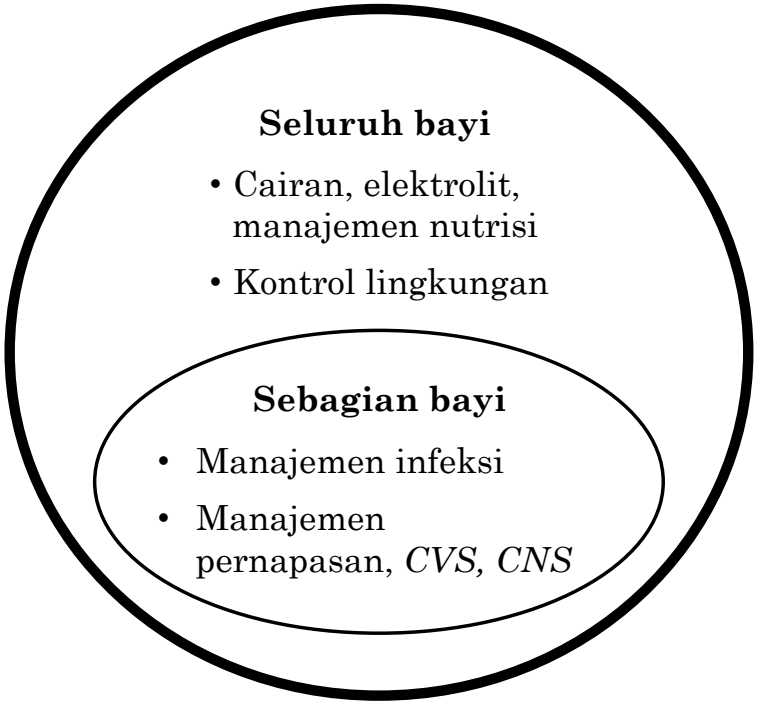
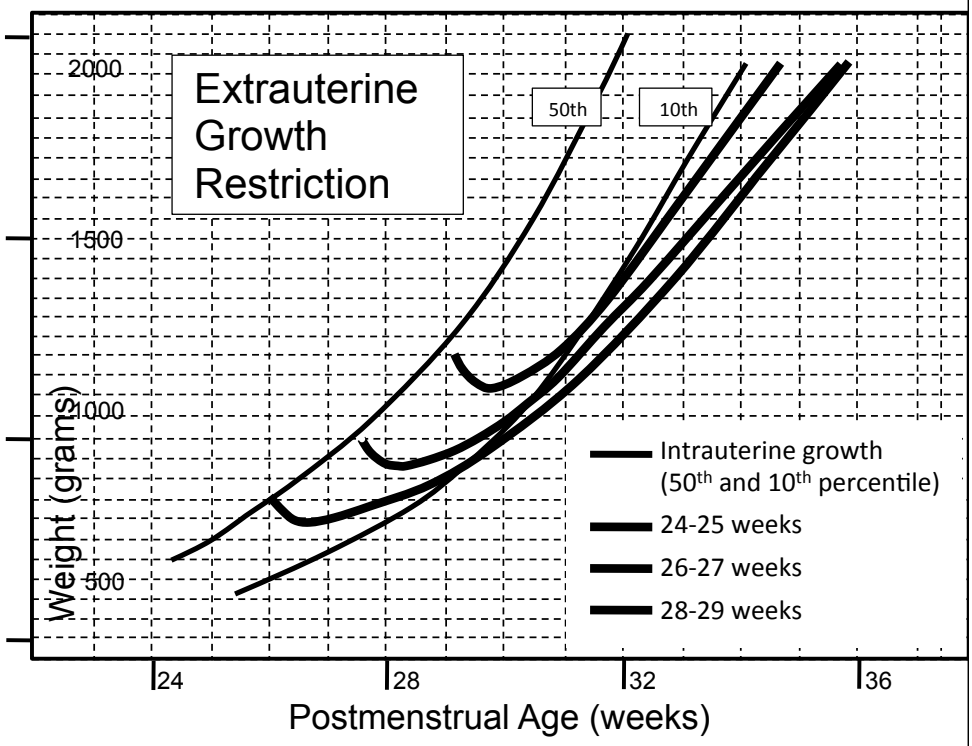
# Manajemen Nutrisi pada Bayi dengan Penyakit Kritis

dr. Aris Primadi, Sp.A(K)

## Kebutuhan Esensial Neonatus



# Growth observational study




Ehrenkranz RA, et al. Pediatrics. 1999;104:280-289.



# Postnatal Growth Failure: Association with Poor Neurocognitive Outcome

**Table 1.** Findings in clinical investigations in extremely preterm infants

| Reference (first author) | Better nutritional support associated with improved growth and less EUGR | Improved growth is associated with improved neurodevelopmental outcomes | Better nutritional support is associated with improved neurodevelopmental outcomes |
|---|---|---|---|
| Wilson, 1997 [30] | X | | |
| Pauls, 1998 [27] | X | | |
| Dinerstein, 2006 [31] | X | | |
| Maggio, 2007 [32] | X | | |
| Cormack, 2013 [33] | X | | |
| Shan, 2009 [34] | X | | |
| Ehrenkranz, 2006 [35] | | X | |
| Poindexter, 2013 [36] | | X | |
| Belfort, 2011 [37] | | X | |
| Poindexter, 2006 [39] | X | | + (effect suggested) |
| Stephens, 2009 [40] | + | | X |
| Eleni dit Trolli, 2012 [41] | + | | X |
| Tan, 2008 [43, 44] | X | X | X |
| Franz, 2009 [45] | X | X | X |

# Nutrisi Bayi Prematur/ BBLR

- Menyediakan nutrisi cukup untuk tumbuh
- Mempertahankan konsentrasi darah normal
- Mencapai fungsi perkembangan optimal

## Contra indication for oral-enteral feeding

- Severe illness (not stable yet)
- Shock
- Gastro intestinal bleeding
- Gastro intestinal Obstruction

## INDICATIONS FOR PARENTERAL NUTRITION

- Unstable CV and respiratory status
- No evidence of gut function, major GI anomalies/ surgery; NEC
- Severe IUGR
- BW < 1000 gram

## When to start total parenteral nutrition in preterm ??

## Nutrisi Intravena: Empat Prinsip Umum: "Bill Hay's Rules"

1. Suplai kebutuhan nutrisi dan metabolik tidak boleh terhenti oleh kelahiran
2. Nutrisi intravena selalu merupakan indikasi jika kebutuhan nutrisi dan metabolik tidak dapat dipenuhi nutrisi enteral
3. Jam, bukan hari, adalah waktu yang panjang untuk bayi yang tidak menerima nutrisi baik intravena ataupun oral
4. Kebutuhan nutrisi dan metabolik seorang neonatus sama atau lebih besar dibanding saat janin



# Clinical Practice:
## Total Parenteral Nutrition Administration

- Should be given early at the first hour, especially for ELBW infant
- Use Birth weight or the highest weight to calculate total fluid intake
- Consider clinical appereance, laboratorium result for giving glucose, amino acid and Lipid

# Sixty Golden Minutes

*Kimberly Jane Doyle, RN, MSN, NNP-BC, CCRN*
*Wanda T. Bradshaw, MSN, RN, NNP-BC, PNP, CCRN*

## ABSTRACT

The *golden hour* concept started in the trauma setting but is becoming more familiar in the neonatal intensive care unit (NICU). For a premature baby, the first hour of life can make the difference between a good outcome, a poor outcome, and death. The golden hour is 60 minutes of team-oriented and task-driven protocols. The focus is on resuscitation, thermoregulation, early administration of antibiotics for suspected sepsis, early intravenous parenteral nutrition, hypoglycemia management, and completed admission within one hour of life. To a premature baby, the first 60 minutes of life are golden and can last a lifetime.

NEONATAL NETWORK
VOL. 31, NO. 5, SEPTEMBER/OCTOBER 2012

## Golden Hour Flow sheet

Doyle KJ, Bradshaw WT.
**Neonatal Network 2012**

| Time-mins | NNP | Admitting RN in Delivery Room | RT | Helper RN at Bedside |
|---|---|---|---|---|
| -10 | Fill out preprinted admission orders. | Set delivery room temperature at 80°F. Ensure:<br>- delivery bed is warm<br>- warm blankets, hat, and plastic body bag are available<br>- transport incubator is warmed and available. | . Check intubation and suction supplies.<br>. Ensure oxygen is humidified and warmed.<br>. Delegate for vent or other needed respiratory equipment at bedside. | . Be sure admitting bed is ready.<br>. Prime intravenous lines with warmed stock parenteral fluids<br>. Delegate tasks needed. |
| 0-10 | Assess infant. Evaluate need for intubation. Assign Apgar Score | Place infant in plastic body bag and hats on head; pulse oximeter on right hand or extremity. | Manage airway; secure ETT if needed. | Sterile set up of umbilical catheter insertion supplies. |
| 0–15 | Stabilize for transport to NICU. | Stabilize for transport to NICU. | Stabilize for transport to NICU. | Stabilize for transport to NICU. |
| 15-20 | Scrub, gown, and glove for umbilical catheter placement. | Assess, weigh infant, obtain measurements, vital signs, administer vitamin K, and secure for umbilical catheter placement with sterile body bag in place. | Connect to vent or NCPAP; connect T-Piece Resusc or bag and mask at bedside; set oxygen limits and titrate as needed. | Chart, assist admitting RN, and have lab tubes ready for blood specimens. |
| 20–30 | Start placing umbilical catheters (arterial first). | Assist NNP for umbilical catheter placement; monitor infant temperature and vital signs. | Obtain and warm appropriate dose of surfactant. | Prepare antibiotics. |
| 30-35 | Obtain blood for labs. | Put blood in lab tubes and label appropriately. | Transport blood gas and return results to bedside. | Send lab specimens; call for x-ray. |
| 35–45 | Insert UVC | Assist with x-ray | Be prepared to adjust ETT if needed, and surf infant when sterile drapes are removed | Chart. |
| 45-55 | Interpret x-ray; adjust and secure umbilical catheters. | Administer antibiotics, connect IV fluids to infant, and begin infusion once placement of umbilical catheters are confirmed. | Chart | Chart; assist with IV pumps if not already running. |
| 55–60 | Interpret labs; write additional orders. | Close incubator, ensure humidity is on and set point, remove plastic bag, bridge and secure umbilical lines, give eye prophylaxis, & nest infant. | Administer surfactant if ordered. | Assist admitting RN. |
| 60 | Chart. | Tidy up bed space in preparation for family. | Chart. | Assist admitting RN. |
| Post | Update family. | Orient family to NICU. Chart. | Monitor respiratory status and prepare to wean vent. | Chart. |

**Abbreviations:** NNP, neonatal nurse practitioner; RN, registered nurse; RT, respiratory therapist

# PARENTERAL NUTRITION
# TOTAL PARENTERAL NUTRITION

- Parenteral nutrition (PN) refers to the supplemental intravenous infusion of nutrients by peripheral or central vein
- Total parenteral nutrition (TPN) is the intravenous infusion of all nutrients necessary for metabolic requirements and growth

- Cairan
- Makronutrien
  - Karbohidrat (dekstrosa)
  - Protein (asam amino)
  - Lemak
- Mikronutrien
  - Elektrolit
  - *Trace elements*
  - Vitamin

## Table 2. Suggested Recommendations for Parenteral Nutrition Macronutrients for Neonates

| Source | Initial Administration | Advancement | Goal | Neonate | Blood Concentration | Potential Complications |
|---|---|---|---|---|---|---|
| Fluid | 60 to 70 mL/kg per day | 10 to 20 mL/kg per day | 130 to 150 mL/kg per day | Term | – | – |
| | 80 to 100 mL/kg per day | 10 to 20 mL/kg per day | 130 to 180 mL/kg per day | Preterm | | |
| Total Energy Intake | – | – | 90 kcal/kg per day | Term | – | – |
| | | | 120 kcal/kg per day | Preterm | | |
| Energy Expended | | | 40 to 60 kcal/kg per day | | | |
| Resting metabolic rate | | | 40 to 50 kcal/kg per day | | | |
| Activity | | | 0 to 5 kcal/kg per day | | | |
| Thermoregulation | | | 0 to 5 kcal/kg per day | | | |
| Synthesis | | | 15 kcal/kg per day | | | |
| Energy Excreted | | | 15 kcal/kg per day | | | |
| Energy Stored | | | 20 to 30 kcal/kg per day | | | |
| Amino Acids[1] | 2 to 3 g/kg per day | 1 g/kg per day | 3 g/kg per day | Term | – | Cholestasis |
| | 2 to 3 g/kg per day | 0.5 to 1 g/kg per day | 3.5 to 4 g/kg per day | Preterm | | |
| Dextrose | 8 mg/kg per minute | 1 to 3 mg/kg per minute | 12 mg/kg per minute | Term | >45 to ≤150 to 220 mg/dL | Hyperglycemia is associated with:<br>1. Death<br>2. Prolonged hospital stay<br>3. Intraventricular hemorrhage Grade 3 & 4<br>4. Necrotizing entercolitis<br>5. Sepsis |
| | 4 to 6 mg/kg per minute[2] | 1 to 3 mg/kg per minute | 12 mg/kg per minute | Preterm | >45 to ≤150 to 220 mg/dL | |
| Fat[3] | 2 to 3 g/kg per day | 0.5 to 1 g/kg per day | 3 to 3.5 g/kg per day | Term | <150 to 250 mg/dL[4] | Cholestasis |
| | 2 to 3 g/kg per day | 0.5 to 1 g/kg per day | 3 to 3.5 g/kg per day | Preterm | <150 to 250 mg/dL[4] | |

Neoreviews Vol.12 N0.3 Maret 2011

## Rekomendasi Asupan Parenteral Harian untuk BBLASR dan BBLSR

| Component (units/kg/day) | ELBW | | | VLBW | | |
|---|---|---|---|---|---|---|
| | Day 0* | Transition† | Growing | Day 0* | Transition† | Growing |
| Energy (kcal) | 40–50 | 70–80 | 100–110 | 40–50 | 60–70 | 90–100 |
| Protein (g) | 2–3 | 3.5 | 3.5–4 | 2–3 | 3.0–3.5 | 3.0–3.5 |
| Glucose (g) | 7–10 | 8–15 | 13–17 | 7–10 | 8–15 | 13–17 |
| Fat (g) | 1 | 1–3 | 3–4 | 1 | 1–3 | 3 |
| Na (mEq) | 0–1 | 2–4 | 3–7 | 0–1 | 2–4 | 3–5 |
| Potassium (K) (mEq) | 0 | 0–2 | 2–3 | 0 | 0–2 | 2–3 |
| Chloride (mEq) | 0–1 | 2–4 | 3–7 | 0–1 | 2–4 | 3–7 |
| Calcium (mg) | 20–60 | 60 | 60–80 | 20–60 | 60 | 60–80 |
| Phosphorus (mg) | 0 | 45–60 | 45–60 | 0 | 45–60 | 45–60 |
| Magnesium (mg) | 0 | 3–7.2 | 3–7.2 | 0 | 3–7.2 | 3–7.2 |

*ELBW*, Extremely low-birthweight: <1000 g; *VLBW*, very low-birthweight, <1500 g.
*Recommended parenteral intakes on the first day of life.
†Period of transition to physiologic and metabolic stability. For most premature neonates, this occurs between 2 and 7 days.

Avery diseases of the newborn, 2012

***TFI = (IWL + Urine + stool water) + growth***

| **UG** (minggu) | ***IWL*** | **Urine** | ***Fecal*** | **Total** (mL/kg/hari) |
|---|---|---|---|---|
| 34-40 | 40 | 30-50 | 5-10 | 75-100 |
| 30-34 | 60-120 | 30-50 | 5-10 | 95-180 |
| <30 | 80-150 | 30-50 | 5-10 | 115-210 |

# FLUID REQUIREMENTS

| Weight | Day 1-2 | Day 3-15 | Day >15 |
|---|---|---|---|
| >2500 g | 70 | 130 | 130+ |
| 1501-2500g | 80 | 110 | 130+ |
| 1251-1500g | 90 | 120 | 130+ |
| 1001-1250g | 100 | 130 | 140+ |
| 750-1000g | 105 | 140 | 150+ |

Fluid requirements mL/kg/day

## Faktor Yang Mempengaruhi Kebutuhan Cairan

- **Faktor yang terkait dengan <u>bayi,</u> seperti**
  - Usia gestasi : ↓ UG → ↑ kebutuhan cairan
  - Gawat napas : ↑ FN → ↑ kebutuhan cairan
  - Demam : ↑ T → ↑ kebutuhan cairan
- **Faktor yang terkait dengan l<u>ingkungan,</u> seperti**
  - *Radiant warmer* → ↑ kebutuhan cairan
  - *Plastic heat shield* → ↓ kebutuhan cairan
  - Terapi sinar → ↑ kebutuhan cairan



- **Penilaian kecukupan cairan:**
  - Pemeriksaan fisik: turgor kulit, UUB, edema
  - Berat bayi
  - Keseimbangan cairan dan diuresis
  - BJ urin

# carbohydrate

Start with 4-6 mg/kg/min or $D_{10}$-$D_{12.5}$

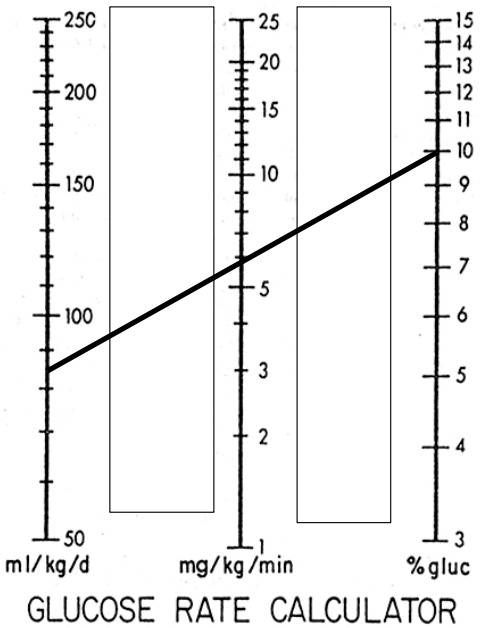
Very PTI may not tolerate that much dextrose.

Need insulin as an infusion to achieve adequate calorie without hyperglycemia

Advance 1-3 mg/kg/min, max 12 mg/kg/min.

GIR >10 mg/kg/min may result iglycosuria and osmotic diuresis

Hyperglycemia is more commonly encountered during anesthesia and surgery



GLUCOSE RATE CALCULATOR

*GIR= Glucose infusion rate*

$$\frac{\%\text{glukosa} \times \text{kecepatan infus (mL/jam)} \times 0{,}167}{\text{berat bayi (kg)}}$$

CONTOH:

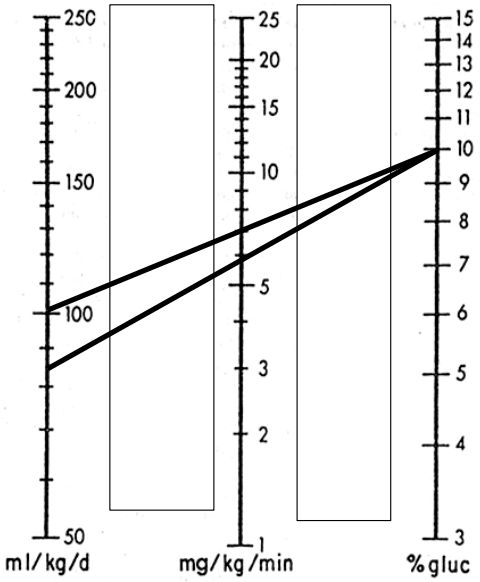
Bayi 2 kg mendapat dekstrosa 10%

7 mL/jam (84 mL/kg/hari)

$$\text{GIR} = \frac{10 \times 7 \times 0{,}167}{2}$$

$$= 5{,}8 \text{ mg/kg/menit}$$

Menaikkan kecepatan infus




*GIR= Glucose infusion rate*

$$\frac{\%\text{glukosa X kecepatan infus (mL/jam) X } 0{,}167}{\text{berat bayi (kg)}}$$

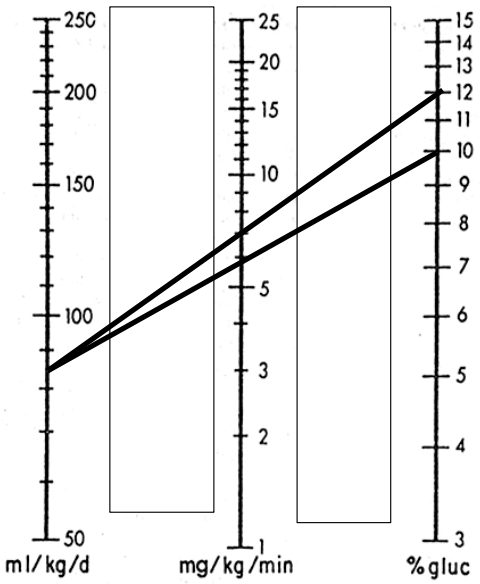
CONTOH:
Bayi 2 kg mendapat dekstrosa 10%
7 mL/jam (84 mL/kg/hari)

$$\text{GIR} = \frac{10 \times 7 \times 0{,}167}{2}$$

= 5,8 mg/kg/menit

→ 7 mg/kg/menit

Menaikkan konsentrasi glukosa

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$$\text{GIR} = \frac{10 \times 7 \times 0{,}167}{2}$$

= 5,8 mg/kg/menit

→ 7 mg/kg/menit

# Protein

The standard solutions originally designed for adults are not ideal because they contain high concentrations of amino acids (eg, glycine, methionine, and phenylalanine) that are potentially neurotoxic

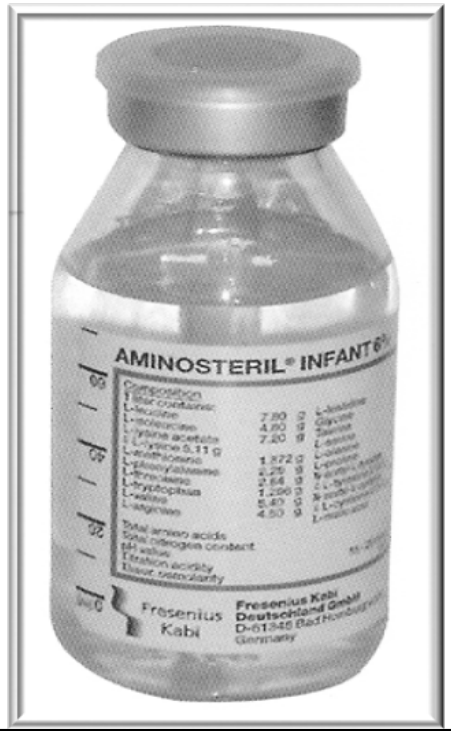
8 essential amino acids + another 7 are needed (histidin, cystein, taurine, tyrosine, prolin, glutamine, arginine)

In neonates, It is recommended to give 3.0-4.0 g/kg/day. The smallest the babies the highest the number

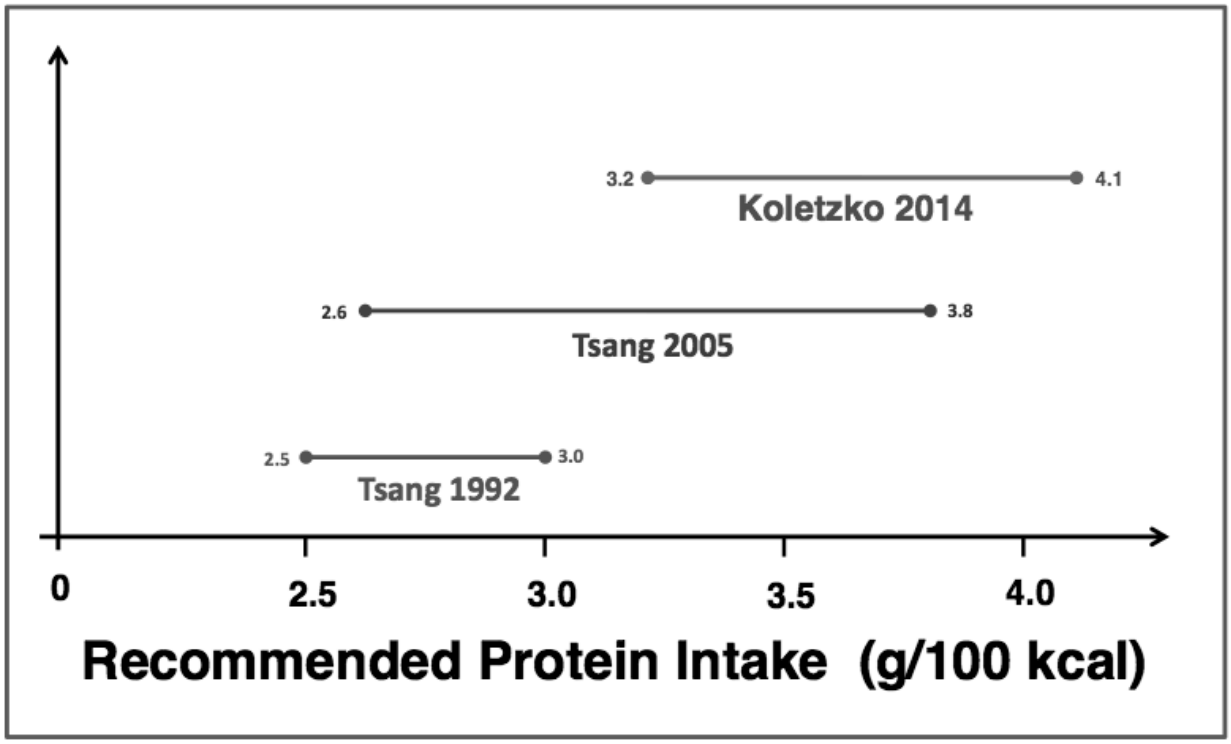
# AMINO ACIDS

- Amino acids are required for growth, formation of the body tissues, enzymes, and erythro
- Taurine

Important in infant brain, and retina development



# Protein




# Lipid/fat

- Lipid prevent essential fatty acid deficiency, provide energy substrates and improve delivery of fat soluble vitamins

- Start lipids at 1 g/kg/day;
- Dose gradually increased up to 3 g/kg/day (3.5g/kg/day in ELBW infants)
- Consider use smaller doses in sepsis, hyperbilirubinaemia

## *…Lipid/fat*

- Preparation of 20% emulsion is better than 10 %
- The use heparin at 0,5 to 1 units/ml of TPN solutions (max 137 units/day) can facilitate lipoprotein lipase activity to help stabilize serum triglyceride values
- Lipid clearance monitored by plasma triglyceride levels (maximum triglyceride concentration ranges from 150 mg/dl to 200 mg/dl)

## *…Lipid/fat*

- Potential complication /risks include:

| | |
|---|---|
| | Hyperlipidemia |
| | Potential risk of kernicterus at low levels of unconjugated bilirubin because of displacement of bilirubin from albumin binding sites by free fatty acids.<br>As a general rule, do not advance lipids beyond 0.5 g/kg/d until bilirubin is below threshold for phototherapy |
| | Lipid overload syndrome with coagulopathy and liver failure |

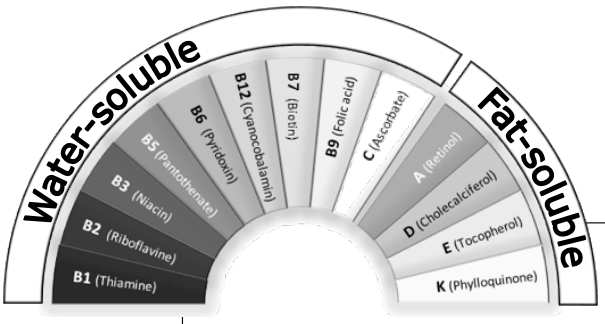
| | |
|---|---|
| Amino Acids | • Start amino acids within 2 hours of birth with 1.5-3 g/kg/day & increase by 1 g/kg daily to max 4.0 g/kg/day |
| Lipid | • Start lipids within 24 hrs of birth at 1.0 g/kg/day & increase by 0.5-1 g/kg daily to max 3.0 g/kg/day |
| Glucose | • Initiate GIR → 4 mg/kg/min & increased daily by 1-2 mg/kg/min |
| TPN | • Don't stop TPN until enteral feeds are > 90% of requirements |

## *Minerals, fat and water soluble vitamins*

- Minerals including trace elements, fat and water soluble vitamins should be put in the PN program directly
- Preterm infants and term infants receiving long-term PN are at increased risk for bone demineralization & fractures
- Calcium and phosphate requirements for LBW infants sometimes exceed their solubility in PN solutions depending on the pH of the individual solution

# ELECTROLYTE REQUIREMENTS

| | |
|---|---|
| SODIUM | • 2-4 mmol<br>• (24 ml ½ N/S contains1.8 mmol Na+) |
| POTASSIUM | • 1-2 mmol<br>• (avoid K+ if BW <1,250 g in first 2 days) |
| CALCIUM & PHOSPHOR | • 1-2 mmol |
| MAGNESIUM | • 0,15-0,3 mmol |




| | Neonatus | |
|---|---|---|
| **Vitalipid® Infant** | 4 ml/kg/day, max 10 ml | |
| **Soluvit®** | 1 ml/kg/day | |

## Daily Dose Recommendations for Pediatric Multivitamins

| Weight | Dose |
|---|---|
| <1 kg | 1.5 mL |
| 1 to 3 kg | 3.25 mL |
| >3 kg | 5 mL |

*Assumes normal age-related organ function. Pediatric multivitamin formulation (5 mL): Vitamin A, 2,300 IU; Vitamin D, 400 IU; Vitamin E, 7 IU; Vitamin K, 200 μg; Ascorbic acid, 80 mg; Thiamine, 1.2 mg; Riboflavin, 1.4 mg; Niacin, 17 mg; Pantothenic acid, 5 mg; Pyridoxine, 1 mg; Cyanocobalamin, 1 μg; Biotin, 20 μg; Folic acid, 140 μg.

Neoreviews Vol.12 N0.3 Maret 2011, Gomella 2013

## Table 3. Trace Elements in Neonatal Parenteral Nutrition (PN)[1]

| Dosing Category (weight) | Zinc[2] (μg/kg per day) | Copper[3] (μg/kg per day) | Manganese[3] (μg/kg per day) | Chromium[4,5] (μg/kg per day) | Selenium[2,5] (μg/kg per day) |
|---|---|---|---|---|---|
| ≤3 kg | 400 | 20 | 1.0 | 0.05 to 0.2 | 2 |
| >3 to 10 kg | 200 | 20 | 1.0 | 0.2 | 2 |
| >10 to 15 kg | 100 | 20 | 1.0 | 0.14 to 0.2 | 2 |

[1]Molybdenum at 1 μg/kg per day is recommended for low-birthweight infants receiving PN for more than 4 weeks. (11)(18)
[2]Infants who have short bowel syndrome lose significant amounts of zinc and selenium in diarrhea and small bowel effluent, necessitating close monitoring of serum zinc and selenium. (11)(18)
[3]Copper supplementation is limited to 10 μg/kg per day, and no manganese is given to infants who have cholestasis. (11)(18)
[4]Chromium is a contaminant of PN solutions that results in a 10% to 100% increase in amount of chromium delivered, necessitating serum chromium monitoring for infants receiving long-term PN. (11)(18)
[5]No chromium or selenium supplementation is recommended for infants who have chronic renal failure. (11)(18)

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## Table 4. Function, Deficiencies, and Toxicities of Trace Elements (11)(18)

| Trace Elements | Function | Reported Deficiencies | Reported Toxicities |
|---|---|---|---|
| Zinc | Important component of several enzymes (eg, carbonic anhydrase and carboxypeptidase), important for growth | Failure to thrive, alopecia, diarrhea, dermatitis (commonly perianal), ocular changes, rash (crusted, erythematous, involving face, extremities, and anogenital areas), nail hypoplasia or dysplasia | Depresses phagocytic and bacterial leukocytic activity, pancreatitis |
| Copper | Component of several enzymes such as cytochrome oxidase, superoxidase dismutase, monoamine oxidase, and lysyl oxidase | Anemia, osteoporosis, depigmentation of hair and skin, neutropenia, poor weight gain, hypotonia, and ataxia later in life | Hepatic cirrhosis |
| Manganese | Role in enzyme activation (eg, superoxide dismutase), important for normal bone structure, role in carbohydrate metabolism | Nausea, vomiting, dermatitis, hair depigmentation, growth retardation | Basal ganglia damage, neurotoxicity, cholestasis |
| Chromium | Role in carbohydrate and lipid metabolism, regulator of insulin action | None | Chronic renal failure |
| Selenium | Component of glutathione peroxidase, important in thyroid metabolism | Implicated in oxidative diseases such as bronchopulmonary dysplasia and retinopathy of prematurity, hypothyroidism, myopathy | None |
| Molybdenum | Essential for several enzymes involved in DNA metabolism | None | Interferes with copper |

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- Esensial untuk mempertahankan dan pertumbuhan bayi prmatur → 90-110 kkal/kg/hari
- *Resting metabolic rate:*
  - *Energy expenditure* yang diperlukan untuk menjaga berlangsungnya proses vital
  - Bayi Prematur dengan NP pada lingkungan termonetral: 30 - 70 kkal/kg/hari
- Energi untuk tumbuh → 20-25 kkal/kg/hari
  - 3 - 4,5 kkal/ gram pertumbuhan berat bayi
  - Pertumbuhan normal 15 g/kg berat bayi/hari

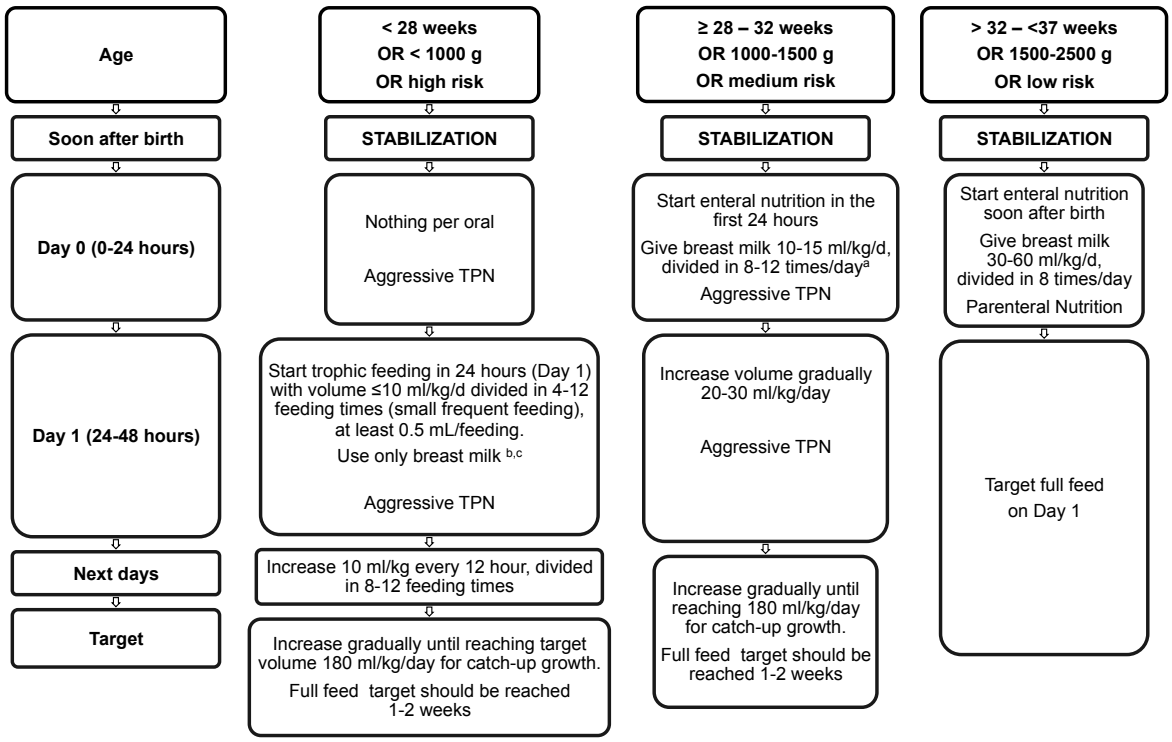
  ooO 45-67 kkal/kg/hari



## Perbandingan protein : non protein

- Karbohidrat 50-55%, protein 15-20%, lemak 20-30%
- Energi non protein:
  - 25% berupa lipid
    - tanpa lipid dapat terjadi lipogenesis dari glukosa yang membutuhkan energi lebih
  - Non protein 30 kkal/kg/hari
    - mengurangi katabolisme protein
  - Rasio nitrogen : *non protein calorie* = 1 : 150-250
    - 1 gram nitrogen = 6,25 gram protein
    - minimum 25 kalori non protein/gram protein

# FEEDING GUIDELINES
# CIPTO MANGUNKUSUMO HOSPITAL




- **Kateter Perifer**
  - Untuk dukungan singkat
  - Toleransi osmolaritas 700-1000 mOsm/L
  - Osmolaritas (mOsm/L) =

    ([asam amino (g/L) X 8] + [glukosa (g/L) X 7] + [sodium (mEq/L) X 2] – 50)
  - Infus dekstrosa $\leq$ 12,5% jika tidak ditambah komponen nutrisi lain
- **Kateter Sentral**
  - Hindarkan infus dekstrosa > 25%

- Infeksi.
- Masalah terkait kateter.
- Komplikasi metabolik
- *Cholestatic liver disease.*
- Komplikasi pemberian lemak.
- Paparan cahaya pada lemak, khususnya terapi sinar, dapat meningkatkan produksi hidroperoksid toksik. Jika bilirubin > 8–10 mg/dL & albumin 2,5–3,0 g/dL, infus lemak tidak boleh melebihi 0,5–1 g/kg/hari.
- Defisiensi asam lemak esensial.
- Defisiensi mineral.



# LAB MONITORING SCHEDULE

| SCHEDULE | LAB |
|---|---|
| DAILY | urine glucose, vital signs (temperature, respiratory rate, heart rate, blood pressure) |
| 3x/WEEK | serum electrolytes, HCO3, renal function, calcium, magnesium, Phosphor |
| WEEKLY | liver function tests incl protein/albumin, haematocrit, FBC |

Serum TG: 4 hrs after increase in lipid dose

PHARMACY SERVICES
NEONATAL TPN ORDER FORM

| NAME: | | |
|---|---|---|
| WEIGHT: | DATE OF BIRTH: | AGE: |

| WARD: | BED NO: |
|---|---|
| SEX ☐ M | ☐ P |
| ROUTE ☐ Central | ☐ Peripheral |

DIAGNOSIS:

FIGURES ARE PER KG PER 24 HOURS

| DATE | | | | | NOTES |
|---|---|---|---|---|---|
| REGIMEN ORDERED | | | | | |
| O Total daily fluid (mL) | | | | | |
| O Total other B fluids (mL) | | | | | |
| O-O Fluid for TPN (mL) | | | | | |
| DOCTOR"S NAME | | | | | |
| SIGNATURE | | | | | |
| Pager Number | | | | | |

| STANDARD REGIMENS/ 24 hrs | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Protein (g/kg) | 1 | 1.5 | 2 | 2.5 | 3 | 3.5 |
| Carbohydrate (%) | 10% | 10% | 12.5% | 12.5% | 15% | 15% |
| Pediatrice (mL/kg) | 1 | 1 | 1 | 1 | 1 | 1 |
| Sodium (mmol/kg) | 5 | 5 | 5 | 5 | 5 | 5 |
| Potassium (mmol/kg) | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Calcium (mmol/kg) | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Magnesium (mmol/kg) | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Phosphate (mmol/kg) | 0.15 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Solivito N (mL/kg) | 1 | 1 | 1 | 1 | 1 | 1 |
| Vitalipid N Infant (mL/kg) | 1 | 1 | 1 | 1 | 1 | 1 |
| Lipid (g/kg) | 0.5 | 1 | 1,5 | 2 | 2.5 | 3 |

# TPN Weaning Guidelines

| Feed Volume (cc/kg) | PN Substrate (CHO/prot/fat)[1] | IV+po Volume (cc/kg) | Total TPN Volume (cc/kg)[2,3] | Ca/P (mEq/ mmol)[5] | MBM/formula concentration (kcal/oz) |
|---|---|---|---|---|---|
| 0-49 | 12/3.5/3 | 100-140 | 100-140 | 3/1.5 | 20 |
| 50-74 | 10/2.5/2 | 120-140 | 70-90 | 2.45/1.2 | 20 |
| 75-99 | 8/2/1.5 | 130-140 | 55-65[4] | 1.75/0.85 | 20 |
| 100-120 | 8/2/1 | 130-150 | 55[4] | 1.75/0.85 | 22 |
| 120-150 | None | NA | None | N/A | 22-24 |
| 150-160 | None | NA | None | N/A | 24 |
| | | | | | |

1. mg CHO/kg/min, g prot/kg, g fat/kg
2. Total TPN volume= (IV+po goal)-(lower end of indicated feed volume range)
3. **Total TPN volume includes lipids**
4. Keep the minimum dextrose/amino acid volume at 50 cc/kg for ordering purposes
5. Amount per kg as ordered on the TPN form

# Nutrisi Enteral pada Neonatus Risiko Tinggi

**Sebelum memulai nutrisi enteral harus dipertimbangkan:**

- KAPAN memberikan asupan?
- CARA memberikan asupan?
- APA yang harus diberikan?



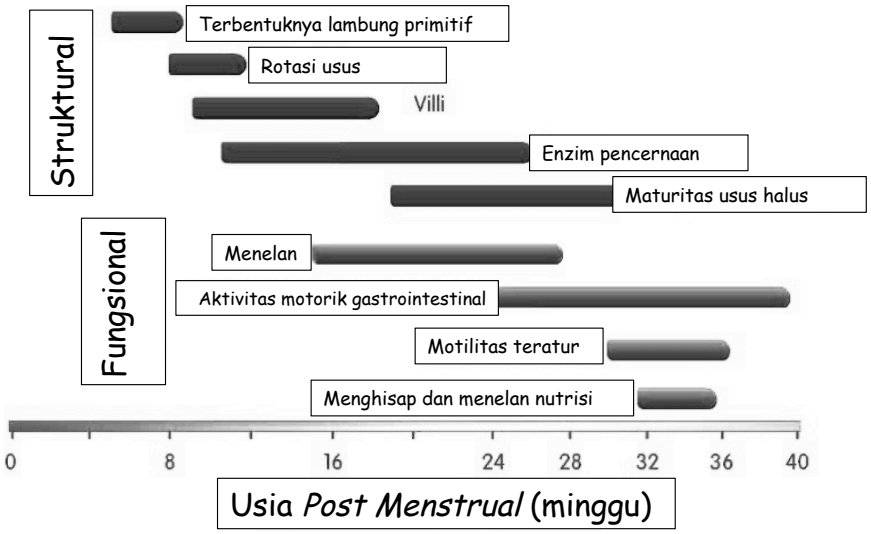
# KAPAN memberikan asupan?

- **SEDINI MUNGKIN**
- **HEMODINAMIK STABIL**

## Pemberian Asupan Dini

- ↓ Intoleransi terhadap pemberian asupan
- ↓ Hari nutrisi parenteral
- ↓ Jumlah hari rawat di rumah sakit
- ↓ Kolestasis
- Asupan enteral penuh dicapai lebih dini
- Tidak ada peningkatan insiden EKN

# KAPAN memberikan asupan?




**Gambar. Perkembangan sistem gastrointestinal**

**Clin Perinatol, 2000**

# CARA memberikan asupan?

**Pemberian asupan oral**

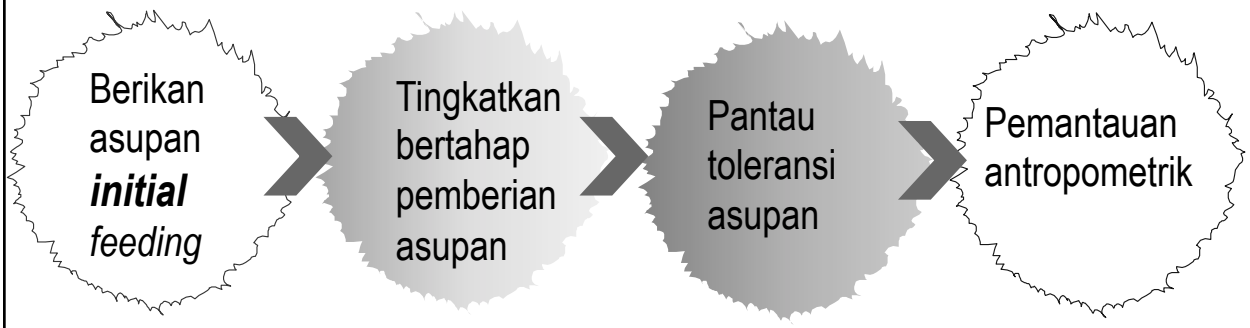
- Setidaknya usia 33 minggu kehamilan
- Tidak terdapat gawat napas (RR < 60 X / menit)

**Pemberian asupan melalui selang naso/ orogastrik**

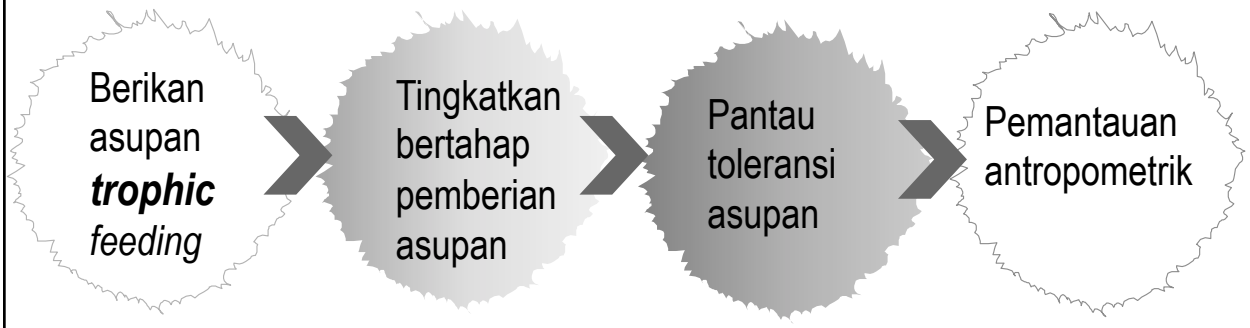
- Kurang dari 33 minggu kehamilan
- Gangguan neurologis (isap/nelan abnormal)
- Gawat napas (tanpa hipoksia)
- Tergantung pada ventilator

**PONEK 2008**

## PROSEDUR PEMBERIAN ASUPAN




## PROSEDUR PEMBERIAN ASUPAN



# Pemberian "Trophic Feeding"

- Disebut juga *gut priming, hypocaloric feeding*
- Stimulasi perkembangan sistem gastrointestinal post natal
- Digunakan paralel dengan nutrisi parenteral

- Mulai segera setelah bayi stabil 1-3 hari
- *MBM/DBM*/formula 10 mL/kgBB/hari
  - →BB < 1 kg 15-20 mL/kgBB/hari
  - →BB ≥ 1 kg 30 mL/kgBB/hari
- Berikan asupan setiap 3-4 jam
- Lanjutkan dengan volume yang sama

PONEK, 2008
Nutrients, 2015


- **Tingkatkan sebanyak 5-20 mL/kgBB/hari**
  - →BB < 1 kg 15-20 mL/kgBB/hari
  - →BB ≥ 1 kg 30 mL/kgBB/hari
- **Waktu tercapainya asupan secara penuh**
  - 03-05 hari pada bayi > 2.000 g
  - 10-14 hari pada bayi < 1.250 g

PONEK, 2008
Nutrients, 2015

## INTERVAL PEMBERIAN MINUM

- BB < 1000 g : setiap jam
- BB < 1500 g : setiap 2 jam
- BB 1500-1800 g : **setiap 3 jam**
- BB 1800-2000 g : setiap 4 jam
- BB > 2000 g : setiap 4 jam/ on demand



## INTOLERANSI PEMBERIAN ASUPAN

Lanjutkan minum dengan hati-hati atau tunda sementara, jika:

- Peningkatan ukuran lingkar perut akut > 2 cm
- Volume residu lambung pada satu waktu >3-4 mL/kg, ATAU >30-50% dari volume minum sebelumnya

Senterre T. Practice of Enteral Nutrition in VLBW and ELBW Infants.
*Nutritional Care of Preterm Infants. 2014*

## INTOLERANSI PEMBERIAN ASUPAN

- Pemeriksaan residu lambung tidak rutin, dilakukan setelah volume per kali minum tercapai:
  - 750-1000 g: 4 mL
  - ≥ 1.000 g: 5 mL
- Masukan kembali residu lambung jika > 5 mL/kg atau > 50% dari volume minum sebelumnya (yang mana lebih tinggi), jumlah minum berikutnya dikurangi jumlah residu
- Jika residu lambung > 5 mL/kg dan > 50% dari volume minum sebelumnya, masukan kembali residu tanpa ditambah.
  → Jika kembali terjadi, pertimbangkan interval yang lebih panjang atau tunda minum

Dutta S et all. Guidelines for feeding VLBW Infants.
*Nutrients. 2015*

## INTOLERANSI PEMBERIAN ASUPAN

Hentikan minum hingga pemeriksaan lanjutan menunjukkan aman, jika:

- Muntah
- Distensi abdomen berat
- Ileus
- Residu lambung berwarna kehijauan
  ooO pastikan pipa bukan transpilorik

Senterre T. Practice of Enteral Nutrition in VLBW and ELBW Infants.
*Nutritional Care of Preterm Infants. 2014*

# Apa Yang Harus Diberikan ?

Pilihan susu untuk pemberian asupan awal

- *Colostrums*
- **Air Susu Ibu**
- **Air susu ibu**
- **Air susu ibu**



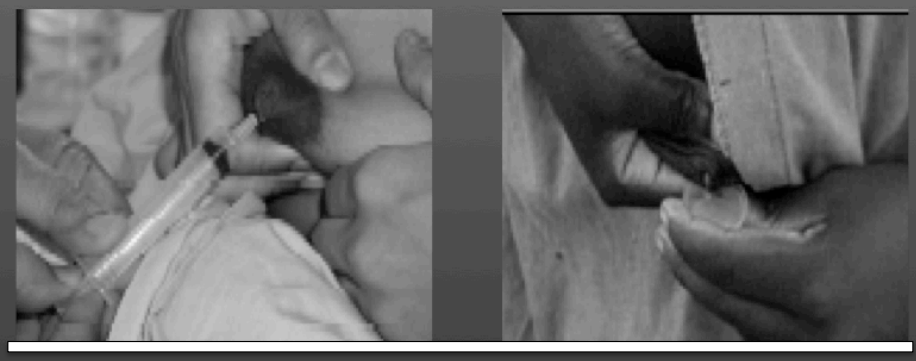

**MAKLUMAT PENTING:** Organisasi Kesehatan Dunia (WHO*) telah merekomendasikan bahwa wanita hamil dan ibu yang baru melahirkan harus diberi informasi tentang manfaat dan keunggulan dari menyusui atau memberikan ASI, khususnya tentang ASI sebagai sumber nutrisi terbaik dan memberikan perlindungan bagi bayi dari resiko sakit. Para ibu harus diberi petunjuk cara persiapan dan perawatan masa laktasi dengan menekankan secara khusus akan pentingnya diet yang seimbang selama masa kehamilan dan setelah melahirkan. Tidak dianjurkan untuk memberikan makanan parsial dengan susu botol, atau makanan dan minuman yang lain karena akan mengakibatkan dampak negatif pada pemberian ASI. Para ibu harus diingatkan akan sulitnya merubah keputusan yang telah diambil untuk tidak menyusui bayinya apabila suatu saat mereka ingin menyusui lagi bayinya. Sebelum menyarankan menggunakan formula bayi, ibu harus diberitahu dampak sosial dan ekonomi yang timbul atas keputusannya: contoh, bila bayi sepenuhnya mengkonsumsi susu botol, akan dibutuhkan lebih dari satu kaleng (450 gram) per minggu, karenanya kondisi keluarga dan biaya harus dipertimbangkan. Para ibu harus diingatkan bahwa ASI tidak hanya sebagai sumber nutrisi terbaik tapi juga paling ekonomis untuk bayi. Bila telah memutuskan menggunakan formula bayi, maka sangat penting untuk memberi petunjuk cara penyajian yang benar, dengan menekankan bahwa air yang tidak dimasak, botol yang tidak direbus atau penyajian yang tidak benar dapat mengakibatkan penyakit.

* Lihat: Kode Etik Internasional tentang Pemasaran Pengganti Air Susu Ibu, diadopsi oleh World Health Assembly pada Resolusi WHA 34.22, Mei 1981.

# Menyusui bayi prematur

Dukungan pada ibu:

- Bantu memerah ASI dimulai dalam 6 jam pasca lahir (6 kali/ 24 jam)



# Keterbatasan Penggunaan ASI untuk Bayi Prematur (1)

- **Produksi ASI <<**
  - Inisiasi laktasi/ minum terlambat
  - ASI jarang diperah
  - Stres
  - Kelelahan
  - Imaturitas Biologik
  - Kesehatan ibu kurang
  - Harus kembali bekerja

Tsang RC. Nutrition of the preterm infant scientific basis and practical guidelines. Edisi ke-2. Ohio:2005. h. 333-56.

# Keterbatasan Penggunaan ASI untuk Bayi Prematur (2)

- **Keterbatasan jumlah cairan masuk**
  - BBLASR sulit menerima volume asupan > 180 mL/kg BB/hari
  - Untuk mencapai ***Premature Recomended Nutrient Intakes*** (P-RNI) untuk protein memerlukan minimal 180 mL/kg BB/hari

Tsang RC. Nutrition of the preterm infant scientific basis and practical guidelines. Edisi ke-2. Ohio:2005. h. 333-56.

# Dukungan Laktasi

- Inisiasi
- Produksi
- Pengumpulan dan penyimpanan
- Mempertahankan Volume ASI

Tsang RC. Nutrition of the preterm infant scientific basis and practical guidelines. Edisi ke-2. Ohio:2005. h. 333-56.

# Nutrient Composition of Human Milk

| Component<br>Unit/dl | Preterm Transitional<br>6-10 day | Preterm Mature<br>22-30 day | Term Mature<br>≥ 30 day |
|---|---|---|---|
| Protein, g | 1.9 ± 0.05 | 1.5 ± 0.1 | 1.2 ± 0.15 |
| Fat, g | 3.4 ± 0.6 | 3.6 ± 0.7 | 3.4 ± 4 |
| Carbohydrate, g | 6.3 ± 5 | 6.7 ± 0.4 | 6.7 ± 0.5 |
| Energy, kkal | 66 ± 6 | 69 ± 5 | 64 ± 8 |
| Ca, mmol | 0.8 ± 0.18 | 0.72 ± 0.13 | 0.65 ± 0.15 |
| P, mmol | 0.49 ± 0.14 | 0.3 ± 0.08 | 0.48 ± 0.08 |
| Mg, mmol | 0.11 ± 0.02 | 0.1 ± 0.03 | 0.13 ± 0.03 |
| Fe, mg | 004 | 0.04 | 0.04 |
| Zn, µmol | 5.8 ± 1.3 | 3.3 ± 1.4 | 1.5 ± 4.6 |
| Cu, µmol | 0.8 ± 0.31 | 0.32 ± 0.63 | 0.3 – 0.6 |
| Mn,µg | 0.6 ± 0.89 | 0.73 ± 0.66 | 0.9 ± 0.41 |
| Sodium, mmol | 1.16 ± 0.6 | 0.88 ± 0.2 | 1.39 ± 0.2 |
| Potassium, mmol | 1.35 ± 0.22 | 1.25 ± 0.32 | 1.28 ± 1.5 |
| Cl, mmol | 2.13 ± 0.35 | 1.48 ± 0.21 | |

Tsang RC. Nutrition of the preterm infant scientific basis and practical guidelines. Edisi ke-2. Ohio:2005. h. 333-56.

# ASI - Pertumbuhan

Apakah ASI saja memadai untuk pertumbuhan bayi prematur ?

**Komposisi ASI**

| Komponen | Kolostrum | Prematur | ASI Matur |
|---|---|---|---|
| Kalori (Kkal/dL) | 67 | 67 | 67 |
| Protein (g/dL) | 3,1 | 1,4 | 1,05 |
| Laktosa (g/dL) | 4,1 | 6,6 | 7,2 |
| Lemak (g/dL) | 2-2,5 | 3,5-4 | 3,5-4,5 |

**Komposisi beberapa susu**

| Komponen | Susu Sapi | Formula Standar | Formula Preterm |
|---|---|---|---|
| Karbohidrat (g/100mL) | 4,5 | 7,5 | 8,6 |
| Lemak (g/100mL) | 3,9 | 3,6 | 4,4 |
| Protein (g/100mL) | 3,4 | 1,5 | 2,0 |
| Kasein/laktalbumin | 4:1 | 2:3 | 2:3 |
| Kalori (/100mL) | 67 | 67 | 80 |
| Natrium (mmol/L) | 23 | 16 | 33 |
| Kalium (mmol/L) | 40 | 65 | 33 |
| Kalsium (mg%) | 124 | 46 | 77 |
| Fosfat (mg%) | 98 | 33 | 41 |
| Besi (mg%) | 0,05 | 0,8 | 0,67 |

Bayi prematur berusia 15 hari mendapat 150 mL/kgBB/hari ASI
→ 90 – 100kkal/kgBB/hari protein, **2 – 2.5 g/kgBB/hari protein**

**Estimasi kebutuhan Kalori Bayi Prematur yang sedang Tumbuh**

| **Nutrisi Enteral** | |
|---|---|
| Tingkat metabolisme pada istirahat | 50 |
| Aktivitas | 0-15 |
| Termoregulasi | 5-10 |
| Efek termik asupan | 10 |
| Pengeluaran feses | 10 |
| Pertumbuhan | 25-35 |
| **Total** | **100-130** |

Hay WW, Brown LD, Denne SC. Energy requirements, Protein-Energy Metabolism and Balance, and Carbohidrates in Preterm Infants.
*Nutritional Care of Preterm Infants 2014.*


- Aditif/suplementasi mulai diberikan setelah 1-3 minggu minum
- Meliputi kalori, protein, Ca, P, Na, vitamin
- Suplementasi besi dimulai pada usia 6-8 minggu (lihat tabel), saat retikulosit mulai meningkat
- Fortifikasi susu hingga berat bayi mencapai 1.800-2.000 g


- Fortifikasi ASI/ HMF :
  karbohidrat, protein, mineral, vitamin
- Minyak MCT : 1 mL = 7,7 kkal
- Minyak kanola : 1 mL = 8,0 kkal
- Polikose: glukosa polimer
- *Nutricom caloric* (5 g = 19 kkal)




## Suplementasi ASI dengan susu PDF

| | Preterm MBM (Term) | + ½ tsp / 100 mL | + 1 tsp / 100 mL | + 1 ½ tsp / 100 mL | + 2 tsp / 100 mL | + 2 ½ tsp / 100 mL |
|---|---|---|---|---|---|---|
| Kalorie per oz | 20 | 22 | 24 | 26 | 28 | 30 |
| **Per 100 mL** | | | | | | |
| Kalori | 67 | 74 | 81 | 87 | 94 | 100 |
| Protein (g) | 1,4 (1,1) | 1,6 (1,3) | 1,8 (1,5) | 2,0 (1,7) | 2,2 (1,9) | 2,4 (2,1) |
| Lemak (g) | 3,9 (4,5) | 4,3 (4,9) | 4,7 (5,2) | 5,0 (5,6) | 5,4 (5,9) | 5,7 (6,3) |
| Karbohidrat (g) | 6,6 (7,1) | 7,3 (7,8) | 8,0 (8,5) | 8,7 (9,1) | 9,3 (9,8) | 10,0 (10,4) |
| Sodium (mg) | 25 (17) | 27 (19) | 29 (22) | 31 (24) | 34 (26) | 36 (28) |
| Kalsium (mg) | 25 (33) | 33 (40) | 40 (48) | 48 (56) | 55 (63) | 62 (70) |
| Phosphor (mg) | 13 (14) | 18 (19) | 22 (23) | 27 (27) | 31 (32) | 35 (36) |
| Vitamin D (IU) | 4 | 9 | 14 | 20 | 25 | 29 |
| Besi | 0,1 (0,3) | 0,2 (0,4) | 0,4 (0,6) | 0,5 (0,7) | 0,6 (0,8) | 0,8 (0,9) |
| Osmolaliti (mOsm/kg) | 255 (280) | | | | | |


## SUPLEMENTASI VITAMIN

- Jangan mulai memberikan suplementasi vitamin dan mineral hingga bayi telah toleran terhadap feeding beberapa hari
- Saat asupan 120 kkal/kgBB/hari
- Multivitamin drop: 0,3 mL/hari

## The Bundle Outlines the following key elements:

- The importance of the use of breast milk (BM)
- The expectation of initiating feeding within 24h of birth
- Fortification of BM in accordance with the AAP recommendation
- The use of minimal enteral nutrition for 5 days for ELBW followed by daily increases
- Daily increases for VLBW
- The establishment of set guidelines of management of residuals
- Standardized definitions of feeding tolerance and intolerance

Prevention of postnatal growth restriction by the implementation of an evidence-based premature infant feeding bundle. **Journal of Perinatology, 2015**

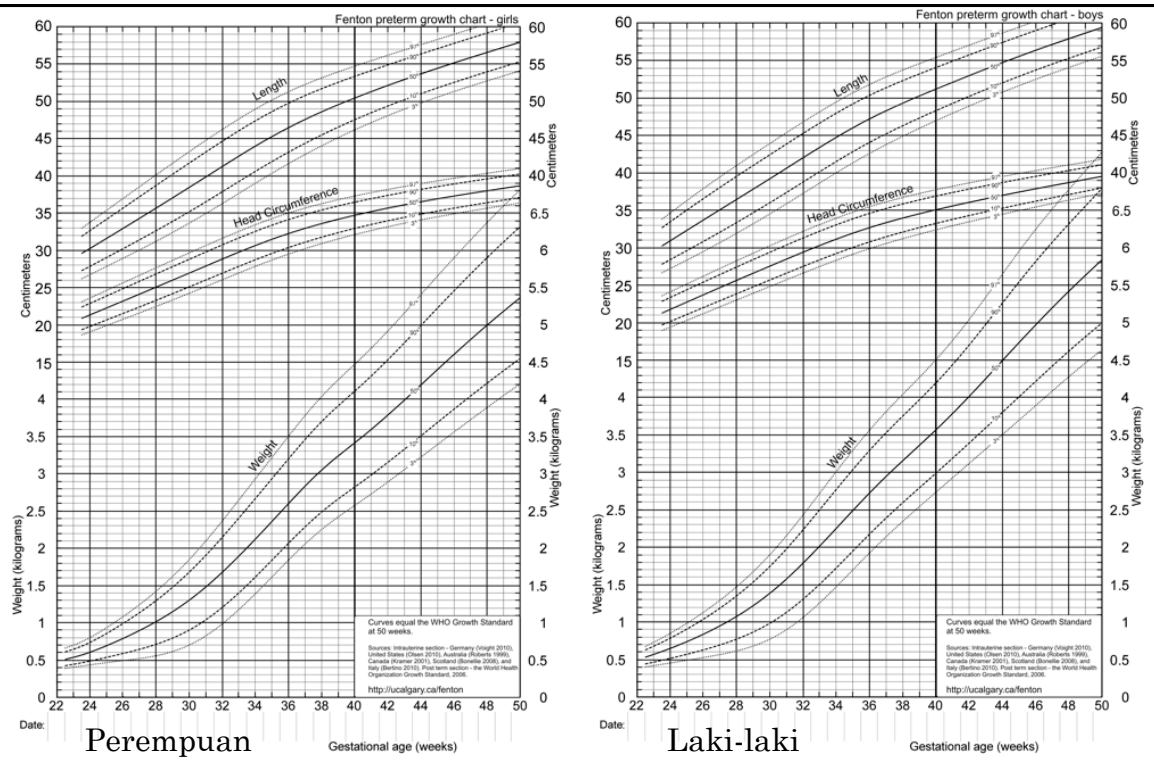
## Strategi optimalisasi nutrisi enteral pada BBLASR (<1.000 g) dan BBLSR (1.000-1.499 g)

| | BBLASR | BBLSR |
|---|---|---|
| Pilihan utama | ASI/PASI Prematur | ASI/PASI Prematur |
| Minum pertama | Usia 6-48 jam | Usia 6-48 jam |
| *Initial feeding* | 0,5 mL/kg/jam atau<br>1 mL/kg/2 jam | 1 mL/kg/jam atau<br>2 mL/kg/2 jam |
| Durasi *initial feeding* | 1-4 hari | 1-4 hari |
| Peningkatan minum | 15-25 mL/kg/hari | 20-30 mL/kg/hari |
| Jika *continuous feeding* | + 0,5 ml/kg/jam tiap 12 jam | + 1 mL/kg tiap 8 jam |
| Jika *intermittent feeding* (tiap 2 jam) | + 1 mL/kg tiap 12 jam | + 1 mL/kg tiap 8 jam |
| Fortifikasi ASI | < 100 mL/kg/hari | < 100 mL/kg/hari |
| Target asupan energi | 110-130 kkal/kg/hari | 110-130 kkal/kg/hari |
| Target asupan protein | 4-4,5 g/kg/hari | 3,5-4 g/kg/hari |

Senterre T. Practice of Enteral Nutrition in VLBW and ELBW Infants. *Nutritional Care of Preterm Infants. 2014.*

# Strategi optimalisasi nutrisi enteral pada BBLR (1.500 – 2.500 g)

| | |
|---|---|
| | |
| Beri minum melalui pipa orogastrik atau naso gastrik. | |
| | |
| Menetek atau pemberian minum melalui botol, jika: | |
| | - Berat >1600 g |
| | - >34 minggu kehamilan |
| | - *Neurologically* intak |
| | |
| → Pada bayi stabil: | |
| | - Minum mulai dengan 80 mL/kg/hari |
| | - Kemudian naik 10–20 mL/kg/hari |
| | |




Perempuan Laki-laki

Grafik Fenton pertumbuhan bayi prematur, digunakan untuk memonitor pertumbuhan bayi prematur dengan usia kandungan 22 minggu hingga 10 minggu post-term

Fenton and Kim. A systematic review and meta analysisi to revise the Fenton growth chart for preterm infants. *BMC Pediatrics 2013* ***13****:59*

## KAPAN BAYI PREMATUR PULANG RAWAT INAP ?

- Berat ≥ 1800 g
- Stabil: tanpa penyakit
- Tumbuh
- Orang tua/Pengasuh mengerti dan siap merawat bayi

**Pada saat pulang !**

- Bayi prematur lebih kecil dari bayi cukup bulan
- Cadangan nutrisi dalam tubuh lebih rendah
- Kebutuhan energi lebih tinggi



## KESIMPULAN

- Nutrisi merupakan salah satu kebutuhan esensial neonatus
- ASI merupakan nutrisi terbaik
- Jika nutrisi enteral tidak memungkinkan atau memadai, diperlukan nutrisi parenteral
- Pemantauan komplikasi nutrisi parenteral
- Untuk menjamin tumbuh kembang anak, nutrisi harus memenuhi kebutuhan energi, cairan, karbohidrat, protein, lemak, *trace elements* dan vitamin