TPN

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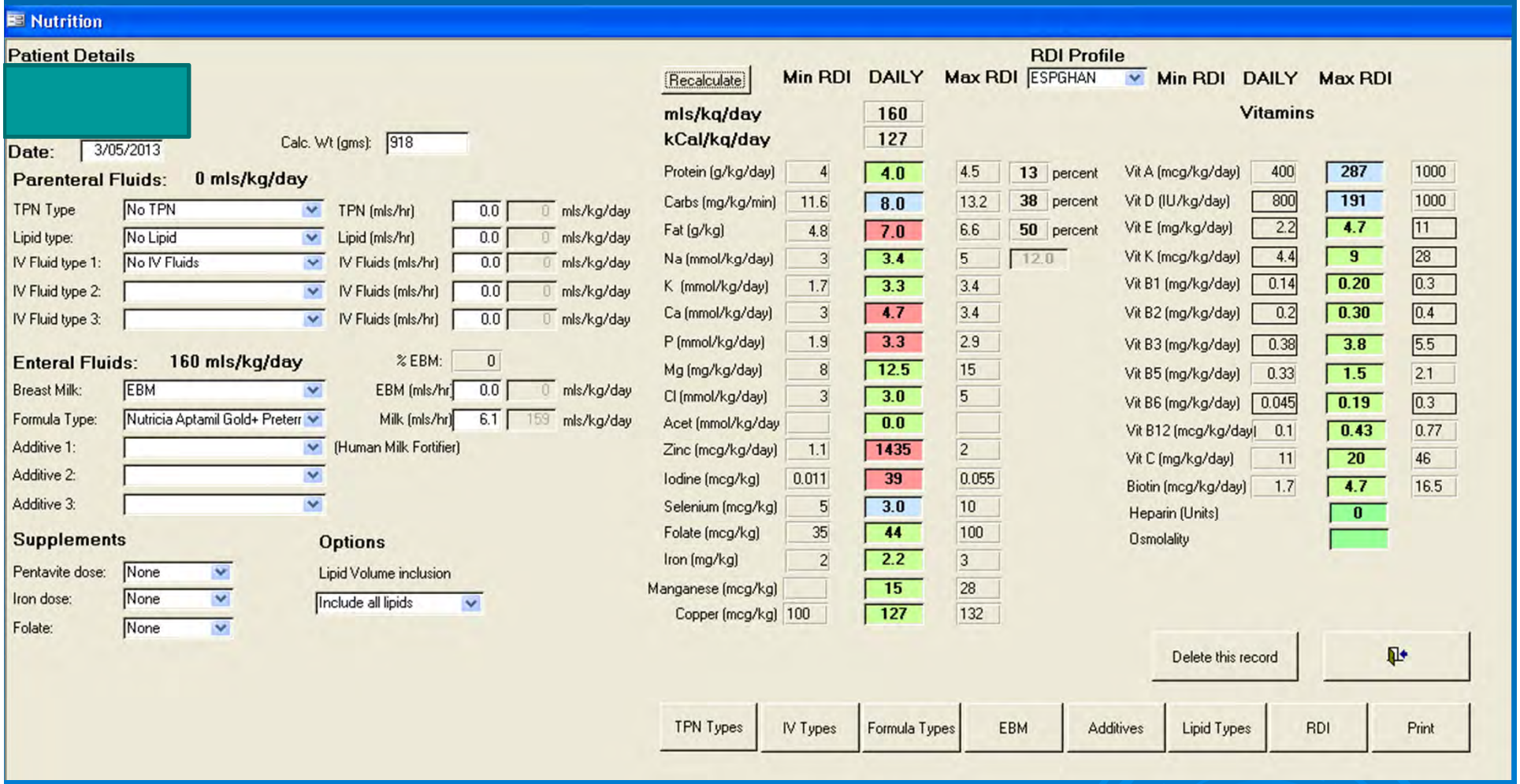
Nutrition Calculator: Nutricia Preterm



NSW Neonatal TPN Consensus Group
9 NICU in NSW

10 NICU in other states

Background

- There are 61 different neonatal formulations
- Objectives:
- (a) deliver the recommended PN intakes to majority of the neonatal population
- (b) are safe, stable and compatible solutions with a long shelf life,
- (c) the regimen is easy and safe to implement and avoids error by rotating frontline staff
- (d) are cost-effective

Methods

- Consensus through:
- (a) reviewing the current nutrition practices, strengths and drawbacks
- (b) evaluating the latest evidence
- (e) develop standardized parenteral TPN formulations


STARTER TPN

Starter TPN


BEFORE ADMINISTRATION MIX THE CONTENTS OF THE SEPARATE CHAMBERS OF THE BAG
BAXTER PHARMACY SERVICES
KEEP OUT OF REACH OF CHILDREN
Store at 2-8°C
Refrigerate. Do Not Freeze.
PROTECT THE SOLUTION FROM LIGHT
NEONATAL CONSENSUS GROUP
STARTER TPN
Baxter
WARNING: THIS SOLUTION IS HYPERTONIC
USE WITHIN 24 HOURS OF REMOVAL FROM REFRIGERATED STORAGE
fold along dotted lines and tape here
Exacta-Mix™
EVA Container
STARTER TPN
Baxter Corporation
Englewood, CO 80112-7082 • USA

Starter TPN

- @60ml/kg/d
- 3g/kg/d of Protein
- 10% dextrose
- 1mmol/kg/d Na
- 1mmol/kg/d Acetate
- 0 Potassium

Starter TPN

	RDI	2013 per 1000 mL	2014 NICU Starter PN			
			per 1000 ml*	60 ml/kg/day	90 ml/kg/day	120 ml/kg/day
Amino acids, g	max 4	33	50	3	4.5	6
Glucose, g	max 12/18	100	100	6	9	12
Sodium, mmol	3 to 5	15	15	0.9	1.35	1.8
Potassium, mmol	2 to 5	0	0	0	0	0
Calcium, mmol	1.3 to 3	**12**	30	1.8	2.7	3.6
Magnesium, mmol	0.2 to 0.28	1.5	1.5	0.09	0.135	0.18
Phosphate, mmol	1 to 2.3	10	23	1.38	2.07	2.76
Chloride, mmol	2 to 3	9.3	12	0.72	1.08	1.44
Acetate, mmol		**5**	15	0.9	1.35	1.8
zinc, ug	450 to 500	**0**	3700	222	333	444
Selenium, ug	2 to 3	**0**	20	1.2	1.8	2.4
Iodine, ug	1	0	8	0.48	0.72	0.96
Heparin, units		500	500	30	45	60
Osmolality(mosm/L)		813				
Bag volume, ml			750			
Starter PN is low sodium and potassium free solution that provides good amount of amino acids at less volumes.						
Starter PN can be considered for both preterm infants up to 48 hrs of age and/or up to 90ml/kg/day and also for term infants with						

Standard Term

Standard Term Bag

- @60ml/kg/d
- 12.5% dextrose
- 1.4g/kg/d Protein
- 1mmol/kg/d of Ca and P04
- 0.8mmol/kg/d Acetate
- 1.3mmol/kg/d Potassium

TERM TPN

	RDI	2013 per 1000 mL	NICU Term PN					
			per 1000 ml*	60 ml/kg/day	90 ml/kg/day	120 ml/kg/day	135 ml/kg/day	150 ml/kg/day
Amino acids, g	max 3	23	23	1.38	2.07	2.76	3.105	3.45
Glucose, g	max 18	120	120	7.2	10.8	14.4	16.2	18
Sodium, mmol	3 to 5	25	25	1.5	2.25	3	3.375	3.75
Potassium, mmol	2 to 5	20	20	1.2	1.8	2.4	2.7	3
Calcium, mmol	1.3 to 3	**12**	22	1.32	1.98	2.64	2.97	3.3
Magnesium, mmol	0.2 to 0.28	1.5	2.5	0.15	0.225	0.3	0.3375	0.375
Phosphate, mmol	1 to 2.3	10	17	1.02	1.53	2.04	2.295	2.55
Chloride, mmol	2 to 3	**26**	22	1.32	1.98	2.64	2.97	3.3
Acetate, mmol		13.5	13.5	0.81	1.215	1.62	1.8225	2.025
zinc, ug	250	1900	1900	114	171	228	256.5	285
Selenium, ug	2 to 3	**20**	20	1.2	1.8	2.4	2.7	3
Iodine, ug	1	8	8	0.48	0.72	0.96	1.08	1.2
Heparin, units		500	500	30	45	60	67.5	75
Osmolality(mOsm/L)		846.6						
Bag volume, mls			1500					

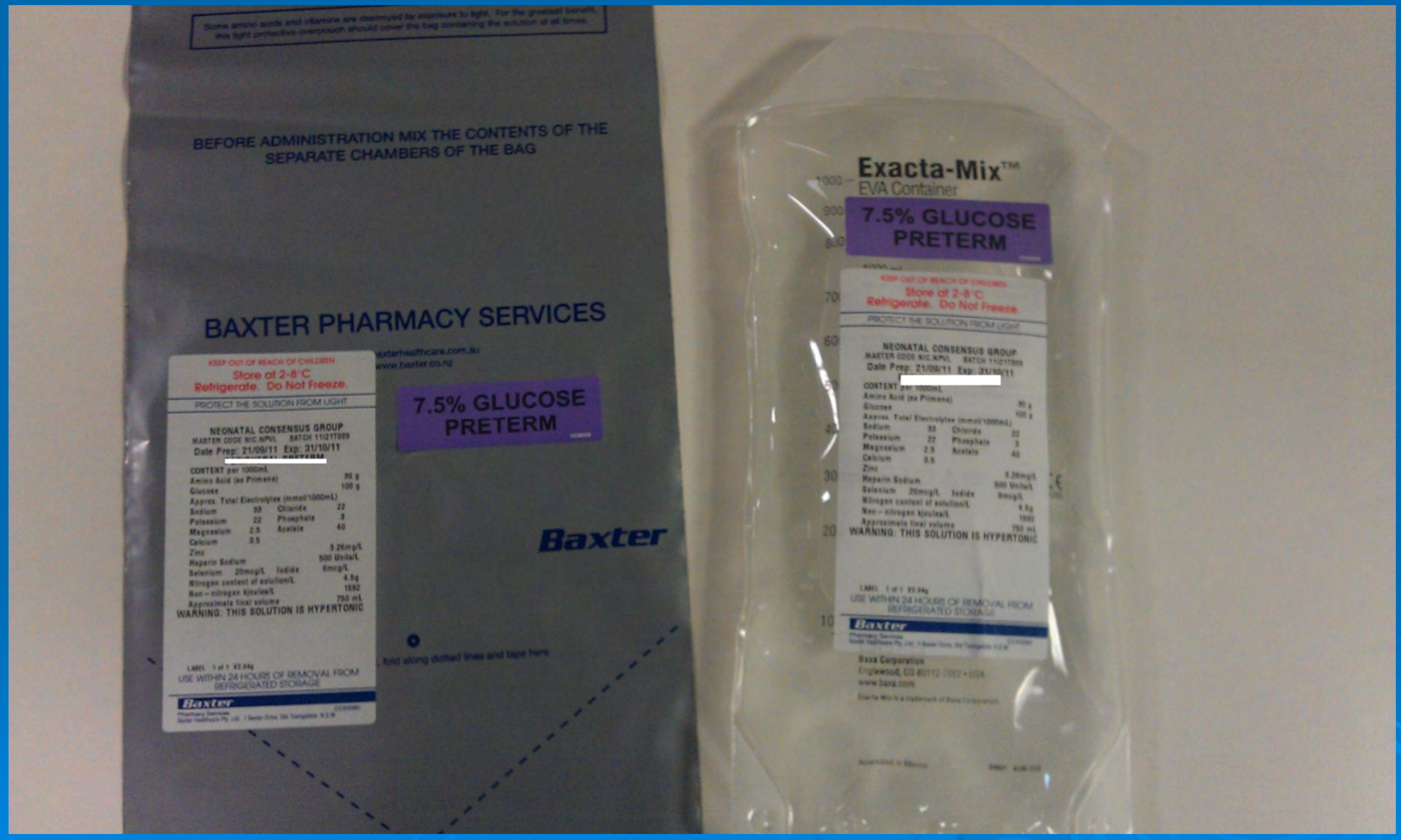
Standard Preterm

	RDI	2013 per 1000 mL	2014 NICU Standard Preterm PN					
			per 1000 ml*	60 ml/kg/day	90 ml/kg/day	120 ml/kg/day	135 ml/kg/day	150 ml/kg/day
Amino acids, g	max 4	30	30	1.8	2.7	3.6	4.05	4.5
Glucose, g	max 12	100	100	6	9	12	13.5	15
Sodium, mmol	3 to 5	33	33	1.98	2.97	3.96	4.455	4.95
Potassium, mmol	2 to 5	22	22	1.32	1.98	2.64	2.97	3.3
Calcium, mmol	1.3 to 3	**12**	22	1.32	1.98	2.64	2.97	3.3
Magnesium, mmol	0.2 to 0.28	1.5	2	0.12	0.18	0.24	0.27	0.3
Phosphate, mmol	1 to 2.3	10	17	1.02	1.53	2.04	2.295	2.55
Chloride, mmol	2 to 3	**13.5**	20	1.2	1.8	2.4	2.7	3
Acetate, mmol		40	20	1.2	1.8	2.4	2.7	3
zinc, ug	450 to 500	**3260**	3260	195.6	293.4	391.2	440.1	489
Selenium, ug	2 to 3	**20**	20	1.2	1.8	2.4	2.7	3
Iodine, ug	1	8	8	0.48	0.72	0.96	1.08	1.2
Heparin, units		500	500	30	45	60	67.5	75
Osmolality(mOsm/L)		790						
Bag volume, mls			750					

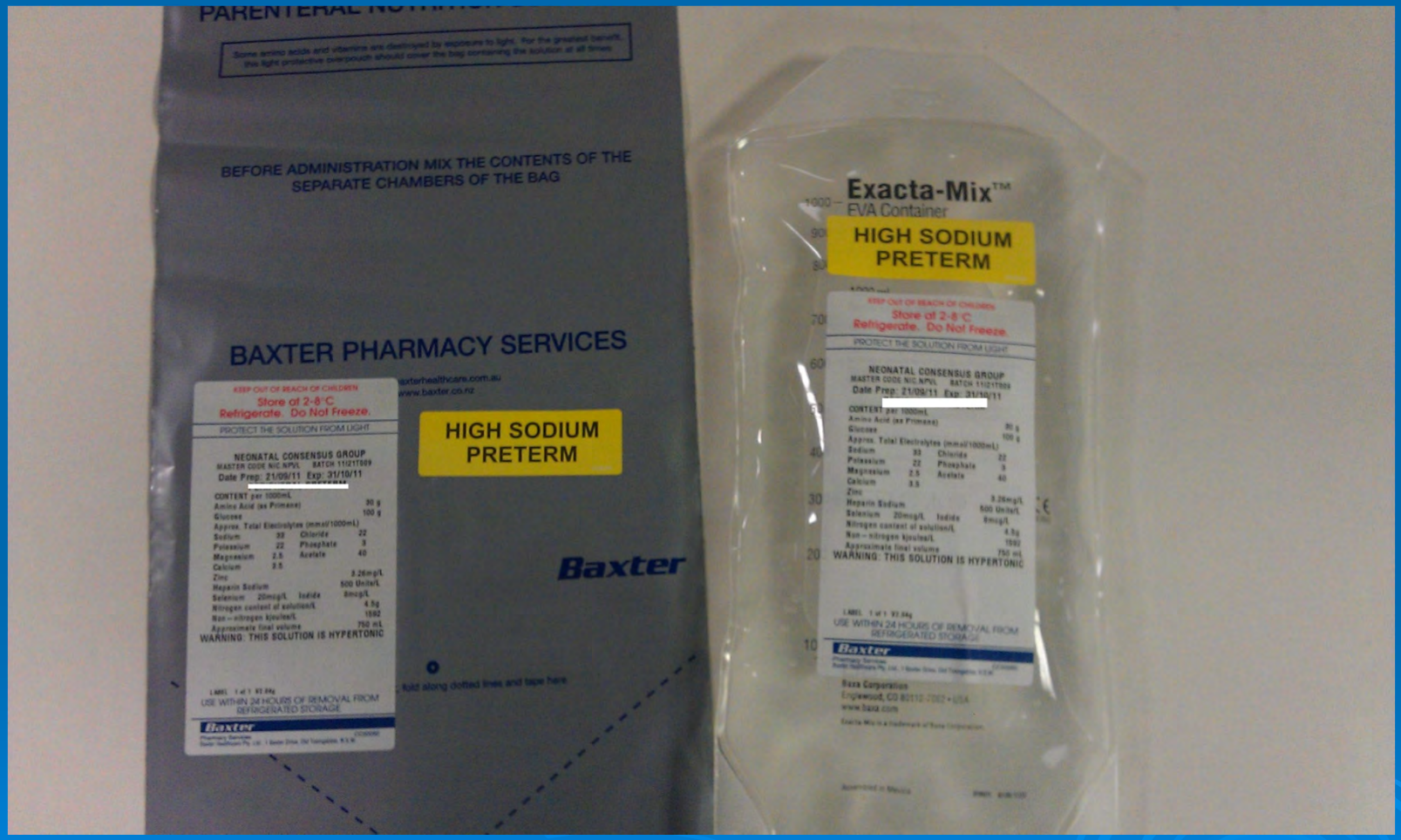
Standard Preterm

- @120mlg/kg/d
- 3.6g/kg/d Protein
- 1.9mmol/kg/d Ca
- 1.5mmol/kg/d P04

7.5% Glucose Preterm



High Sodium Preterm



@120ml/kg/d = 8mmol/kg/d Na

48 vs 24 hour Neonatal TPN bags: Cost Benefit Analysis

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Background

- Changing TPN bags every 24 hrs is common practice in NICU.
- A few units are using 48 hour bags.
- To date there has been no published studies comparing these practices.

Methods

- This retrospective study compares the infection rates and costs associated with 24 vs 48 hr TPN bag changes over two consecutive period
- 11/07 to 5/08 & 10/08-9/09

TPN: 24 hour Period:

Pharmacy added to every standard bag prepared by Baxter. Thereby every bag was a custom bag

TPN: 48 hour Period

Baxter prepares all bags as standard bags and 15% bags were custom

Results

	24 hr bags Period	48hr bags Period
Number of patients	391	386
Babies on TPN	118	105
Mean birth weight (g)	1549	1487
Mean gestation	30.66	29.9
Mean duration of TPN	11.8 days	14.15 days

Septic Rate

	24 hr bag period N = 391	48 hr bag period N = 386
Culture proven Sepsis episodes	11	9
Organisms isolated	Staph epi 9 Ecoli 2	Staph epi 6 Ecoli 1 Strep 1

Nursing Time per 48hr period

	24 hr bag period	48hr bag period
Checking TPN	10 min 2 nurses	2 min 2 nurses
Change TPN	20 min 2 nurses	20 min 2 nurses
Per 48hr	120 mins	44 mins

The 48hr bag save nurses time by 76 min every 48hrs per patient

Cost difference per year

	24 hr bag period	48 hrs bag period	Difference
100 patients per year av 14 days on TPN	1400 bags	700 bags	700 bags
Cost of bags	$157640 @112.60	$94500 @135	$63140
Consumables per bag change	$116452	$15253	$101199
Nursing staff time	2800 hr	513hrs	2286 hrs
Pharmacy staff time	422 days work @145min	26 days work @18 min /bag	

Consumables

	24 hr bag Period	48 hr bag Period
TPN	$243.34 @112.60	$135
IV lines	$30	$15
Gloves	1.64	0.82
Swabs	1.20	0.60
Dressing pack	5.54	2.77
filter	5.20	2.60
Biochem testing of bag before use	$39.60 @$19.80	0
total	$326.28	$156.67

Conclusions

Changing from 24 hr to 48 hr TPN bags did not increase the risk of infections and there were significant cost savings in using 48 hr bags.

Our unit saved $164339 per annum by changing from 24 to 48 hour bags.

Pharmacy time was equivalent to 2 FTE to prepare the individual bags compared to 5 weeks work per year for 48hour bags

Changing Bags 48hrs

- amino acid-dextrose solutions
  - hypertonic (1200 to 2000 mOsm/L)
  - acidic (pH 5.8-6.2)
  - does not support the growth of most micro organisms
  - these extreme conditions have proven to be bactericidal
    - (Didier, Fischer et al. ; Sacks GS 2002).
- AA/Dextrose Hang time to 48 hours reduced the incidence of Central Line Associated Blood Stream Infections (Bolessity 2011)
- Changing both AA/Dextrose and lipid bag/syringes and tubing set at the same time
  - avoids re-spiking of TPN bags with the already used infusion set,
  - thereby preventing contamination.

A Randomized Trial of 72- Versus 24-Hour Intravenous Tubing Set Changes in Newborns Receiving Lipid Therapy

Anne G. Matlow, MD; Ian Kitai, MD; Haresh Kirpalani, MD; Nicola H. Chapman, MSc; Mary Corey, PhD; Max Perlman, MD; Paul Pencharz, MD; Sue Jewell, RN, BA; Cindy Phillips-Gordon, RN, BScN; Richard Summerbell, PhD; E. Lee Ford-Jones, MD

ABSTRACT

OBJECTIVE: To compare the microbial contamination rate of infusate in the intravenous tubing of newborns receiving lipid therapy, replacing the intravenous delivery system at 72-hour versus 24-hour intervals.

DESIGN: Infants requiring intravenous lipid therapy were randomly assigned to have intravenous sets changed on a 72- or a 24-hour schedule, in a 3:1 ratio, in order to compare the infusate contamination rates in an equivalent number of tubing sets.

SETTING: A 35-bed, teaching, referral, neonatal intensive-care unit (NICU).

PARTICIPANTS: All neonates admitted to the NICU for whom intravenous lipid was ordered.

METHODS: Patients were randomized in pharmacy, on receipt of the order for intravenous lipid therapy, to either 72- or 24-hour administration set changes, and followed until 1 week after discontinuation of lipids or discharge from the NICU. Microbial contamination of the infusate was assessed in both groups at the time of administration set changes. Contamination rates were analyzed separately for the lipid and amino acid-glucose tubing sets. Patient charts were reviewed for clinical and epidemiological data, including birth weight, gestational age, gender, age at start of lipid therapy, duration of parenteral nutrition, and type of intravenous access.

RESULTS: During the study period, 1,101 and 1,112 sets were sampled in the 72- and 24-hour groups, respectively. Microbial contamination rates were higher in the 72-hour group than the 24-hour group for lipid infusions (39/1,101 [3.54%] vs 15/1,112 [1.35%]; P=.001) and for amino acid infusions (12/1,093 [1.10%] vs 4/1,103 [0.36%]; P=.076). Logistic regression analysis controlling for birth weight, gestational age, and type of venous access showed that only the tubing change interval was significantly associated with lipid set contaminations (odds ratio, 2.69; P=.0013). The rate of blood cultures ordered was higher in the 72- versus the 24-hour group (6.11 vs 4.99 per 100 patient days of total parenteral nutrition; P=.017), and a higher proportion of infants randomized to the 72-hour group died (8% vs 4%; P=.05), although the excess deaths could not clearly be attributed to bacteremia.

CONCLUSION: Microbial contamination of infusion sets is significantly more frequent with 72- than with 24-hour set changes in neonates receiving lipid solutions. This may be associated with an increased mortality rate (*Infect Control Hosp Epidemiol* 1999;20:487-493).

Hang time Lipids

- 2 RCTs the lipid administration set changes in NICU
- 72-hour vs 24 hours vs 48hrs.

- Results: 166 infants
- Microbial contamination more at 72 hour change.

- higher fungal contamination if change 24 hrs compared to 48 hours.

- negligible impact on peroxide concentrations and vitamin degradation.

TPN Manufacturing Plant

TPN plant

Key Points

- Formulations to be commenced soon after birth.
- The maximum TFR is generally limited to 150 ml/kg/day.
  - ie lipid emulsion 3 g/kg/day and 135 ml/kg/day of AA/Dextrose solutions.
- The contents of the AA/Dextrose formulations are calculated to provide the RDIs at 135 ml/kg/day.
- Hanging time for AA/Dextrose and lipids is 48 hours.
- Recommended Ca/Ph molar ratio of 1.3:1 is maintained in the solutions.
- Zinc, selenium and iodine are added to AA/Dextrose formulations
- Other trace elements not required unless TPN for > 1/12 of TPN

Calorie requirements

- (ESPGHAN 2005)
- 110-120 kcal/kg/day
  - VLBW infants maximal intakes
    - glucose at 12 g/kg/day,
    - protein at 4 gm/kg/day
    - lipids at 3 gm/k/day,

Calorie requirements

- Caloric Value per gram
  - Protein 4 kcal
  - Glucose 4kcal
  - Lipid 9-10 kcal
- Liberal fluid intake:
  - increased trends of PDA, NEC, CLD, and iIVH (Bell 2008).
- Liberal glucose infusion with insulin support offered no clinical benefit (Beardsall 2008).

Blood Urea Nitrogen

- Reflection of a higher AA oxidation rate.
- BUN reference values for human umbilical cord blood are
  - 7.5 to 14.3 mmol/L
    - (te Braake, van den Akker et al. 2005).
- BUNs (up 20mmol/L) without other metabolic compromise such as metabolic acidosis.
  - (Clark, Chace et al. 2007; Blanco CL 2008)

Amino Acids

- Protein requirements: to stop catabolism
  - (a) Protein accretion goal of 2 gm/kg/day
  - (b) Rate of protein loss of 1.1 to 1.5 gm/kg/day
  - (c) Efficiency of protein retention of 70%.
- Therefore:
  - AA intake of 1.1 to 2.5 g/kg/day
  - caloric intake of 30-60 kcal/kg/day is required to positive nitrogen balance.

	Clarke ,2007	Blanco ,2007	Kasyap ,2007	Thureen,2003
No infants	122	62	101	28
Study centre	multicentre			
Study population	<30 wks	ELBW	<1250gm	<1300gm
Intervention				
Begin	1.5g within 48 H	2gm at birth	18% of energy/protein	3g/kg/d
Advancement	Increase by 1gm	Increase by 1 gm		
Max	3.5gm	4gm	4gm	3gm
Control group				
Begin	1gm within 48 h		0.5gm at birth	12.5% energy as protein.
Advancement	0.5gm/kg/day	Increase by 0.5gm		
Max	2.5g/kg/d	3g/kg/d	3g/kg/d	1g/kg/d
Result	No diff in growth. Plasma AA higher.	No diff in growth. Higher BUN.TPN ceased in 20%	Improved growth	increased protein accretion. Well tolerated

Amino acid administration to premature infants directly after birth

te Braake, F.W.J et al, J Pediatr | vol. 147, 457 - 461, 2005.

RCT BW <1500 g n =135

10% Dextrose to start

stepwise increase in AA intake to 2.4 g AA/(kg.d) by day 3 (n=69).

vs

2.4 g AA/(kg.d) from birth onward

Results.

- No adverse side effects in the group with high protein start
- AA concentrations were within reference ranges

Aggressive early TPN in LBW infants, Ibrahim et al, J.Perinatology 24;482-486:2004.

- 501 -1250 gm, 24-32/40

  n=16: AA 3.5g/k/d and Lipids 3g/k/d within 2 h of life

  n =16: AA 2g/k/d and Lipids 0.5 g/k/d on day 2 of life

- Results:
- strongly improved nitrogen balance and energy intake without any negative effect
  - BUN
  - Cholesterol
  - triglycerides
  - metabolic acidosis.

First-Week Protein and Energy Intakes Are Associated 18-Month Developmental Outcomes in ELBW Stephens et al, Pediatrics 2009;123;1337-1343

Retrospective study. 148 ELBW

Results

During week 1,

each 1 g/ kg/day in protein intake had a 8.2-point increase in the MDI;

higher protein intake was also associated with lower likelihood of length 10th percentile

Early provision of parenteral amino acids in ELBW neurodevelopmental outcome , Poindexter BB et al, J Pediatr. 2006 Mar;148(3):300-305

- 1018 infants , RCT
- Early n = 182
- Late n = 836

- Infants were stratified by 5 days of life
- ≥ 3 g/kg/day
- < 3g/kg/d

Poindexter: Results

- RESULTS:
- At 36 weeks CA, improvement
  - Weight
  - Length
  - Head circumference in favour of the infants who received early AA;
- the odds of having wt < 10th % for age was 4x higher for infants in the late group.

Carbohydrates

- The optimal glucose/lipid ratio:
  - 60:40 to 75:25 of non-protein calories.
- Maximal glucose oxidation in
  - Preterm: 8.3 mg/kg/min (12 g/kg/day)
  - Term: 13 mg/kg/min (18 g/kg/day)

(ESPGHAN 2005)

Carbohydrates

- **NIRTURE Trial (Beardsall 2008):**
- Multicentre European trial
  - Early insulin vs no insulin use
- Aimed to recruit 500 infants.
- Recruitment was suspended after 389 infants.
- Data and safety monitoring committee, on an interim analysis, suggested abnormal ultrasound images with an excess of IVH and PVL with insulin group

NSW Group Consensus

- Preterm:
  - On balance not to routinely exceed 10% Dex
  - 10% Dex provide 13.5 gm/kg/day at 135 ml/kg/day
    - (ESPHAGN 12 g/kg/day).
- Term:
  - dextrose is 12.5% - provides 17 g/kg/day
  - (ESPHAGN 18 g/kg/day)

Electrolytes

- Na:
  - Both hyponatremia and hypernatremia are a problem and so some Na supplementation in the starter PN solution.
- K:
  - Starter PN solution is K free
- RDI at 135ml/kg/d of Standard PN solution

ACETATE

RCT of acetate in preterm neonates receiving TPN Peters et al, Archives of Disease in Childhood 1997;77:F12–F15

- 58 neonates of < 32 weeks GA,
- TPN from D 3 -D 10
- standard parenteral nutrition vs
- replacement of any chloride dose > 3 mmol/kg/day as acetate

Results

Acetate (0 to 14.2 mmol/kg/day) reduced the incidence of hyperchloraemia from 77% to 25%,

- a increase in BE from day 5 onwards
- an increased pH (day 8, 7.34 vs 7.26)
- The acetate group received less bicarbonate (median 0 mmol vs 4.8 mmol) and less colloid (41 ml/kg vs 204 ml/kg).

Conclusion

- Acetate in neonatal TPN reduces metabolic acidosis and hyperchloraemia.

Change in practice

- The results of this study are now being put into practice on a systematic basis on their neonatal unit.
- The only change has been the definition of a maximum dose of acetate of 6 mmol/kg/day, because of concerns over hypercarbia.
- A daily dose at this level represents a mean blood pCO_2 of 8 kPa.
- The anion regimen is therefore the
- first 3 mmol provided as chloride,
- the next 6 mmol as acetate,
- and thereafter as chloride again.

Calcium and Phosphate

- **ESPGHAN 2005**
  - 1.3-3 mmol Ca/kg/day and 1-2.3 P04 mmol/kg/day
  - Ca:P ratio in the range of 1.3-1.7

- **AAP 2009 Recommendations:**
- Ca:Ph ratio of 1.7:1 by weight
- (1.3:1 by molar ratio, similar to the fetal mineral accretion ratio) allows for the highest absolute retention of both minerals.

- This ratio equates to
  - 1.9 mmol/k/day of calcium
  - 1.45 mmol/k/day of phosphorus.

- ie1 Kg baby receiving 150 ml per day of AA/Dextrose formulation, we need to add 12.6 mmol Ca and 9.6 mmol P in 1 litre PN bag.

Ca P04 in TPN NSW

- Organic calcium (calcium gluconate)
- organic phosphate in a molar ratio of 1.3:1.
- The current Ca gluconate and inorganic phosphate contents at a ratio of 1.3:1 (12 and 9 mmol/L) provide RDIs.
- Baxter Stability Manual doesn't support Ca and inorganic Ph in excess of 12 and 10 mmol per litre respectively.
- Outcome: Final formulations will contain no more than 12 mmol Ca and 9/10 mmol Ph per litre.

Trace elements

ESPGHAN Recommendations 2005

- PN solutions may be contaminated with aluminium and chromium.
- Patients with cholestatic jaundice should be monitored for copper toxicity.
- Renal impairment can't excrete Se, Mn, Mo, Zn & chromium.
- Trace elements are recommended with long term PN.
- Manganese (Mn) – Dose not well documented for neonates.
  - High Mn: cholestasis, and deposition in basal ganglia, thalamus, BS & cerebellum.
- Molybdenum (Mo) – No reports of deficiency in infants.
  - 1 ug/kg/day is adequate for the LBW infant on longterm PN.
- Selenium (Se) – 2-3 ug/kg/day is recommended for LBWI on PN.
- Zinc (Zn) – 450-500 ug/kg/day for preterm & 250 ug/kg/day for term on PN.

AAP Recommendations

- If TPN is limited < than 4 weeks, only zinc need be added. Thereafter, addition of the remaining elements is advisable.
- Omit Manganese and copper in patients with obstructive jaundice.
- Omit in patients with renal dysfunction.

Trace Elements: AUSPEN vs Peditrace

- Neither Baxter's AUSPEN Trace element nor Peditrace contains the right combination for neonates.
- Peditrace 1 ml contains lot more fluorine than recommended
- Baxter's AUSPEN 1 ml contains lot less zinc and lot more copper, manganese and iodine
- Main concern: ?any toxicity from these trace element mixtures e.g. copper, manganese, chromium etc.

Element	AAP 2009		ESPGHAN 2005	Baxter AUSPEN 1 ml	Peditrace 1 ml
	<1000 gm	1000-1500 gm			
Zinc, µg/kg/day	400	400	450-500	91	250
Copper, µg/kg/day	20	20	20	38	20
Selenium, µg/kg/day	1.5-4.5	1.5-4.5	2-3	3.1	2
Chromium, µg/kg/day	0.05-0.3	0.05-0.3	0	0.25 µg	
Manganese, µg/kg/day	1	1	1	2.2	1
Molybdenum, µg/kg/day	0.25	0.25	1	0	0
Iodine, µg/kg/day	1	1	1 µg /day	6.4	1
Fluorine, µg/kg/day	?	?	?	0	57

Selenium

- (Darlow 2003) Cochrane Meta-analysis:
  - significant reduction in sepsis associated with selenium supplementation [summary RR 0.73 (0.57, 0.93); RD -0.10 (-0.17, -0.02);
    - NNT 10 (5.9, 50)].

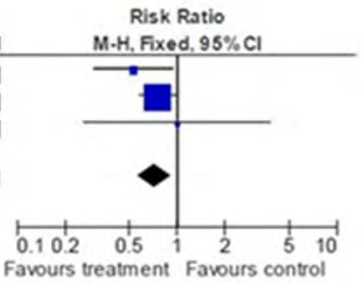
Selenium and sepsis

Comparison of Supplemental selenium vs placebo or nothing. Effect on... http://www.nichd.nih.gov/cochrane/Darlow2/tables/0106.html

1.6 One or more episodes of sepsis

Study or Subgroup	Selenium Events	Selenium Total	Placebo Events	Placebo Total	Weight	Risk Ratio M-H, Fixed, 95% CI
Daniels 1996	8	19	15	19	14.2%	0.53 [0.30, 0.95]
Darlow 2000	67	267	86	258	82.9%	0.75 [0.57, 0.99]
Huston 1991	3	10	3	10	2.8%	1.00 [0.26, 3.81]
Total (95% CI)		**296**		**287**	**100.0%**	**0.73 [0.57, 0.93]**
Total events	78		104			

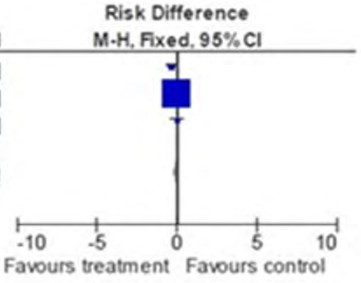
Heterogeneity: Chi² = 1.40, df = 2 (P = 0.50); I² = 0%
Test for overall effect: Z = 2.56 (P = 0.01)



1.6 One or more episodes of sepsis

Study or Subgroup	Selenium Events	Selenium Total	Placebo Events	Placebo Total	Weight	Risk Difference M-H, Fixed, 95% CI
Daniels 1996	8	19	15	19	6.5%	-0.37 [-0.66, -0.08]
Darlow 2000	67	267	86	258	90.0%	-0.08 [-0.16, -0.00]
Huston 1991	3	10	3	10	3.4%	0.00 [-0.40, 0.40]
Total (95% CI)		**296**		**287**	**100.0%**	**-0.10 [-0.17, -0.02]**
Total events	78		104			

Heterogeneity: Chi² = 3.77, df = 2 (P = 0.15); I² = 47%
Test for overall effect: Z = 2.62 (P = 0.009)

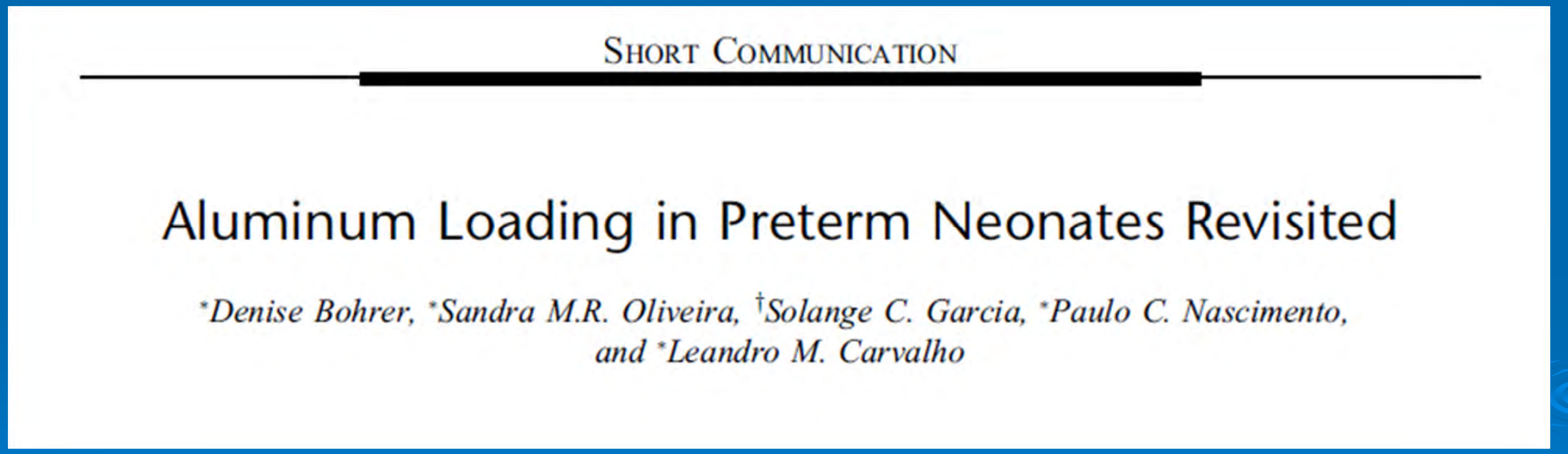


NSW Group Consensus

- Group has agreed to add the following individual trace elements to all the bags:
  - zinc, selenium and iodine.
- For other trace elements such as
  - copper, manganese and chromium,
  - the group will liaise with Baxter to develop a trace element preparation containing these and can be given separately.
- In summary,
- all the AA/Dextrose formulations should aim to supply the following trace element dosages at 135 ml/kg/day:
  - Zinc – 450-500 ug/k/day
  - Selenium – 2-3 ug/k/day
  - Iodine – 1 ug/kg/day

Aluminium toxicity

- Excess AL: reduced developmental attainment.(Bishop, Morley et al.).
- Ca gluconate and Na P04: glass ampoules have high AL
- Bulk non-glass have low AL



SHORT COMMUNICATION

Aluminum Loading in Preterm Neonates Revisited

*Denise Bohrer, *Sandra M.R. Oliveira, †Solange C. Garcia, *Paulo C. Nascimento, and *Leandro M. Carvalho

RCT heparin in TPN to prevent sepsis Heparin in Long Line Total Parenteral Nutrition (HILLTOP) trial.

Birch et al, *Arch Dis Child Fetal Neonatal Ed 2010;**95:F252–F257.***

- RCT heparin 0.5 IU/ml with no heparin in TPN infused through a neonatal long line,
- Results: 210 infants were enrolled (TPN with heparin n=102, TPN without heparin n=108).
- There was a statistically significant reduction in all episodes of
- culture-positive CRS in those infants with heparin added to the TPN compared with those without heparin.

Iodine

- Infants are in negative iodine balance on current standard regimens of total parenteral nutrition.
- (ESPGHAN 2005) recommendation: A daily dosage of 1 ug/day was recommended in parenterally fed infants
- (AAP 2009) Recommendation:
  - 1 ug/kg/day

Lipids

- **Dosage:** Dosage of lipid emulsions should not exceed the capacity for lipid clearance.
- (**ESPGHAN 2005) Recommendations**
  - To prevent EFA deficiency:
    - 0.25 g/kg/day to preterm and 0.1 g/kg/day to term
  - The upper limit:
    - In preterm infants, 3 g/kg/day
    - In term infants, fat oxidation reaches a maximum at 4 g/kg/day.
- **Lipids in the total fluid volume:**
  - 20% lipid emulsions contain 80% water.
  - Eg 50 ml of clinoleic 20% or Intralipid 20%
    - contain 41 ml(82%) water.
  - 6 ml/kg/day – 1 gm/kg/day, of which 5 ml (80%) is water
  - 12 ml/kg/day – 2 gm/kg/day, of which 10 ml (80%) is water
  - 18 ml/kg/day – 3 gm/kg/day, of which 15 ml (80%) is water
- When the lipids are run @3 gm/kg/day - count 15 ml/kg/day in TFR.

Lipids

- Many NSW units do not like to exceed parenteral fluid intake over 150 ml/kg/day. This means amino acid/dextrose solution should meet the
  - amino acid, dextrose, electrolyte and other mineral intakes at 135 ml/kg/day
- Clinoleic 20% is the agreed lipid emulsion.

Parenteral fat emulsions based on olive and soybean oils: RCT

Gobel,Koletzko et al,Pediatr Gastroenterol Nutr. 2003 Aug;37(2):161-7.

- Clinoleic:
- based on olive and soybean oils (ratio 4:1),
- less polyunsaturated fatty acids (PUFA)

- Premature infants (gestational age, 28-<37 weeks) were randomized to receive one of the two emulsions within the first 72 hours of life.

Results

- 33 patients (15 soybean oil, 18 olive oil emulsion).

- lower PUFA supply with the olive/soybean oil emulsion
  - enhance linoleic acid conversion.
- The olive oil-based emulsion is a valuable alternative for parenteral feeding of preterm infants who are often exposed to oxidative stress, while their antioxidative defense is weak.

Lipids

- The current IV lipid preparation in our unit is Clinoleic 20%.
  - olive oil(80%) and soya oil(20%).
- Mono-unsaturated FA(65%),
- saturated FA(15%)
- essential polyunsaturated FA (20%).

NSW Group Consensus

- Following lipid emulsions in 50 ml amber coloured syringes and 150 ml bags

- Each 50 ml contains:
- Clinoleic 20% - 36 ml
- Vitalipid 10% - 11.2 ml
- Soluvit reconstituted in WFI 2.8 ml
- Total Volume: 50 ml

UV protection

- generates organic peroxides and hydrogen peroxide that represent an oxidative load.
- Light-exposed had higher levels of plasma triglycerides and hypertriglyceridaemia indicating decreased plasma clearance.

Energy Ratio

Ratio: @ 150ml/kg/d kcal

1g protein = 4kcal

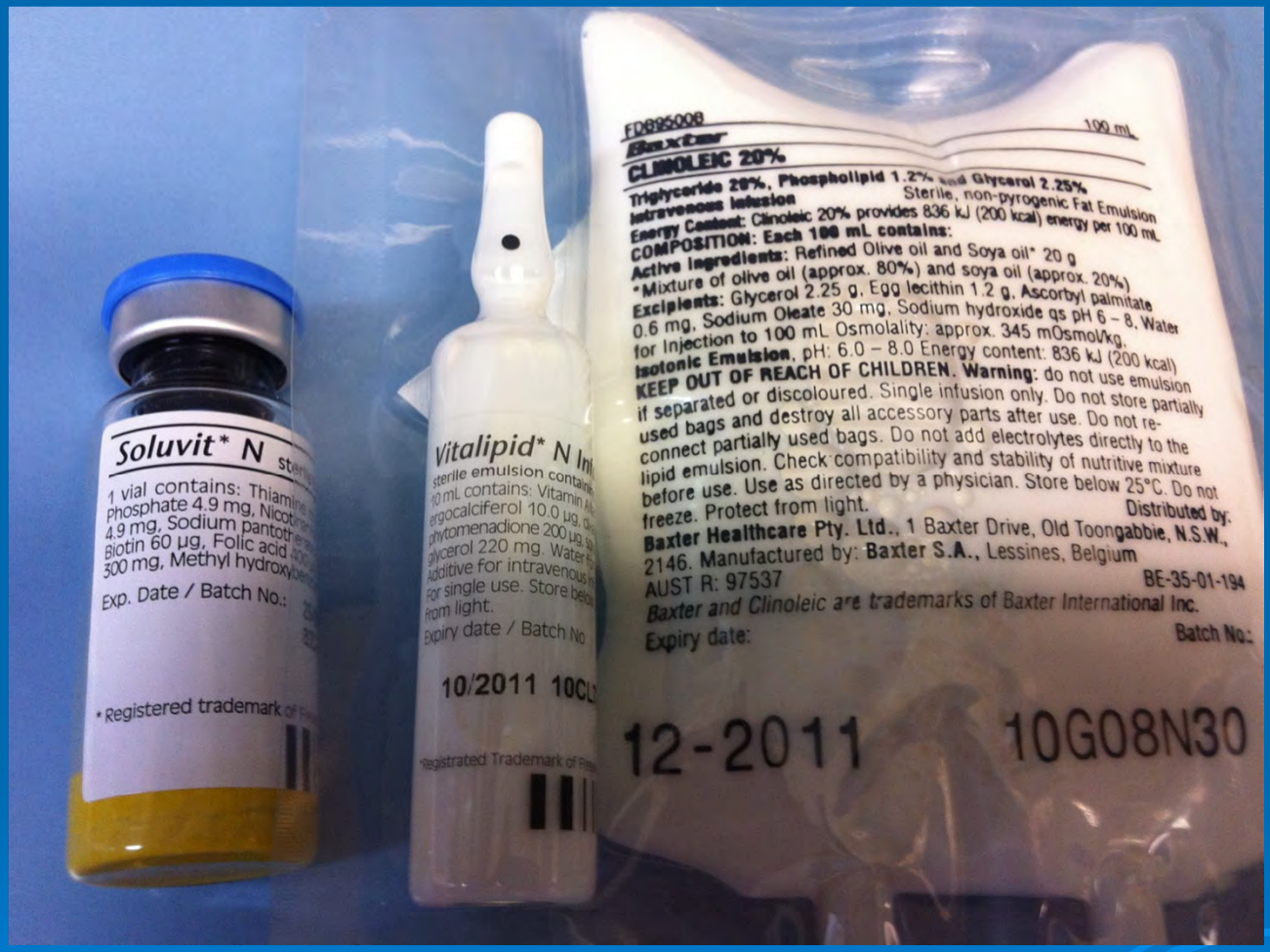
1g COH = 3.4kcal

1g fat = 10kcal

Glucose:	Fat:	Protein
53:	31:	16

Calculating Calories

- **Carbohydrate**:
- $\frac{\text{ml/24h TPN} \times \%\ \text{Dextrose} \times 3.4\ \text{kcal/g}}{100 \times \text{wt (kg)}} = \text{kcal/kg}$
- **Fat**: $\frac{\text{ml/24h 20\% intralipid} \times 2\ \text{kcal/ml}}{\text{wt (kg)}} = \text{kcal/kg}$
- **Protein**: $\frac{\text{g/kg protein} \times 4\ \text{kcal/g}}{} = \text{kcal/kg}$


Soluvit* N
1 vial contains: Thiamine
Phosphate 4.9 mg, Nicot
4.9 mg, Sodium pantoth
Biotin 60 µg, Folic acid
300 mg, Methyl hydroxy
Exp. Date / Batch No.:
*Registered trademark of
Vitalipid* N In
sterile emulsion contain
10 mL contains: Vitamin A
ergocalciferol 10.0 µg,
phytomenadione 200 µg,
glycerol 220 mg. Water
Additive for intravenous
For single use. Store belo
from light.
Expiry date / Batch No
10/2011 10CL
*Registrated Trademark of
FD895008
100 mL
Baxter
CLINOLEIC 20%
Triglyceride 20%, Phospholipid 1.2% and Glycerol 2.25%
Intravenous Infusion
Sterile, non-pyrogenic Fat Emulsion
Energy Content: Clinoleic 20% provides 836 kJ (200 kcal) energy per 100 mL
COMPOSITION: Each 100 mL contains:
Active Ingredients: Refined Olive oil and Soya oil* 20 g
*Mixture of olive oil (approx. 80%) and soya oil (approx. 20%)
Excipients: Glycerol 2.25 g, Egg lecithin 1.2 g, Ascorbyl palmitate
0.6 mg, Sodium Oleate 30 mg, Sodium hydroxide qs pH 6 – 8, Water
for Injection to 100 mL Osmolality: approx. 345 mOsmol/kg.
Isotonic Emulsion, pH: 6.0 – 8.0 Energy content: 836 kJ (200 kcal)
KEEP OUT OF REACH OF CHILDREN. Warning: do not use emulsion
if separated or discoloured. Single infusion only. Do not store partially
used bags and destroy all accessory parts after use. Do not re-
connect partially used bags. Do not add electrolytes directly to the
lipid emulsion. Check compatibility and stability of nutritive mixture
before use. Use as directed by a physician. Store below 25°C. Do not
freeze. Protect from light.
Distributed by:
Baxter Healthcare Pty. Ltd., 1 Baxter Drive, Old Toongabbie, N.S.W.,
2146. Manufactured by: Baxter S.A., Lessines, Belgium
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Expiry date:
Batch No.:
12-2011
10G08N30

Vitalipid N

Vitalipid N Infant. Per mL: vitamin A (retinyl palmitate) 69 microgram (230 IU), vitamin D_2 (ergocalciferol) 1 microgram (40 IU), vitamin E (alpha tocopherol) 0.64 mg (0.7 IU), vitamin K_1 (phytomenadione) 20 microgram, soya oil 100 mg, egg lecithin 12 mg, glycerol 22 mg, sodium hydroxide to pH 8, water for injections to 1 mL.

Description See Table 1.

Refer to Table 1.

Vitalipid N **Table 1**

One mL contains	Adult	Infant
Vitamin A (as retinyl palmitate)	99 microgram	69 microgram
Ergocalciferol	0.5 microgram	1.0 microgram
dl-α-Tocopherol	0.91 mg	0.64 mg
Phytomenadione	15 microgram	20 microgram
Soya oil	100 mg	100 mg
Egg lecithin	12 mg	12 mg
Glycerol	22.0 mg	22.0 mg
Sodium hydroxide	to pH 8	to pH 8
Water for Injections	to 1 mL	to 1 mL

Soluvit N

Soluvit N

Company Fresenius Kabi

Primary Section: Nutrition - Parenteral vitamins, minerals and nutrition

MIMS revision date: 01 Jun 2011

Composition Per vial: thiamine nitrate 3.1 mg, riboflavine sodium phosphate (corresponding to vitamin B_2 3.6 mg) 4.9 mg, nicotinamide 40 mg, pyridoxine hydrochloride (corresponding to vitamin B_6 4.0 mg) 4.9 mg, pantothenic acid 15.0 mg, sodium ascorbate (corresponding to vitamin C 100 mg) 113 mg, biotin 60 microgram, folic acid 400 microgram, cyanocobalamin 5.0 microgram.

Lipid Syringes

- 1g/kg/d of lipid translates to 5-6 ml/k/d
- Lipids has (Vitalipid and soluvit)

  It has 50 ml syringe for small infants and 150 ml for infants over 3.5 Kg.

  - Each syringe costs about $40, for 48hours
  -

Element	AAP <1000 gm	AAP 1000-1500 g	ESPGHAN	Lipid emulsion@ 3gm/kg/d
Vit A, IU/k/day	700-1500	700-1500	150-300	920
Vit D, IU/k/day	40-160	40-160	32	160
Vit E, IU/K/day	2.8-3.5	2.8-3.5	2.8-3.5mg	2.8
Vit K, µg/k/day	10	10	10	80
Ascorbate, mg/k/day	15-25	10	15-25	10
Thiamine, µg/k/day	200-350	200-350	Up to 500	310
Riboflavine, µg/k/day	150-200	150-200	150-200	360
Pyridoxine, µg/k/day	150-200	150-200	150-200	400
Nicotinamide, mg/k/day	4-6.8	4-6.8	4-6.8	4
Pantothenate, mg/k/day	1-2	1.2	1-2	1.5
Biotin, µg/k/day	5-8	5-8	5-8	6
Folate, µg/k/day	56	56	56	40
Vit B12, µg/k/day	0.3	0.3	0.3	0.5

TPN guidelines

TPN:
Starter and Peripheral TPN Bags for preterm infants in NICU Fridge.
Starter Bags to be used soon after birth for infants $\leq$ 1500g, $\leq$ 31 weeks
Starter Bags for Central lines as have standard amount of Ca in it.
If peripheral line only can start with Peripheral TPN on day 1. Has more Na and K then Starter Bags.

Lipids: for 48 hours hanging time
50ml syringe (amber colour for UV protection) and 150ml lipid Mini Bag
Include the lipid volume into Total Fluid Requirement as 80% is water

Ordering TPN:
Fill standard form and fax to Pharmacy
Custom Bags order by filling standard form before 9am and fax to Pharmacy:
Custom bags can be used for 48hrs as preparation at Baxter is the same method as all standard bags