

Optimal nutrition in critically ill children

MODULE 3: PART 2

Nutrition therapy implementation: Algorithms and case studies

Developed by

*The Asia Pacific – Middle East Consensus
Working Group on Nutrition Therapy in the
Paediatric Critical Care Environment*

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Learning objectives

- To understand the benefits of using an enteral nutrition (EN) algorithm
- To understand the elements of an effective EN algorithm
- To be able to follow an EN algorithm, with adaptations to local practice and available resources, where required
- To understand the implementation of nutrition therapy in the PICU in selected patient types based on case studies

Overview

1. *Benefits of implementing an EN algorithm in the PICU*
2. *Algorithms for initiating and advancing EN feeding*
 - 2.1. *US example*
 - 2.2. *Suggested algorithm for adaptation in Asia Pacific and the Middle East*
3. *Case studies to illustrate implementation of nutritional therapy in the PICU*
 - 3.1. *Severe malnutrition (risk of refeeding syndrome)*
 - 3.2. *Sepsis/respiratory failure*
 - 3.3. *Oncology*
4. *Test your knowledge*

1 Benefits of implementing an EN algorithm in the PICU

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Why use an EN algorithm?

- Evidence has shown that implementing an EN algorithm in the PICU:
 - Improved EN delivery¹⁻⁴
 - Decreased avoidable EN interruptions²
 - Decreased reliance on PN^{2,3}
 - Decreased time to feed initiation^{3,4}
 - Increased proportion of patients who reached their energy intake goal, and decreased time to goal^{2,5}
 - Reduced GI and infective complications⁶
 - Reduced prevalence of acquired infections⁷

2 *Algorithms for initiating and advancing EN feeding*

2.1. US example

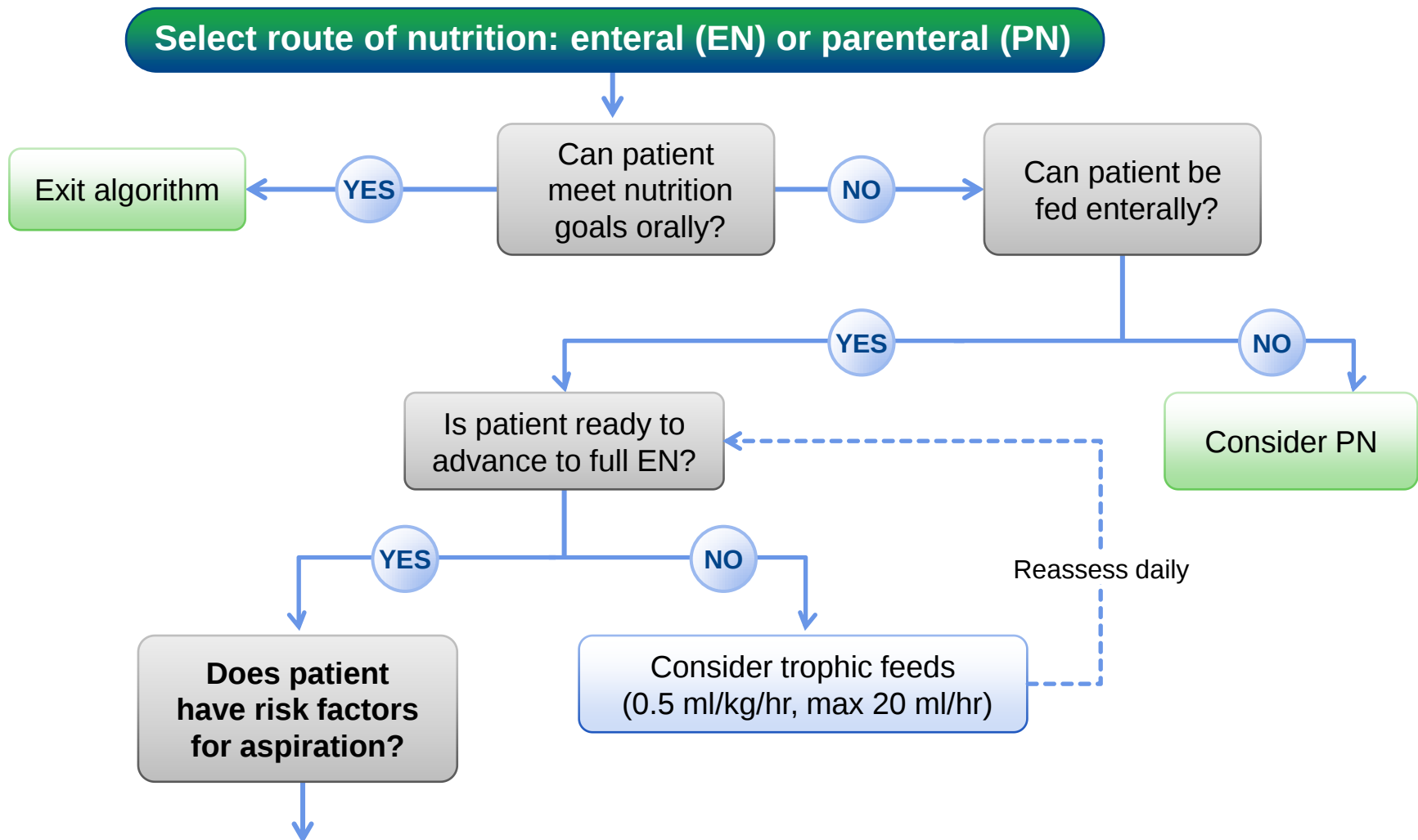
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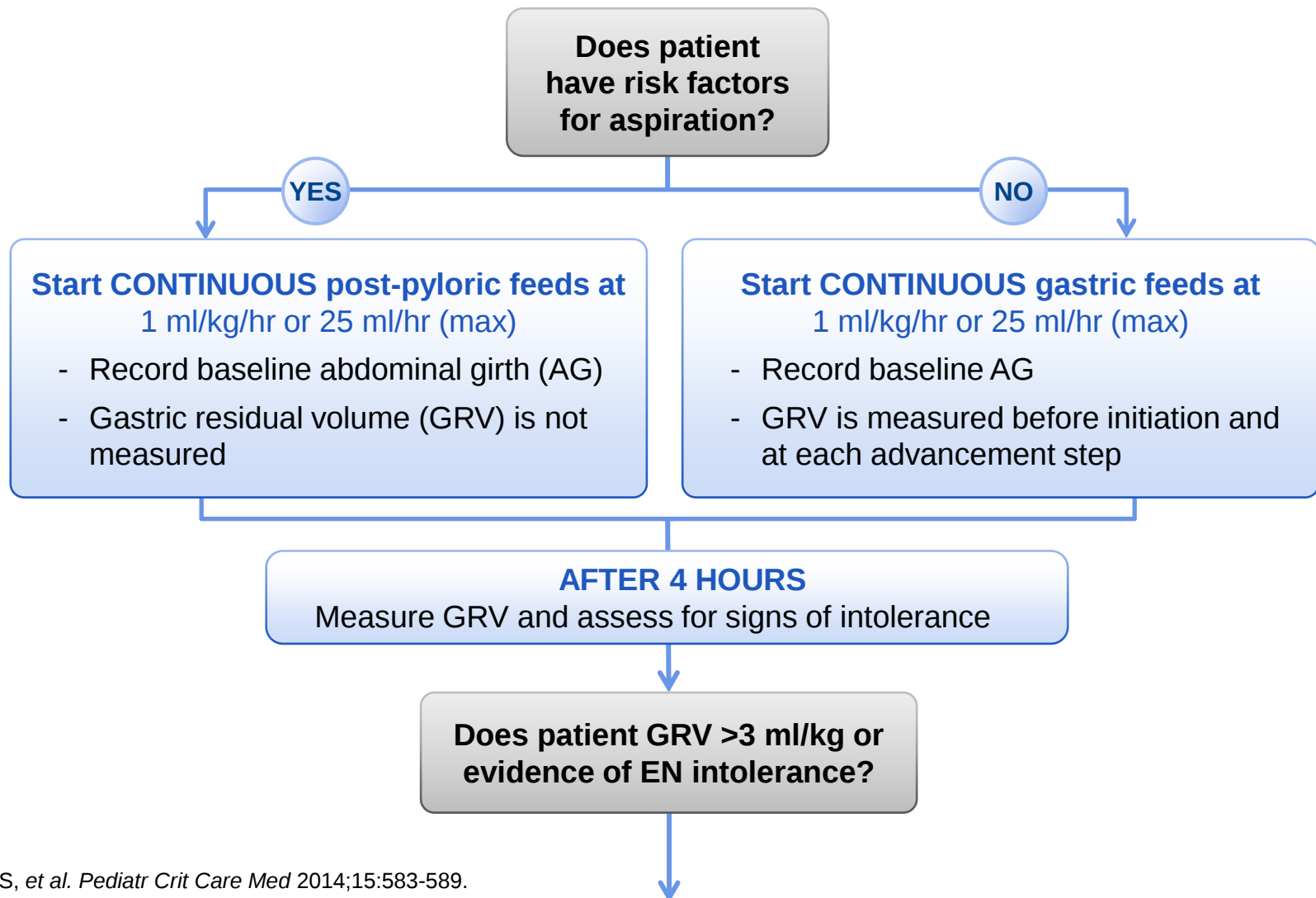
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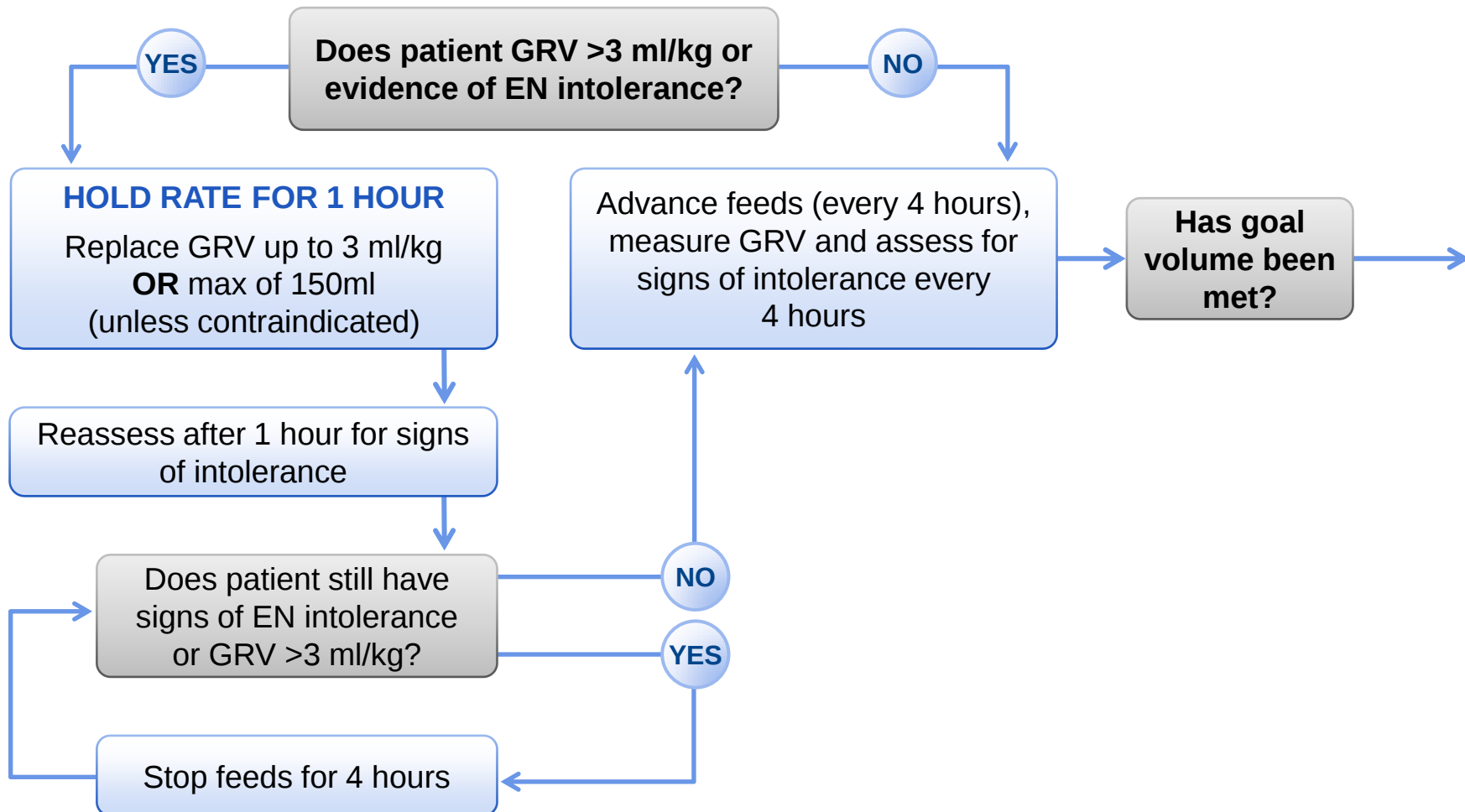
Algorithm for initiating and advancing EN in the PICU – US example



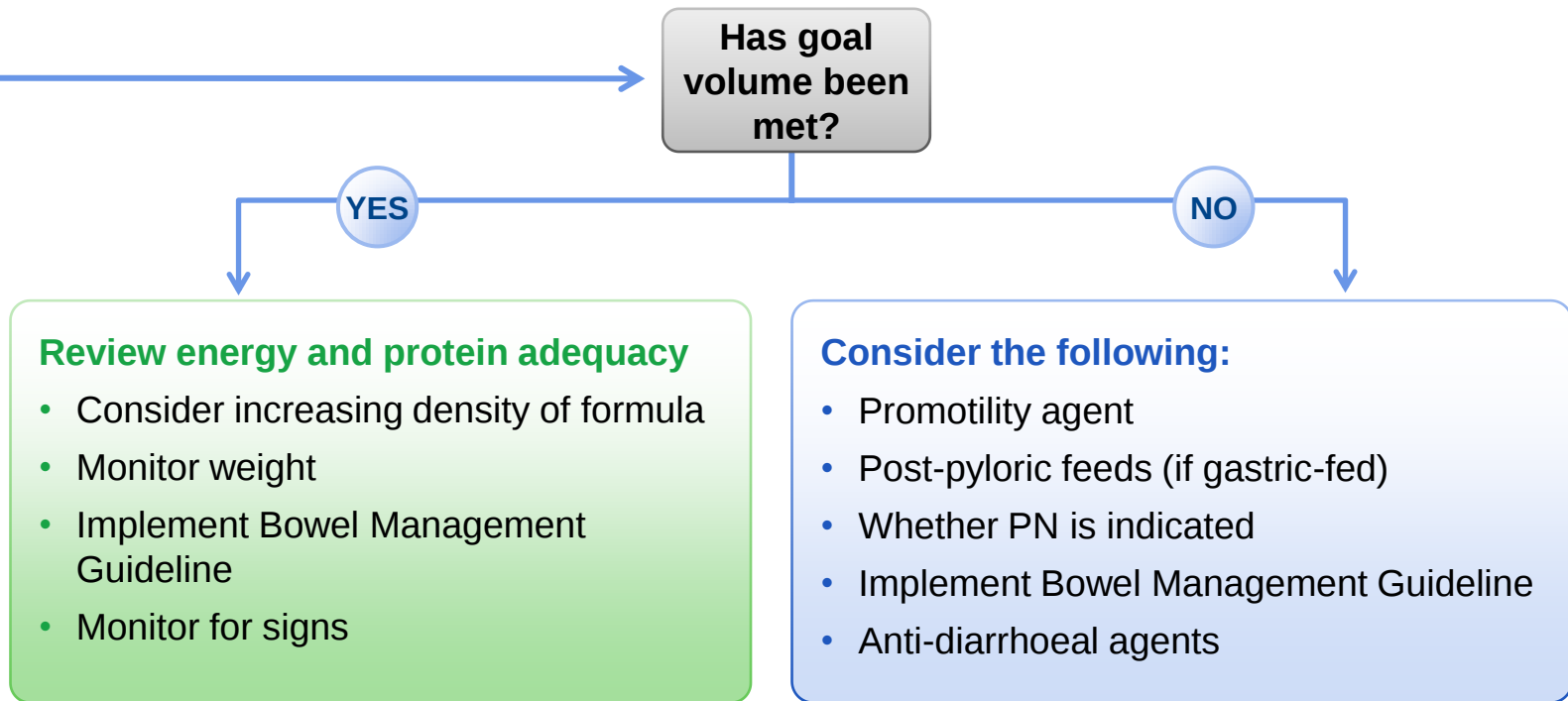
Algorithm for initiating and advancing EN in the PICU – US example



Algorithm for initiating and advancing EN in the PICU – US example



Algorithm for initiating and advancing EN in the PICU – US example



2 *Algorithms for initiating and advancing EN feeding*

2.2. Suggested algorithm for adaptation in Asia Pacific and the Middle East

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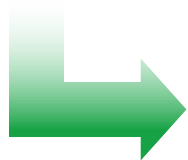
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Developing/adapting an EN algorithm for local/regional use

- **Best practice, evidence and local barriers** must be taken into account when designing a stepwise algorithm for nutrition therapy
- Recommendations must be consensus-based, and involve **multidisciplinary** experts:
 - Nurses, gastroenterologists, dieticians, pharmacists, surgeons, anaesthetists, infection control specialists, and cardiologists
- The following **algorithm adapted for local use** was developed by the Asia Pacific – Middle East Consensus Working Group on Nutrition Therapy in the Paediatric Critical Care Environment



This algorithm may be adapted further according to local practices/resource limitations

Components of an adequate EN algorithm

Screening for high-risk patients
– e.g. malnutrition, pre-existing illness

Advancement – rate, frequency

Prescription of energy/protein
(volume) goals

How to address **intolerance**
– definition, response, restart

Mode of nutrition – EN vs. PN and
route of EN (gastric vs. post-pyloric)

How to address common barriers – e.g.
fasting times. **Simple bedside solutions**

Initiation – timing,
trophic vs. full, formula

Built-in process of **auditing** to assess
adherence and impact

EN algorithm adapted for local use

1

Nutrition screening

Nurse:

- **Weight and length:** within 24 hours of admission
- Repeat **weight** *weekly* (minimum) and **length** *monthly*
- **BMI** (for children >2 years age)

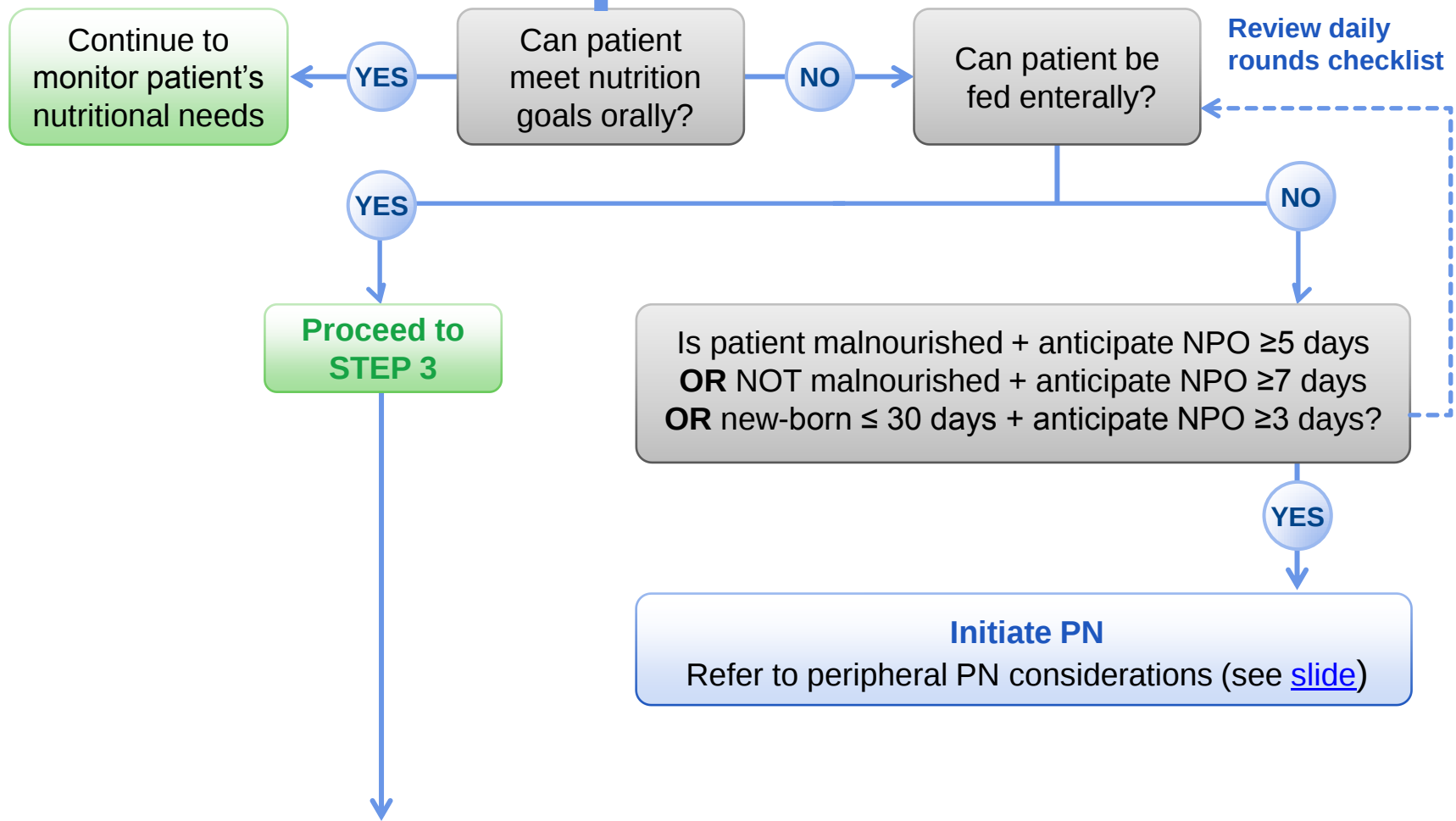
Nutrition support team/physician/dietician:

- Anthropometry
- **Consult on patients meeting criteria for malnutrition:** weight for age, weight for height or BMI z-scores (<-2 or >+2)
- Recommend **energy** (kcal/day) and **protein** (g/day) goals
- Volume goal assessed daily
- Recommend route of administration
- Recommend formula
- Repeat assessment and recommendation by dietician (if available) weekly (at minimum)
- Review criteria for indirect calorimetry (IC; if available) and discuss with team (see [slide](#)).

Proceed to STEP 2

EN algorithm adapted for local use

2 Select enteral nutrition (EN) or parenteral nutrition (PN)



EN algorithm adapted for local use

3 Select route for enteral feeding (gastric vs. post-pyloric/small bowel)

Does patient have ANY of these risk factors for aspiration?

(Adjust risk factors according to local practice)

- Previous history of aspiration
- Altered intestinal motility
- Delayed gastric emptying
- Witnessed regurgitation/aspiration
- Significant gastro-oesophageal reflux
- Altered mental status with depressed gag reflex
- Persistent vomiting
- Non-invasive ventilation

YES

Consider post-pyloric/small bowel feeds

- Gastric residual volume (GRV) is not measured
- Record baseline abdominal girth (AG)
- Discuss and consider simultaneous gastric decompression
- Ideal site for small bowel-tube tip is in the jejunum

NO

Consider gastric feeds (intermittent or continuous, according to local practice and resources)

- GRV is measured before initiation and at each advancement step
- Record baseline abdominal girth

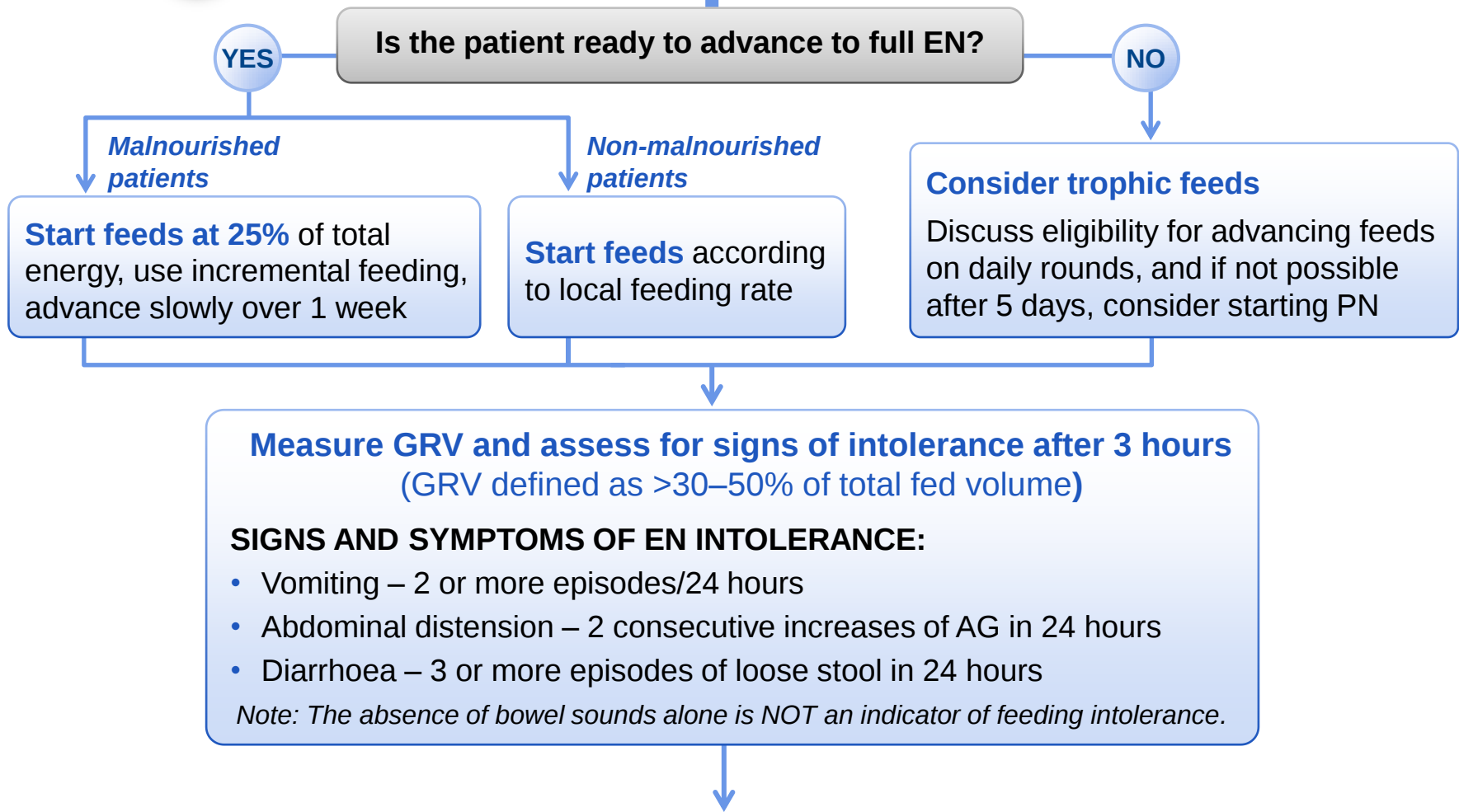
**GRV may not be attainable with smaller sized feeding tubes*

Proceed to STEP 4

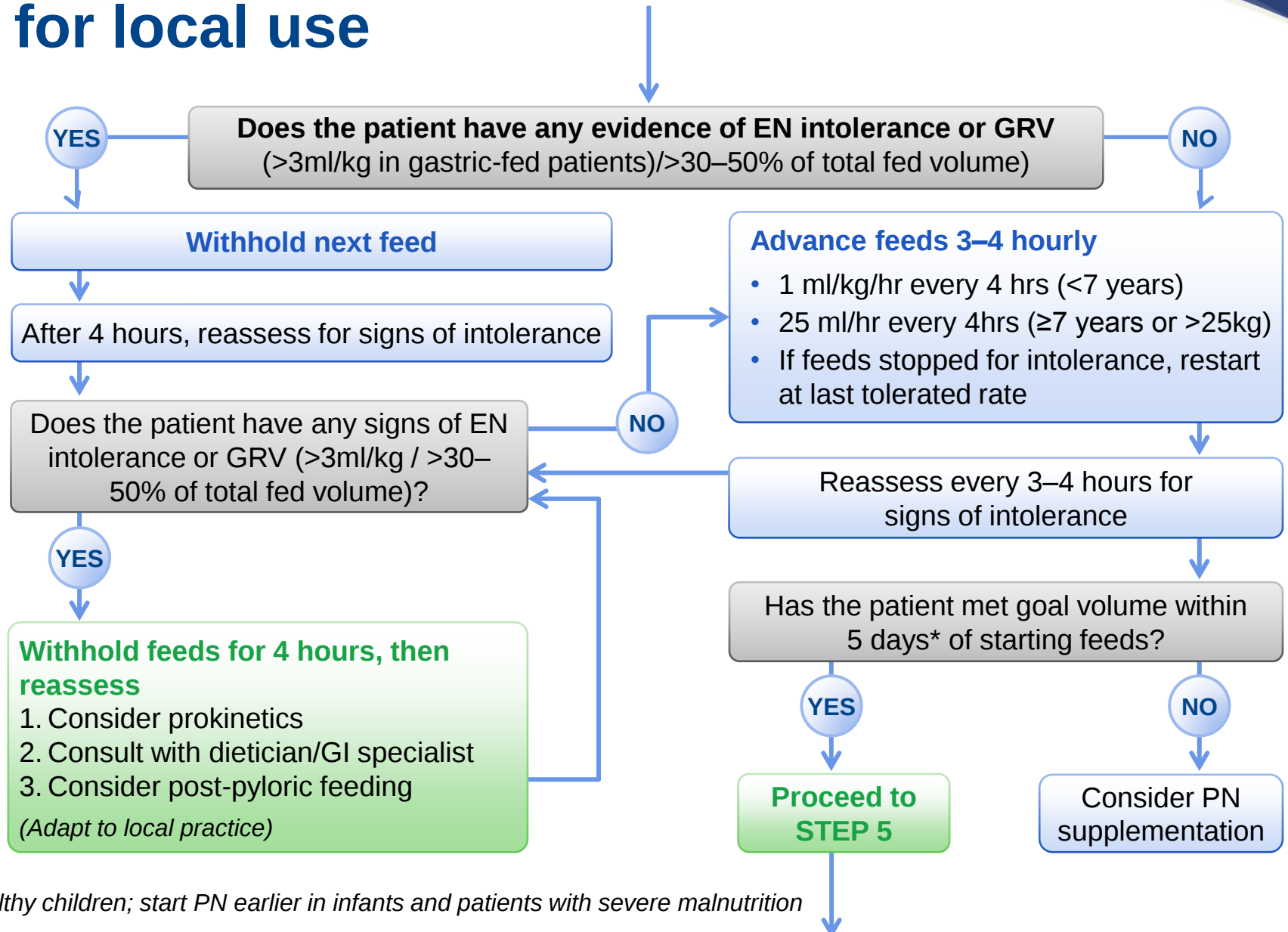
EN algorithm adapted for local use

4

EN prescription and advancement to goal



EN algorithm adapted for local use



*In healthy children; start PN earlier in infants and patients with severe malnutrition

EN algorithm adapted for local use

5

EN maintenance

Energy and protein goal reached (adapt to local practice)

- Review energy and protein adequacy with dietician on daily rounds
- Consider increasing density of formula if required
- Continue to monitor for signs of intolerance – routine measurement of GRV not indicated unless other signs and symptoms of intolerance are present
- Monitor weight weekly (minimum)
- Consider indirect calorimetry to calculate resting energy expenditure (refer to [slide](#))
- Avoid unnecessary and prolonged interruptions to EN
- Implement bowel management protocol by Day 3 of starting EN
- Monitor for signs of overfeeding (excessive weight gain, new ventilator dependence, hyperglycaemia, hypertriglyceridemia)

Contraindications for EN

Definite contraindications	Relative contraindications (adapt to local preference)
• Escalating vasoactive/inotropic support/haemodynamic instability • Suspected or confirmed NEC • Mechanical bowel obstruction • Ischaemic bowel	• <48 hrs post cardiac surgery • <24 hrs since cardiac arrest • Open chest • Central cooling • Requiring 2 or more vasoactive/inotropic agents • Severe ileus with high NGT output and/or vomiting • High output stoma • Complex GI surgery • Intractable diarrhoea • Duct-dependant cardiac defects

Considerations for peripheral PN

Peripheral PN may be considered if:

1

PN anticipated for <1 week or used as a bridge while awaiting central access

2

Newborn <30 days, anticipated to be NPO for ≤ 3 days

3

Well-nourished patients (or only mild nutritional depletion)

4

Not presumed to be hypermetabolic

5

Not fluid restricted

Refeeding syndrome: What is it?

What is refeeding syndrome?

- A constellation of electrolyte (hypokalaemia, hypophosphatemia, hypomagnesaemia), fluid and metabolic disturbances that occur when EN is reintroduced to patients who have a history of severe malnutrition or have been NPO for an extended period

Who is at risk of refeeding syndrome?

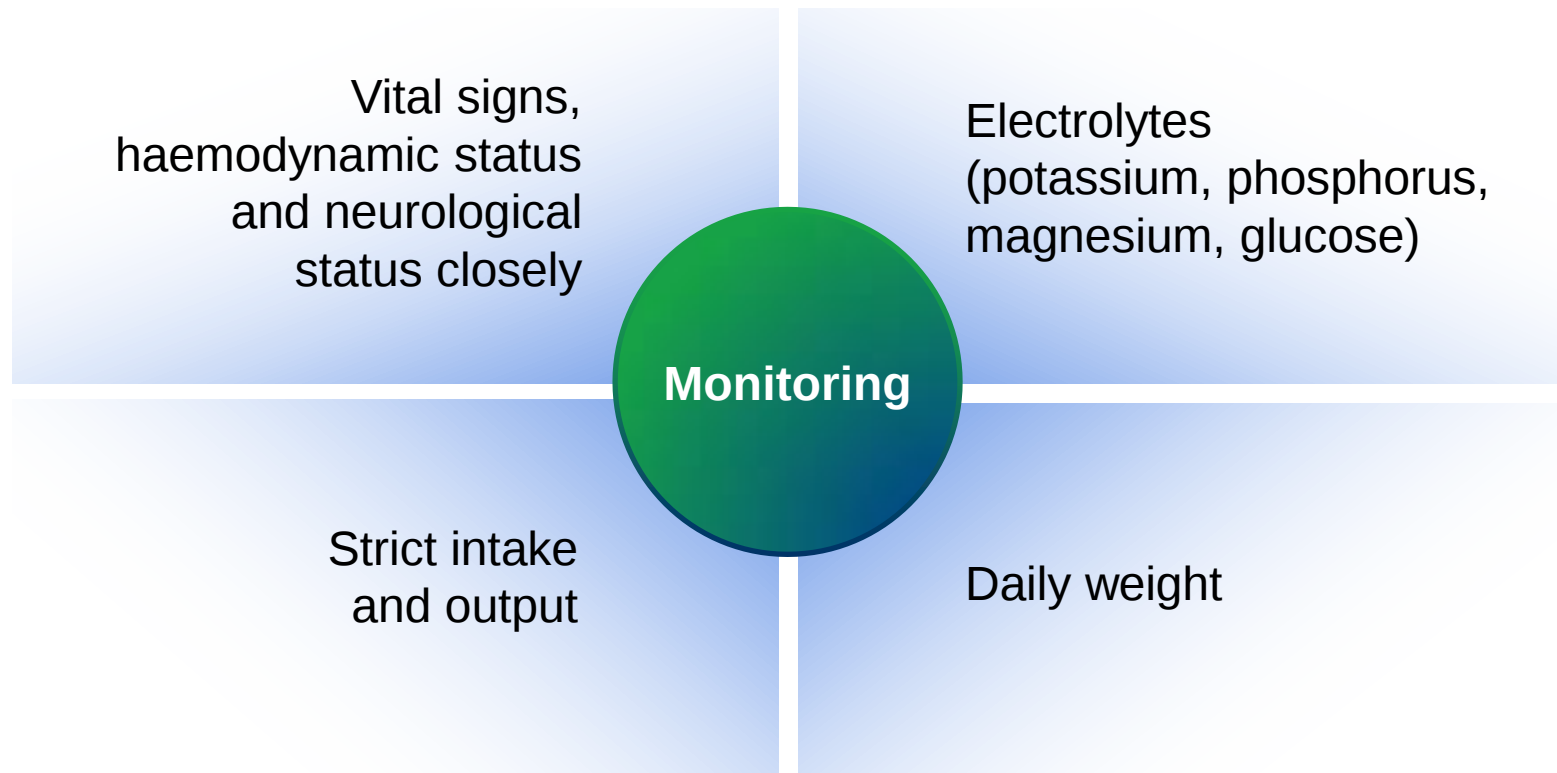
- Patients with acute or chronic malnourishment (based on anthropometrics and Waterlow criteria)
- Patients with recent severe weight loss or prolonged nutrition depletion (delayed nutrition therapy, cancer cachexia/anorexia, maldigestion/malabsorption)

Management of refeeding syndrome

Advancing nutritional therapy:

- Patient's initial caloric rate and estimated energy goals are individualised. A nutrition consultant is indicated to assist in developing a nutrition plan
- Electrolyte abnormalities must be corrected before nutritional therapy is initiated
- EN or PN should be initiated at lower rate (0.5ml/kg/hr) and advanced slowly. Begin at a reduced caloric rate of ~50% of the patient's estimated REE, or based on what the patient's caloric intake was prior to admission. Goal energy needs may be reached usually after ~5–7 days

Management of refeeding syndrome



Recommended criteria for IC (if available)

- 1 Underweight (BMI <5th percentile for age), at risk of overweight (BMI >85th percentile), or overweight (BMI >95th percentile)
- 2 >10% weight gain or loss during PICU stay
- 3 Failure to consistently meet prescribed calorie goals
- 4 Failure to wean or escalation in respiratory support
- 5 Need for muscle relaxants for >7 days
- 6 Neurologic trauma with evidence of dysautonomia
- 7 Oncologic diagnoses
- 8 Need for ventilatory support >7 days
- 9 Suspicion of severe hypermetabolism
- 10 PICU stay >4 weeks

Common reasons for EN interruption/inadequate intake

Routine interventions

Perceived or actual gastric intolerance

Procedures that require fasting

Physicians' ignorance of nutritional requirements

Reluctance to feed haemodynamically unstable children

Lack of a uniform definition and inconsistency in managing EN intolerance

Concerns about risks of aspiration pneumonia

Failure to prioritise nutritional therapy during daily rounds

Acceptable times for elective interruption to EN

Reason for EN interruption	Acceptable time (hrs)
Endotracheal extubation or elective intubation	4
Surgical procedure under general anaesthetic (OR)	6
Radiologic/interventional radiology procedure under general anaesthetic/sedation	4
Radiologic procedure (not under general anaesthetic)	2–4
Malfunctioning/displaced enteral feeding tube	6–8
Bedside procedures under sedation	2–4

If EN is interrupted for any reason other than intolerance, feeds should be restarted at the previously tolerated rate

feeds should be restarted at the previously tolerated rate

3 *Case studies to illustrate implementation of nutritional therapy in the PICU*

3.1. Case study I – Severe malnutrition (risk of refeeding syndrome)

Developed by

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Background

- 9-month-old boy
 - Weight 5kg, length 67cm
 - BMI = 11 kg/m², WH z-score <-4SD
- History of presentation
 - 2 weeks history of diarrhoea, vomiting and lethargy
 - Rectal prolapse due to severe diarrhoea
- Feeding was mainly condensed milk, due to parents' financial constraints over the previous 2 months
- Child was previously well
 - weight at 7 months was 7kg
 - z-score was at median



Diagnosis

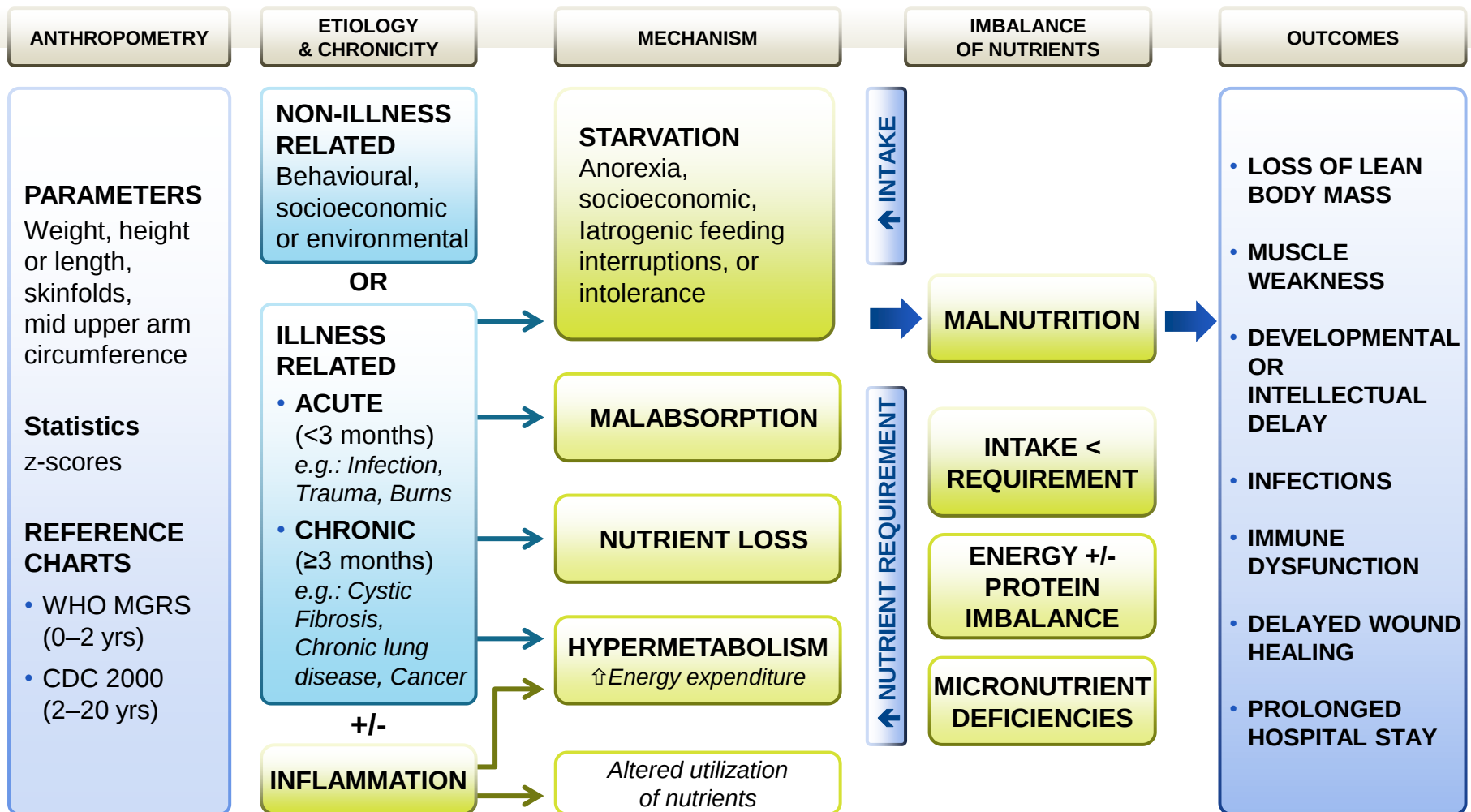
Upon examination, the child:

- Was emaciated, lethargic
- Hypertonic posture, poor head control
- Poor skin turgor, shrunken eye ball
- Fever, HR 150bpm, tachypnoea RR 45 bpm, BP 117/47 mmHg
- Abdomen soft and mildly distended, liver 3cm, spleen 3cm

Case of severe acute malnutrition, complicated with diarrhoeal disease and negligence

diarrhoeal disease and negligence

Classification of malnutrition



Treatment

- Child was given intravenous fluid bolus and intravenous maintenance fluid with correction of dehydration
- Intravenous antibiotic was started
- Full feeding with infant formula was started immediately on admission

Outcome

- Child became oedematous and developed cardiorespiratory arrest at day 3 of admission due to fluid overload and cardiac failure
- He developed hypokalemia, hypophosphatemia, hypomagnesaemia and feature of heart failure
- All symptoms suggestive of **refeeding syndrome** from the initiation of full feeding with usual milk formula

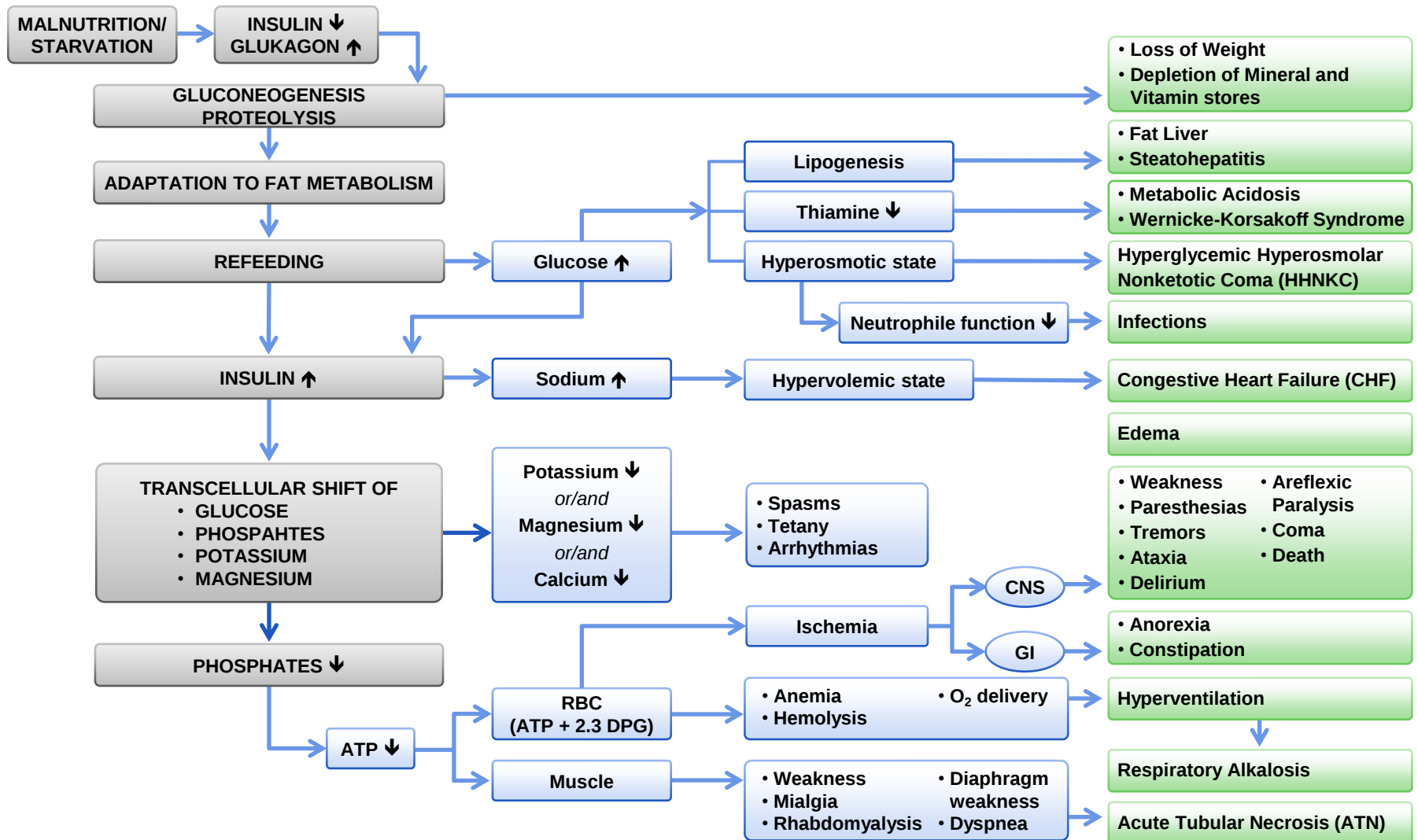
Investigation

	Day 0	Day 1	Day 2
Sodium (mmol/L)	124	128	139
Potassium (mmol/L)	4.2	3.5	2.8
Phosphate (mmol/L)	1.08	0.98	0.43
Magnesium (mmol/L)	0.86	0.74	0.68
Albumin (g/L)	13	9	8
Urea (mmol/L)	1.2	1.1	1.3
Creatinine (umol/L)	32	32	40
Haemoglobin (g/dL)	5.4	4.8	8.6
Platelet	121,000	107,000	19,000

Refeeding syndrome

- Refeeding syndrome is a potentially lethal condition defined as severe electrolyte and fluid shift associated with metabolic abnormalities in malnourished patients undergoing refeeding, whether orally, enterally, or parenterally
- It can be associated with significant morbidity and mortality
- Clinical features are fluid-balance abnormalities, abnormal glucose metabolism, hypophosphatemia, hypomagnesaemia and hypokalemia. In addition, thiamine deficiency can occur

Pathophysiology of refeeding syndrome



Learning points

- Dehydration is commonly misdiagnosed and inappropriately treated in malnourished patients.
- It is the ***most common cause of death***
- Malnourished child should be rehydrated orally whenever possible.
- Intravenous infusions are dangerous and not recommended unless there is severe shock, loss of consciousness and confirmed dehydration

Rehydrating severely malnourished children

- A WHO-recommended modified oral rehydration solution (ORS) for malnourished children (ReSoMal) should be used to rehydrate severely malnourished children.¹
- Additional fluid should not be given to a malnourished child who has a normal circulatory volume, to prevent the recurrence of dehydration.
- Normally much less ORS is sufficient to restore adequate hydration in a malnourished than a normally nourished child.
- Start with 5 ml/kg every 30 minutes for the first two hours orally or by nasogastric tube (2% body weight), and then adjust according to the weight changes observed. Weigh the child each hour and assess liver size, respiration rate and pulse.
- After rehydration, 30ml of ORS can be given for each watery stool.

1. https://www.lshtm.ac.uk/eph/dph/research/nutrition/improving_inpatient_treatment_of_severe_malnutrition.pdf

Feeding the severely malnourished child to prevent refeeding syndrome

- Refer the patient to a dietician early, for appropriate assessment and a nutritional prescription
- Use oral (trophic) feeding wherever possible
- Start feeding at 25% of the total resting energy requirement, and advance slowly in small increments over 7 days, depending on electrolytes, blood glucose levels and tolerance
- Feed frequently to avoid hypoglycaemia
- Review electrolytes frequently (2, 4, or 6-hourly till stable) and correct any electrolyte imbalance especially hypokalemia and hypophosphatemia

Feeding the severely malnourished child to prevent refeeding syndrome

- Start feeding with a low level of protein (1 g/kg/day), then advance gradually to 2.5 or 3 g/kg/day over one week
- The World Health Organization's F-75 is the recommended formula for feeding a malnourished child, followed by F-100 for catch-up feeding

Recipe for F-75 and F-100 formulas

- Using an electric blender, mix the milk powder, sugar and oil with some of the warm boiled water, add electrolyte/mineral solution, the remaining water and blend at high speed
- If no blender is available, mix the milk, sugar, oil and electrolyte/mineral solution to a paste, and then slowly add the rest of the warm boiled water and whisk vigorously
- Store made-up formula in refrigerator

	F-75 (starter)	F-100 (catch-up)
Dried skimmed milk (g)*	25	80
Sugar (g)	100	50
Vegetable oil (g)	30 (or 35ml)	60 (or 70ml)
Electrolyte/mineral solution (ml)	20	20
Water: make up to 1000ml or add	870ml	830ml
Contents per 100 ml		
Energy kcal	75	100
Protein g	0.9	2.9
Lactose g	1.3	4.2
Potassium mmol	4.0	6.3
Sodium mmol	0.6	1.9
Magnesium mmol	0.43	0.73
Zinc mg	2.0	2.3
Copper mg	0.25	0.25
% energy from protein	5	12
% energy from fat	36	53
Osmolarity (mOsmol/l)	413	419

Alternative formulation for F-75 and F-100

F-75 starter formulas

Full cream dried milk 35g, 100g sugar, 20g (or ml) oil, 20ml electrolyte/mineral solution, and make up to 1000ml or add 870ml water

Full cream cow's milk (fresh or long life) 300ml, 100g sugar, 20g (or ml) oil, 20ml electrolyte/mineral solution and make up to 1000ml or add 570ml

F-100 catch-up formulas

Full cream dried milk 110g, 50g sugar, 30g (or ml) oil, 20ml electrolyte/mineral solution, and make up to 1000ml or add 830ml water

Full cream cow's milk (fresh or long life) 880ml, 75g sugar, 20g (or ml) oil, 20ml electrolyte/mineral solution and make up to 1000ml or add 30ml water

Isotonic and cereal based F-75

Cereal-based low osmolar F-75 (334mOsmol/l). Replace 30g of the sugar by 35g cereal flour in F-75 recipes above. Cook for 4 minutes. This may be helpful for children with osmotic diarrhoea

Conclusions

- Refeeding syndrome is commonly missed in malnourished patients, often leading to adverse events
- Hydration and feeding of malnourished child should be carefully managed
- Electrolyte balance must be regularly observed and feeding should be established gradually in malnourished children

3 *Case studies to illustrate implementation of nutritional therapy in the PICU*

3.2. Case study II – Sepsis/respiratory failure

Developed by

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Background

- 1 year and 4 months old, male, 8kgs, length 74cms, moderately malnourished (<-2SD)
- Admitted for cough, fever, and fast breathing
- Productive cough for 1 week associated with fever (maximum temperature 40⁰C)
- No consultation was done and no medications were administered. Child had a poor appetite
- Pallor and fast breathing noted on the day of admission
- Admitted as a case of PCAP-C (moderate risk)
- Vitals: Heart rate 140/min, respiratory rate 60/min, temperature 40⁰C
- Physical exam: (+) pallor, alar flaring, chest in-drawing, bilateral lung crackles, strong pulses

Background

- Given oxygen via facemask at 10LPM and started on Cefuroxime IV. Oxygen tapered to 2LPM via nasal prong after 24 hours
- 3rd hospital day, patient developed acute respiratory failure, intubated, and transferred to PICU
- Recurrence of fever noted. Repeat complete blood count showed mild anaemia, leukocytosis and neutrophilia
- Repeat chest X-ray showed progression of pneumonia. Cefuroxime switched to a Meropenem IV

Diagnosis

- In the PICU, patient was managed as PCAP-D and sepsis
- Mechanical ventilator attached and sedation with Midazolam infusion to address patient-ventilator asynchrony
- Other labs: Glucose normal, hypokalemia, arterial blood gas showed respiratory acidosis
- TACS grew *S. aureus*, blood culture with antimicrobial removal device (ARD) had no growth

Objectives

- To counteract on-going catabolic state due to severe pneumonia and sepsis
- To provide nutrition build-up during the anabolic phase for effective weight gain (catch-up growth)

Treatment

1st PICU day

- NPO for 24 hours. Electrolyte derangement corrected
- Mechanical ventilation to correct respiratory acidosis

2nd PICU day

- Started intermittent gastric bolus feeding with age-appropriate standard formula (1cal/ml) at 10% of target volume via NGT. GRV monitored not to exceed 30% of milk volume given
- IVF was adjusted with enteral feeding to maintain urine output within 1–2ml/kg/hr

3rd PICU day

- Started feeding increments at 1oz after 2 successful feedings
- Zinc, folic acid and single dose of vitamin A administered
- GRV and abdominal circumference monitored

Nutritional Intervention

4th–8th PICU day

- Target volume of standard formula reached at 100 kcal/kg/day, protein at 25 gms/day
- IVF discontinued
- No signs of gastric intolerance noted

9th PICU day

- Oral feeding with standard formula started using a cup with aspiration precaution
- Further increments of milk feeding was contemplated to be started in the paediatric ward to reach target calories at 130 kcal/kg/day (catch-up growth)

Outcomes

- Enteral feeding (intermittent bolus) using age-appropriate standard formula was tolerated. Incremental feeding starting with low volume did not encounter problems related to gastric intolerance
- 100kcal/kg/day of feed was achieved within 7 days
- Pneumonia started to resolve, fever lysed, and patient was weaned from controlled ventilatory support to SIMV mode
- Patient was extubated on the 8th PICU day. Oral feeding was initiated on the 9th PICU day
- Patient was eventually transferred to paediatric ward on 10th day

Conclusions

- Metabolic derangements should be corrected within 24 hours
- Unless contraindicated, enteral feeding should be started early
- No data to support initiation of milk feeding at low volumes but shown to be successful
- Age-appropriate standard formula was used because it can be given for tube and oral feeding. It is lactose-free and contains MCT, prebiotic and probiotics which can be beneficial to patients with acute lung injury and sepsis. It can be given as a sole source of nutrition to children at risk of malnutrition

Learning Points

1

Holistic approach in the management of critically ill children

- List all problems apart from the chief complaint
- Manage and treat co-morbidities

2

Hospital-acquired malnutrition is common in the PICU

- **Determine nutritional status** in all patients admitted to the PICU
- Patients at high-risk for acute malnutrition may be missed out during admission

3

Early enteral feeding is recommended unless contraindicated

- Correct haemodynamic instability within 24 hours
- Correct electrolyte imbalance, if any, and monitor glucose
- Start oral feeding as soon as patient can tolerate it
- Avoid unnecessary feed interruptions

4

NPO should be no longer than 4 hours before extubation or just before the next feed

3 *Case studies to illustrate implementation of nutritional therapy in the PICU*

3.3. Case study III – Oncology

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Background

- 8-year-old child with acute lymphocytic leukaemia (ALL), recently completed induction chemotherapy
- Patient experienced intermittent fever for 3 days, neutropenic
- Increased work of breathing, bilateral haziness on chest X-ray with minimal pleural effusion, generalised oedema
- Received fluid boluses in the ward and started on dopamine infusion for hypotension
- Started on supplemental oxygen, transferred to the PICU for worsening respiratory distress and hypotension

Examination findings

- Vitals, heart rate 144/min; normal sinus rhythm, cool extremities with capillary refill time of 3 seconds. Blood pressure: 88/45 mmHg
- Temperature: 40°C; no new rash
- Respiratory rate 35/min saturation 89% in room air and 93% in BB O₂ via face mask. Scattered crackles bilaterally
- Generalised puffiness/oedema
- Abdomen distended but soft, recent stool+
- Mucositis++

Laboratory findings

- Haematocrit 8.2 %; white blood cell count 0.1/ μ l blood; neutrophils <200/ μ l blood; platelets 88/ μ l blood
- Na 130mmol/L; K 3.3 mmol/L; Mg 1.0 mmol/L
- ALT/AST, serum bilirubin within normal limits
- Blood gas (venous): pH 7.30/pCO₂ 58 torr/pO₂ 69 torr/Bicarbonate 16 mmol/L/Blood sugar 204 mg/dL

Initial management

- Noninvasive ventilator support – continuous positive airway pressure (CPAP) at 10cm and FiO₂ 40% started, with stabilisation of respiratory decline
- Decreased work of breathing, saturation 99%, improvement in venous blood gas
- Hemodynamic status improved after fluid bolus x 2 and the patient required Dopamine at 10 mcg/kg/min for the first 12 hours after which it was discontinued due to improved BP and perfusion
- Blood cultures were negative, but empiric broad spectrum antibiotics were continued
- Over next 3 days, patient was continued on CPAP, coming off for brief periods during the day. Chest x-ray showed bilateral basal haziness with stable, mild pleural effusion

Nutritional management

Assessment

- Nutritional status
- Macronutrient requirements
- Micronutrient requirements

Prescription

- Drug nutrient interactions

Delivery

- Route of nutritional intake
- EN (tolerance) vs. PN (timing of initiation)
- Electrolytes and fluid issues

Learning points – I

- Oncology patients are often malnourished as a result of their disease process, cachexia and mucositis (and consequent inability to take nutrition orally or via nasogastric tube). Patients may be at risk of refeeding when nutrient intake is rapidly increased after a period of starvation or low intake
- These patients may require PN from the start; place a peripherally inserted central catheter (PICC) line on admission
- Once the patient is haemodynamically stable, commence PN on Day 2 via a PICC line or a central line
- Monitor electrolytes frequently (every 2–4 hours for potassium and glucose). The patient is likely to be deficient in magnesium, phosphorus and potassium, so these should be supplemented. Initiate PN at lower calories than the requirement, and advance feeding and fluids gradually

Learning points – II

- Small amounts of oral feeding is helpful. The eventual aim is to progress to EN, using a high-calorie formula. Use of a hydrolysed protein formula may be recommended if patient is unable to tolerate regular formula. Maintain strict aseptic precautions for central lines
- The role of enteral nutrition by nasogastric or nasojejunal tubes during CPAP is debated
- Risk of aspiration must be carefully assessed when determining gastric versus post-pyloric feeding strategy
- CPAP is not a contraindication for enteral nutrition

Module summary

- Implementing EN algorithms in the PICU have led to improved nutrition delivery, reduced feed interruptions and PN use, and improved patient outcomes.
- Best practice, evidence and local resources must all be taken into account when designing an EN algorithm for local use.
- Recommendations must be consensus-based, and involve multidisciplinary experts.
- An algorithm should include nutritional assessment, accurate prescription of energy/protein goals, mode of nutrition, feed initiation, advancement, and protocols to manage feed intolerance and malnutrition on presentation.

4 *Test your knowledge*

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Test your knowledge

1. Which of these outcomes can be achieved by implementing an EN algorithm? *(Select all that apply)*

A

Reduced mortality in the PICU

B

Reduce avoidable interruptions to EN feeding

C

Reduce reliance on PN

D

Reduced GI symptoms and infections

E

Reduced prevalence of acquired infections

1. Which of these outcomes can be achieved by implementing an EN algorithm?

- **Answer:**

- B. Reduce avoidable interruptions to EN feeding
- C. Reduced reliance on PN
- D. Reduced GI symptoms and infections
- E. Reduced prevalence of acquired infections

There is evidence to show that implementing an EN algorithm in the PICU has achieved all these outcomes, except reducing mortality in the PICU, which has not yet been demonstrated.

Test your knowledge

2. Trophic feeding should be considered in a patient who has a functional GI tract but is not yet ready to receive full EN

A

True

B

False

2. Trophic feeding should be considered in a patient who has a functional GI tract but is not yet ready to receive full EN

- **Answer:**

A. True

According to the algorithm developed by Hamilton *et al.* in the US, trophic feeding should be considered in a patient who is capable of being fed enterally, but is not yet ready to advance to full-strength EN (Hamilton S, *et al. Pediatr Crit Care Med* 2014;15:583-589).

Test your knowledge

3. How long is it acceptable to interrupt EN feeding for a bedside procedure carried out under sedation?

A

2–4 hours

B

12 hours

C

6–8 hours

D

10–12 hours

3. For how long is it acceptable to interrupt EN feeding for a bedside procedure carried out under sedation?

- **Answer:**

- A. 2–4 hours

According to the EN algorithm developed at the Boston Children's Hospital, USA, it is acceptable to interrupt EN feeding for 2–4 hours to carry out a bedside procedure under sedation. Prolonging feed interruptions longer than necessary should be avoided, to ensure that the patient's energy and protein goals are met.

Test your knowledge

4. If the patient has GRV >3 ml/kg, you should:

A

Hold feed for 1 hour

B

Hold feed for 4 hours

C

Hold feed for 8 hours

D

Replace GRV immediately

4. If the patient has GRV >3 ml/kg, you should:

- **Answer:**

B. Hold feed for 4 hours

- According to the algorithms presented in this module, 4 hours is the period that EN feeding should be suspended if GRV is >3mg/kg or >30–50% of the total fed volume.

Test your knowledge

5. If a patient has malnutrition on admission to the PICU, you should:

A

Initiate full EN feeding on admission to the PICU and attempt to meet energy requirements as soon as possible

B

Initiate feeding at 25% of the total energy requirement and advance slowly over a period of 7 days

5.If a patient has malnutrition on admission to the PICU, you should:

- **Answer:**

B. Initiate feeding at 25% of the total energy requirement and advance slowly over a period of 7 days

- This step is necessary to avoid the complications of refeeding syndrome that can arise from initiating feeding at full strength in a patient who presents with severe malnutrition.