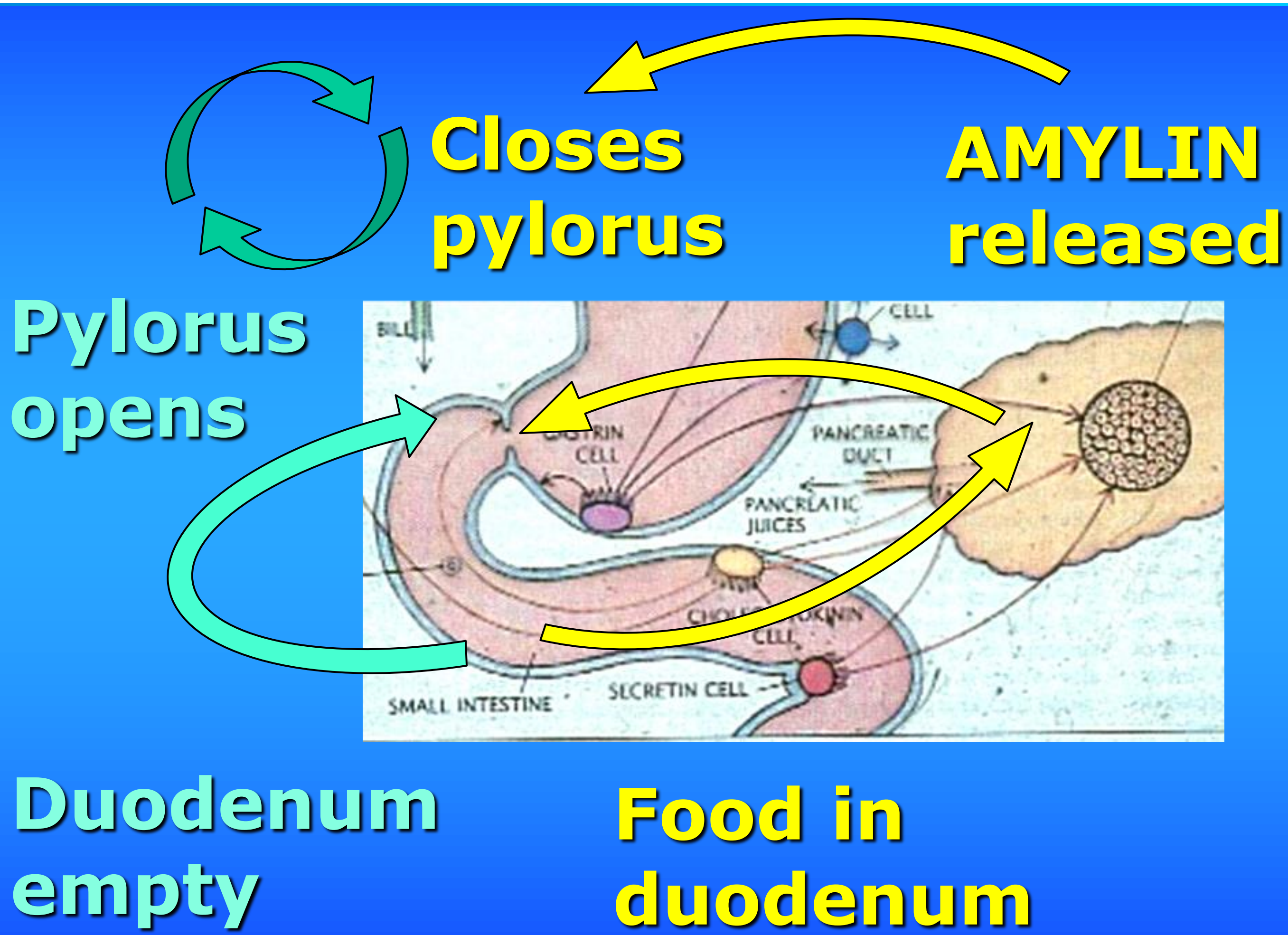
GER




Gastroesophageal Reflux
Esophagus
Lower Esophageal Sphincter Open Allowing Reflux
Diaphragm
Lower Esophagus Sphincter Closed
Pylorus
Liquid
Stomach
© 2004 MedicineNet, Inc.

HO

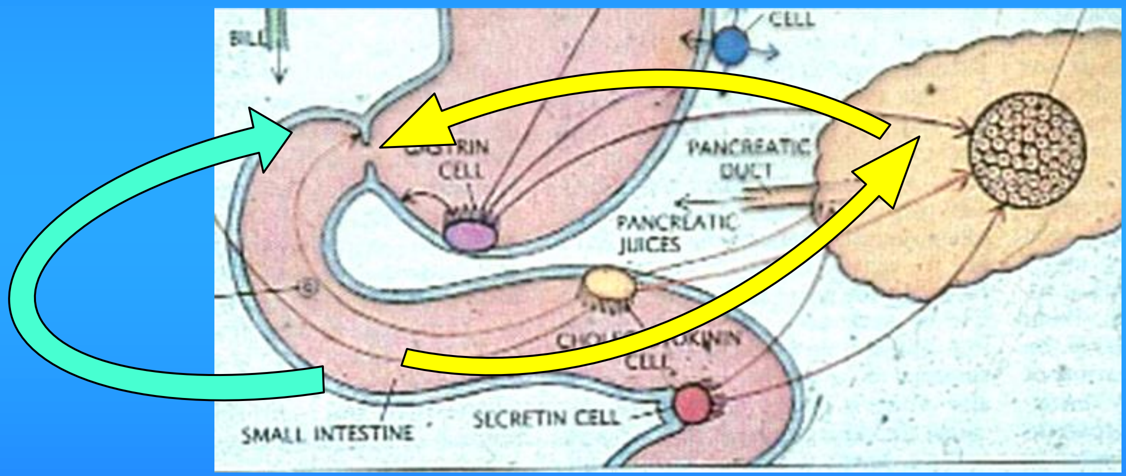
Amylin peptide is increased in preterm neonates with feed intolerance



HO

Amylin peptide is increased in preterm neonates with feed intolerance

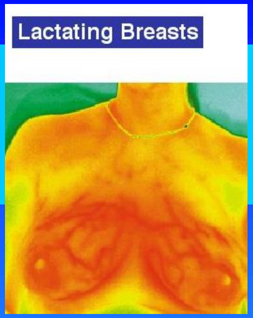
V R Kairamkonda,[1] A Deorukhkar,[2] C Bruce,[3] R Coombs,[2] R Fraser,[3] A-P T Mayer[4]



"Feed intolerance" …

… or VOLUME intolerance?

HYPOGLYCAEMIA



SSC Glucose production = Glucose consumption

Approximate GLUCOSE

SNS stress → Glucose consumption INCREASE

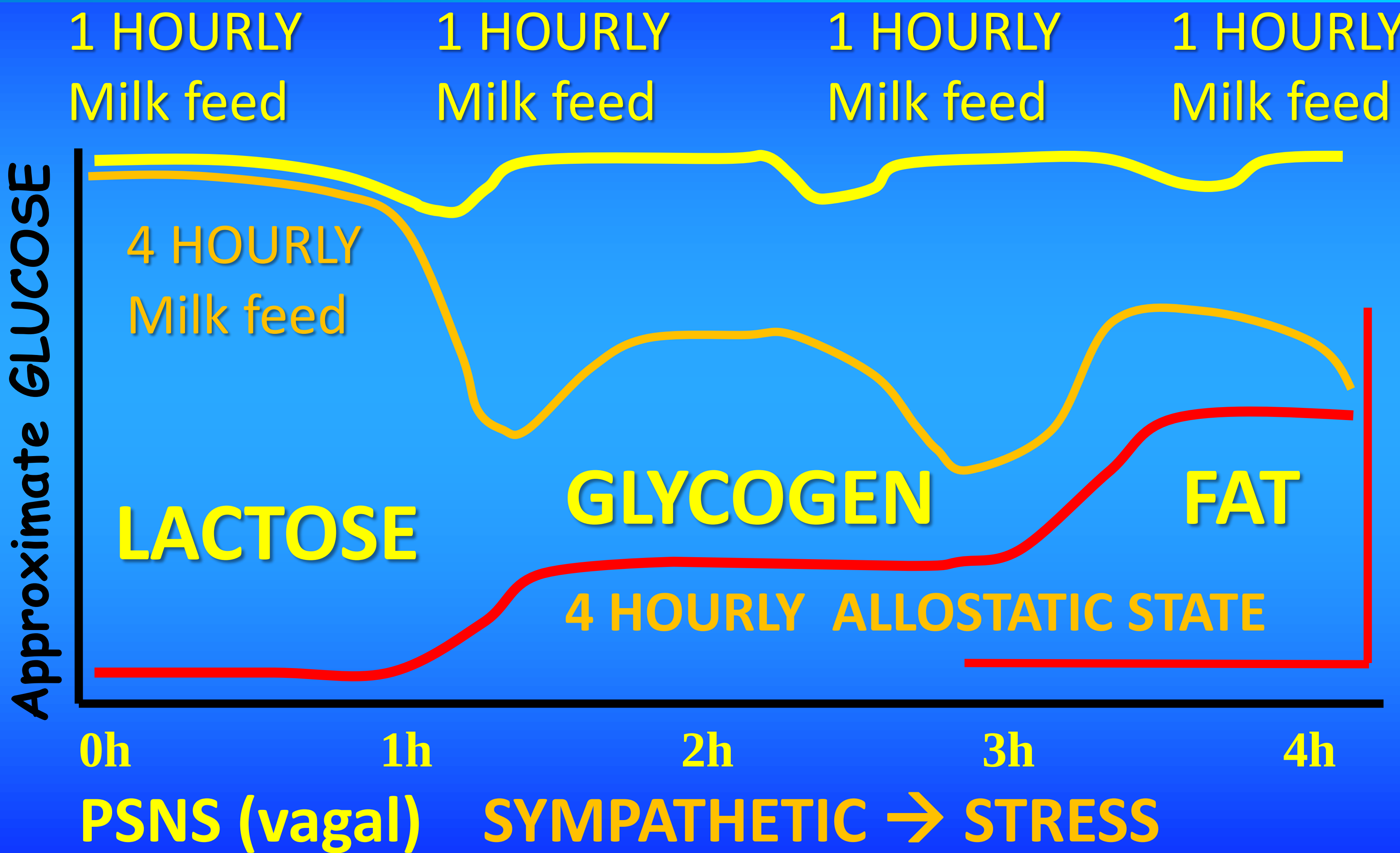
PSNS dissociation →
Glucose production DECREASE

Separation

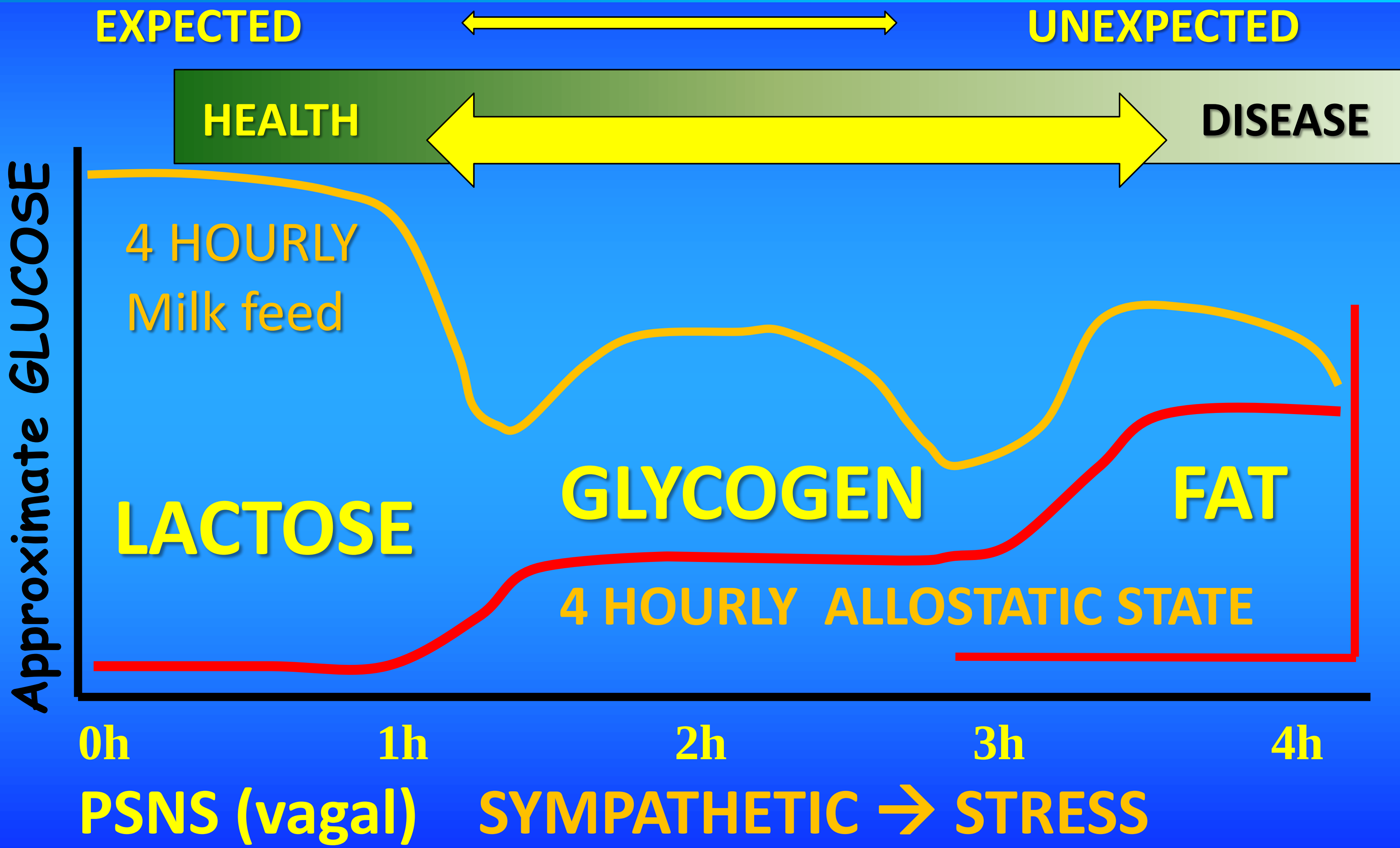
HYPOGLYCEMIA

	SSC	Cot
0h 1h 2h 3h 4h → → 2 days		
Blood glucose (1 hr)	3.17	2.56

METABOLISM


1 HOURLY
Milk feed
1 HOURLY
Milk feed
1 HOURLY
Milk feed
1 HOURLY
Milk feed
Approximate GLUCOSE
4 HOURLY
Milk feed
LACTOSE
GLYCOGEN
FAT
4 HOURLY ALLOSTATIC STATE
0h
1h
2h
3h
4h
PSNS (vagal)
SYMPATHETIC → STRESS

METABOLISM


EXPECTED
UNEXPECTED
HEALTH
DISEASE
Approximate GLUCOSE
4 HOURLY
Milk feed
LACTOSE
GLYCOGEN
FAT
4 HOURLY ALLOSTATIC STATE
0h
1h
2h
3h
4h
PSNS (vagal)
SYMPATHETIC → STRESS

ACTA PÆDIATRICA
NURTURING THE CHILD

Acta Pædiatrica ISSN 0803-5253

VIEWPOINT ARTICLE

Neonatal stomach volume and physiology suggest feeding at 1-h intervals

Nils J Bergman (nils@kangaroomothercare.com)

Department of Human Biology, Department of Paediatrics, University of Cape Town, Cape Town, South Africa

Keywords
Feeding interval, Gastro-oesophageal reflux, Hypoglycaemia, Neonatal, Stomach capacity

Correspondence
Nils Bergman, 8 Francis Road, Pinelands 7405, South Africa.
Tel: +27 21 531 5819|
Fax: +27 21 531 5819|
Email: nils@kangaroomothercare.com

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DOI:10.1111/apa.12291

ABSTRACT

There is insufficient evidence on optimal neonatal feeding intervals, with a wide range of practices. The stomach capacity could determine feeding frequency. A literature search was conducted for studies reporting volumes or dimensions of stomach capacity before or after birth. Six articles were found, suggesting a stomach capacity of 20 mL at birth.

Conclusion: A stomach capacity of 20 mL translates to a feeding interval of approximately 1 h for a term neonate. This corresponds to the gastric emptying time for human milk, as well as the normal neonatal sleep cycle. Larger feeding volumes at longer intervals may therefore be stressful and the cause of spitting up, reflux and hypoglycaemia. Outcomes for low birthweight infants could possibly be improved if stress from overfeeding was avoided while supporting the development of normal gastrointestinal physiology. Cycles between feeding and sleeping at 1-h intervals likely meet the evolutionary expectations of human neonates.

Improved survival needs early and FREQUENT Breastfeeding.

SKIN-TO-SKIN
causes → BREASTFEEDING
physiological → ANS same as
regulation for sleep!
STABILITY → Stomach small!
→ approx hourly

Improved survival needs early and FREQUENT Breastfeeding.

In HIC / MIC
all the effects
of overfilling
can be treated

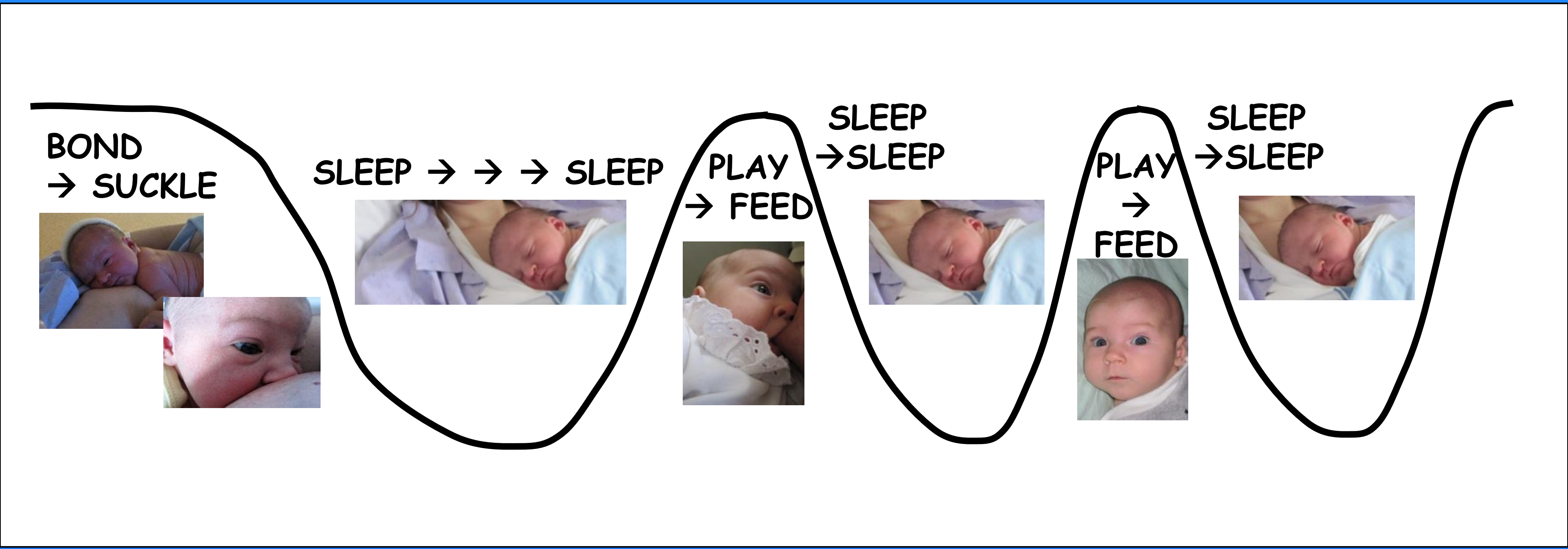
In LIC →
effects of
excess volumes
long intervals
may contribute
to mortality

Infant feeding frequency:

Proposal based on available evidence and neuroscience

"Small and frequent feeds, adjusted to the sleep cycle"

Infant sleep cycling and synchronicity with maternal sleep ensure development.

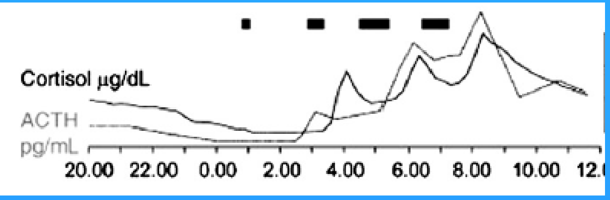


6-8 weeks … small frequent feeds between SINGLE sleep cycles

Joseph 2014

Arch Dis Child Fetal Neonatal Ed. 2014 Sep 22. pii: fetalneonatal-2014-306104.
doi: 10.1136/archdischild-2014-306104. [Epub ahead of print]

Getting rhythm: how do babies do it?



MELATONIN
day-night rhythm

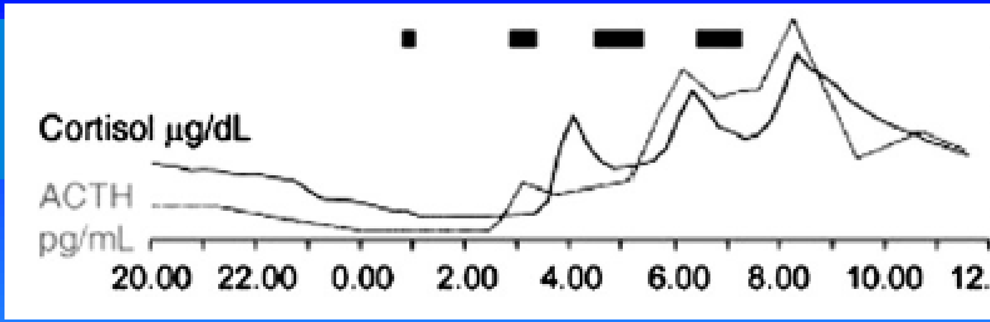
H3f3b gene
detected

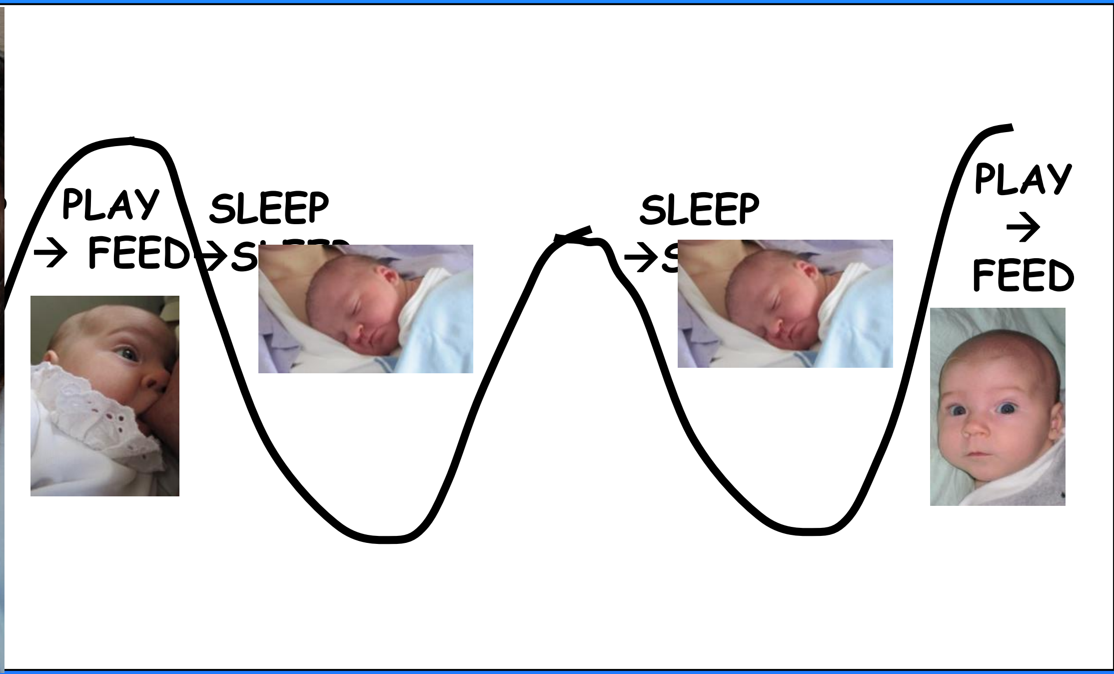
CORTISOL
day-night
rhythm

TEMPERATURE
day-night
rhythm

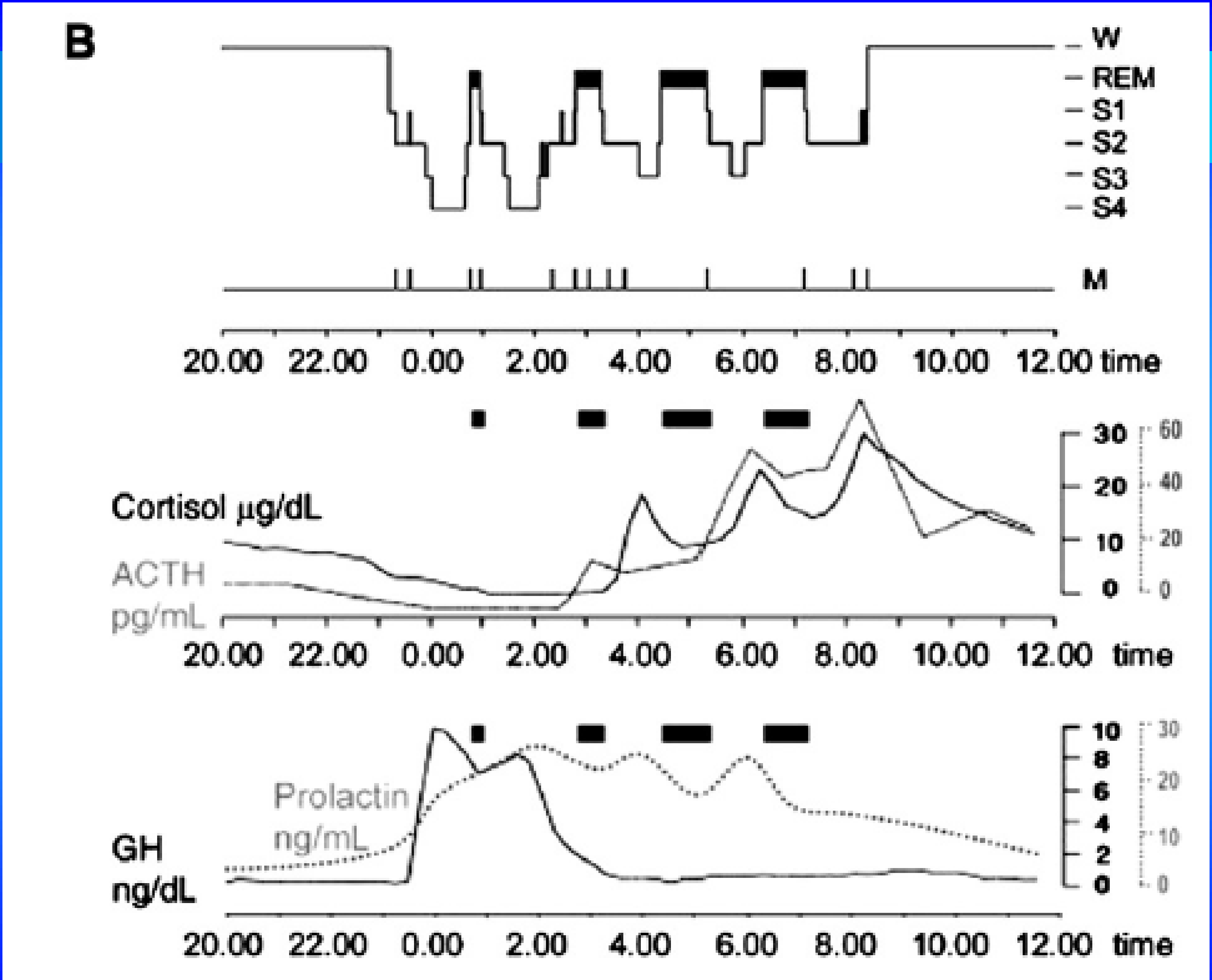
Birth ~ /~ 8w 9w 10w 11w

dates averaged → "between 6 and 18 weeks"

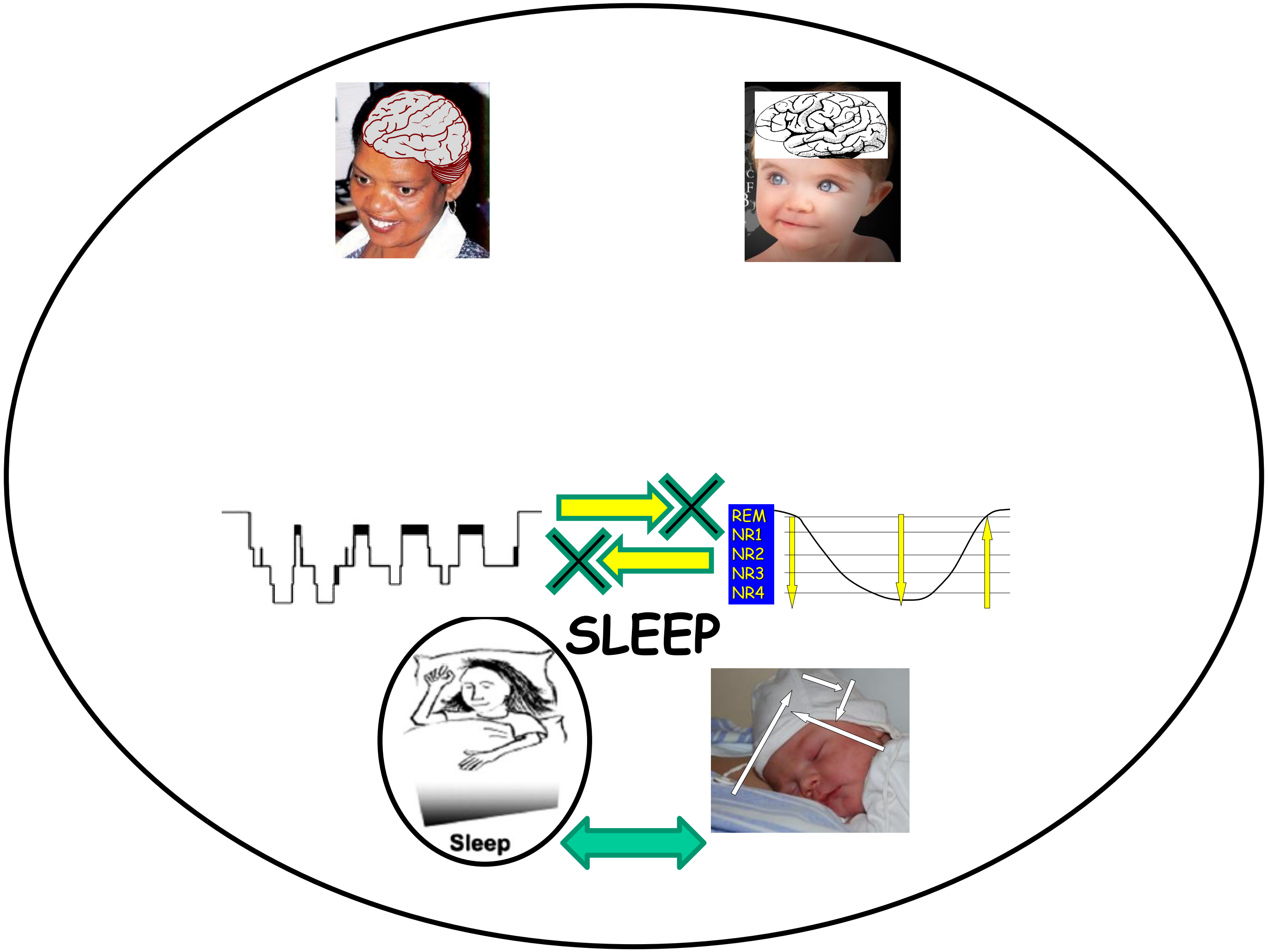


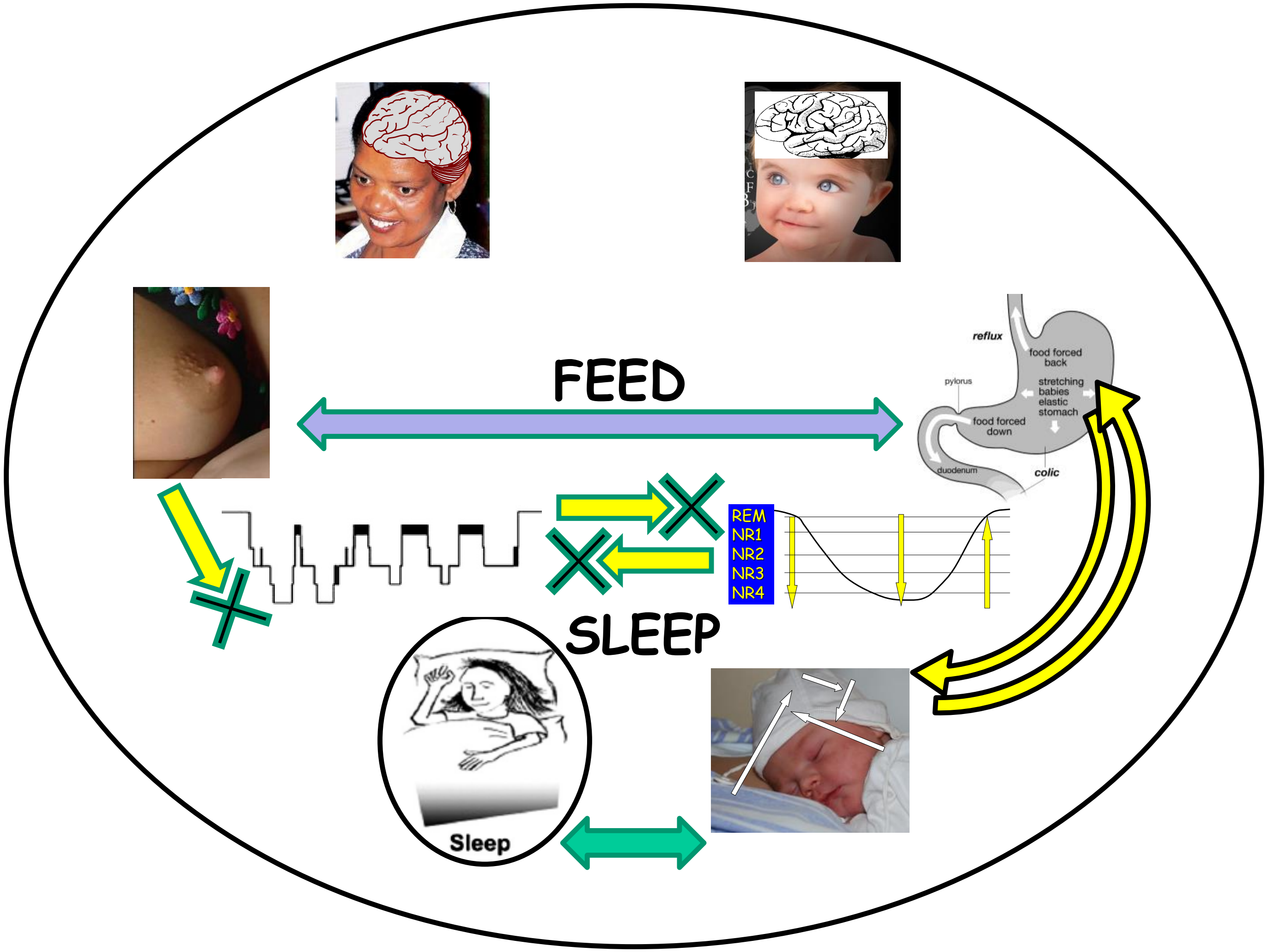


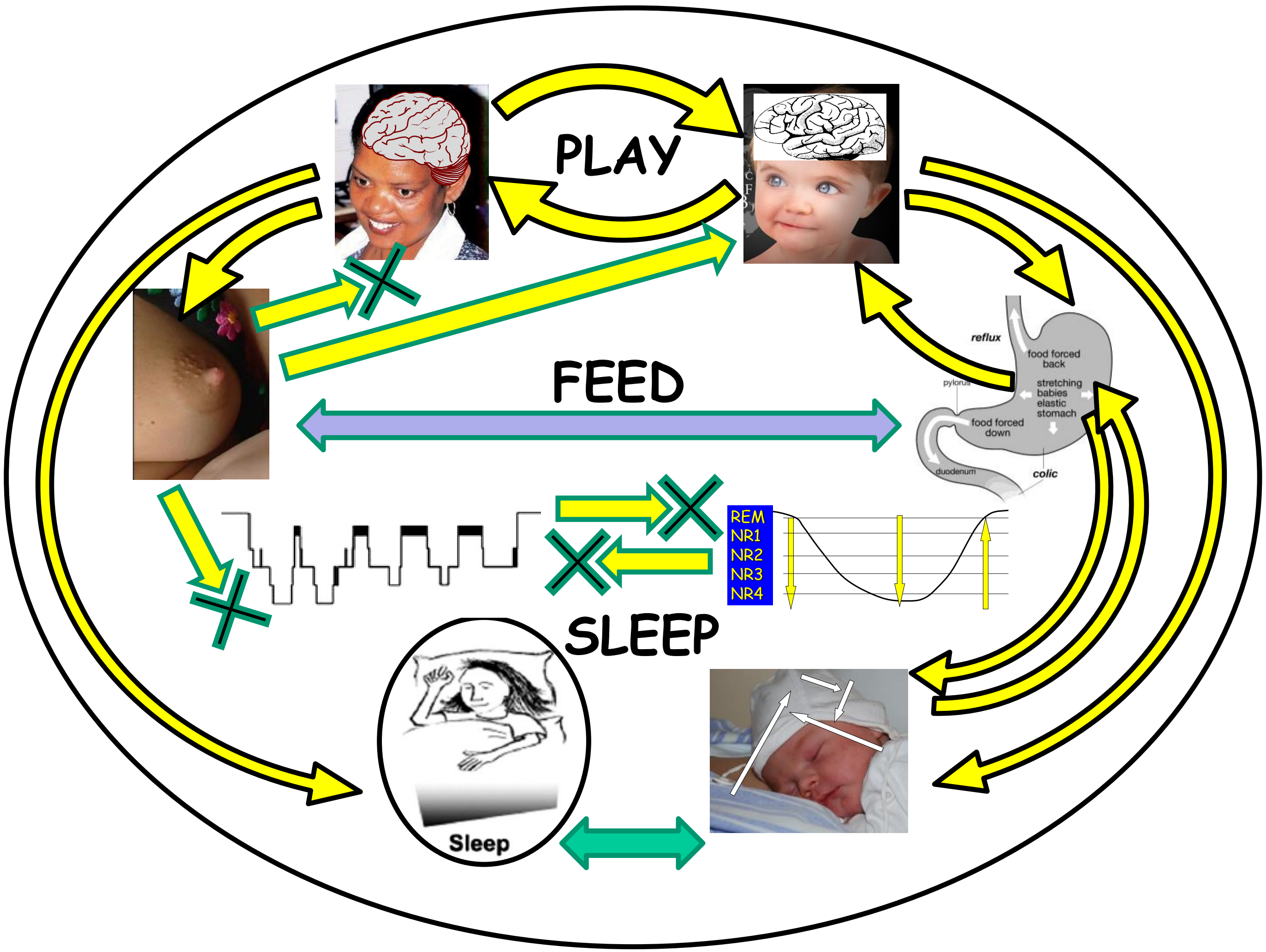
Once diurnal rhythm established → Blocking of sleep cycles can begin



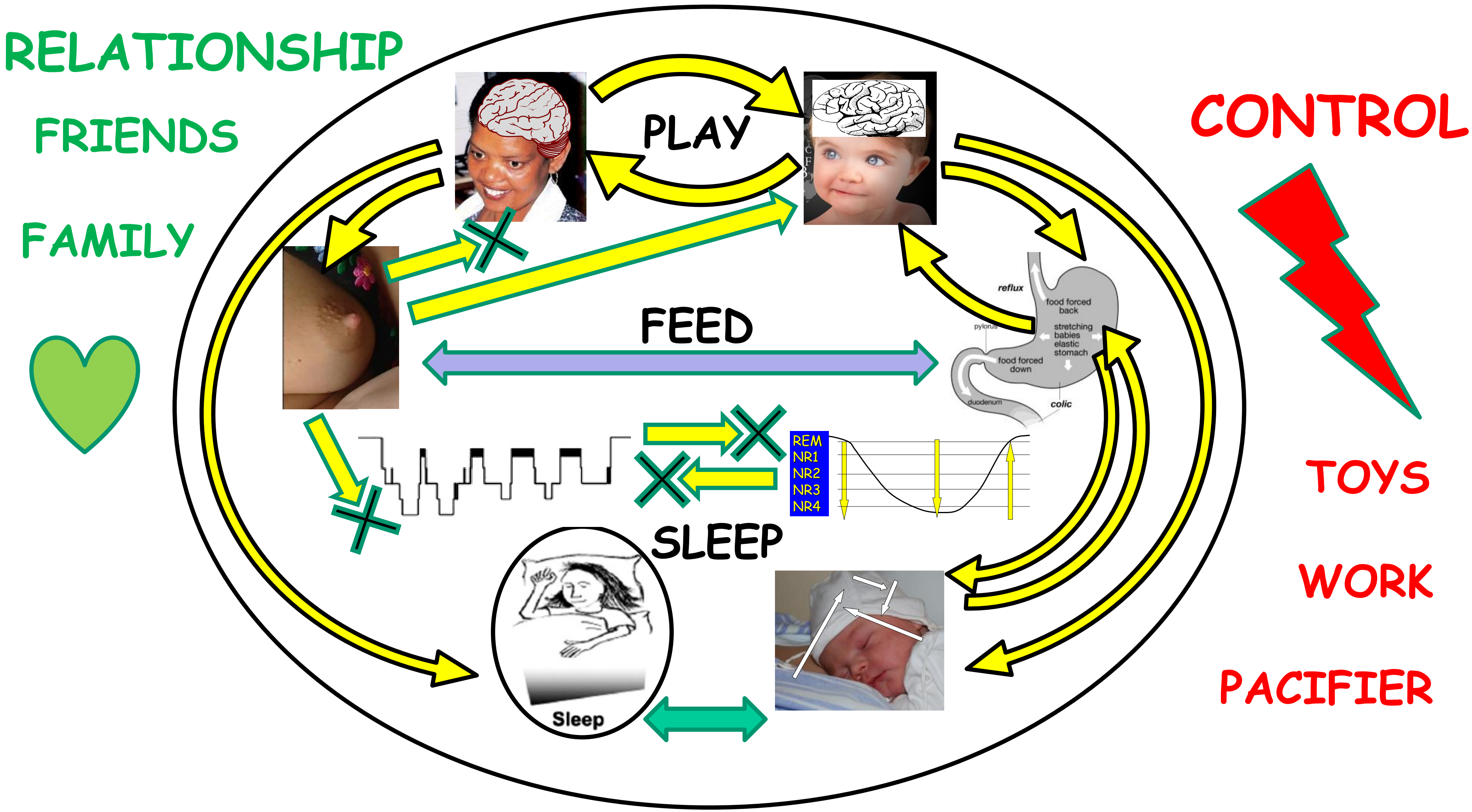
B
W
REM
S1
S2
S3
S4
M
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time
Cortisol µg/dL
ACTH pg/mL
30 20 10 0
60 40 20 0
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time
Prolactin ng/mL
GH ng/dL
10 8 6 4 2 0
30 20 10 0
20.00 22.00 0.00 2.00 4.00 6.00 8.00 10.00 12.00 time


REM
NR1
NR2
NR3
NR4
SLEEP
Sleep

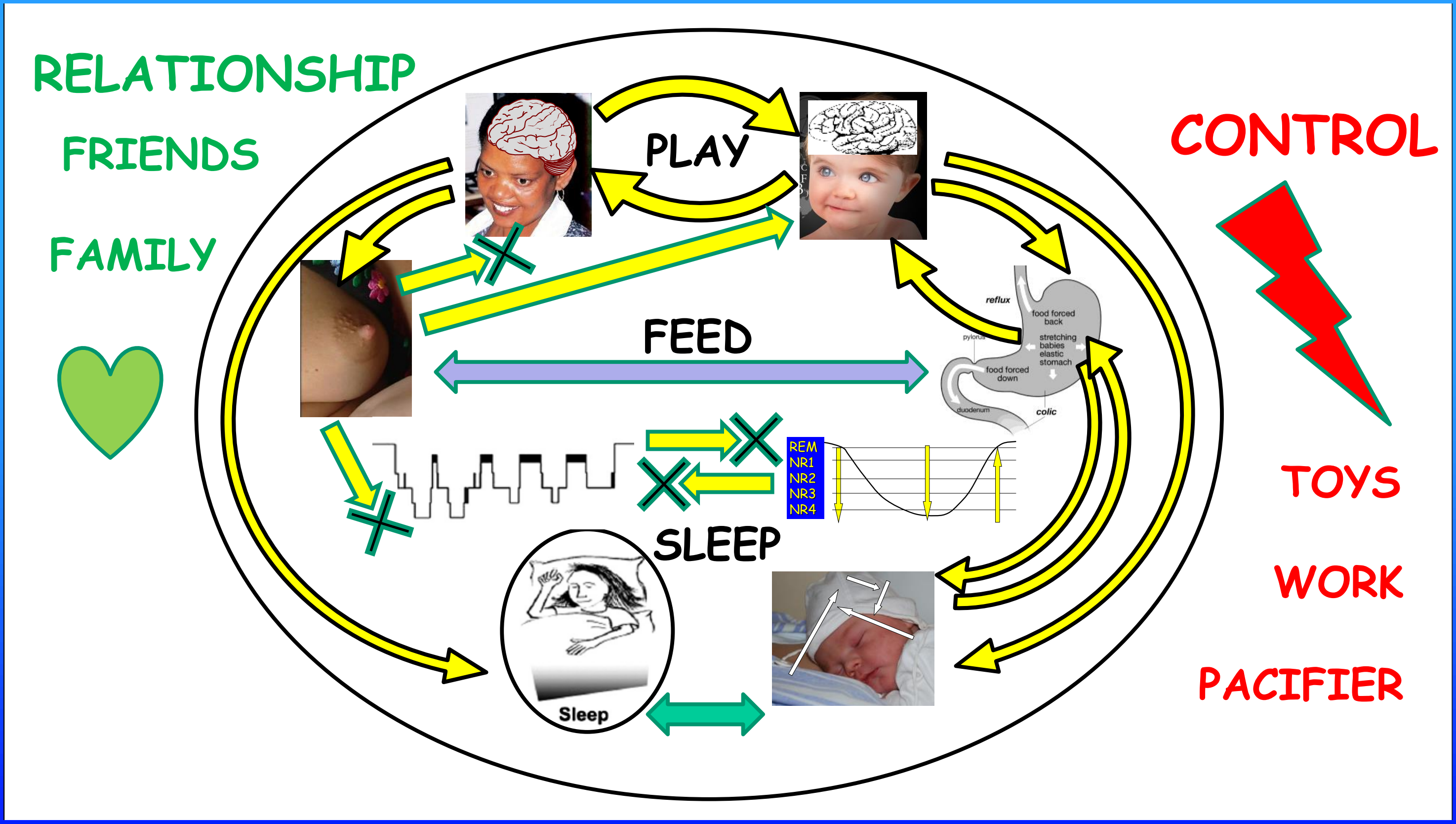

FEED
reflux
food forced back
pylorus
stretching babies elastic stomach
food forced down
duodenum
colic
REM
NR1
NR2
NR3
NR4
SLEEP
Sleep



PLAY
FEED
reflux
food forced back
pylorus
stretching babies elastic stomach
food forced down
duodenum
colic
SLEEP
REM
NR1
NR2
NR3
NR4
Sleep


RELATIONSHIP
FRIENDS
FAMILY
PLAY
FEED
reflux
food forced back
pylorus
stretching babies elastic stomach
food forced down
duodenum
colic
REM
NR1
NR2
NR3
NR4
SLEEP
Sleep
CONTROL
TOYS
WORK
PACIFIER

Consolidation of dyadic lifestyle leads to emotional and social competence



Infant feeding frequency:
Proposal based on available evidence and neuroscience

"Small and frequent feeds, adjusted to the sleep cycle"

Improved survival needs early and FREQUENT Breastfeeding.

"Small and frequent feeds, adjusted to the sleep cycle"