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• Nutrition and refeeding syndrome

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- 5th August 2024



**CHILD
STUNTING**

LOW HEIGHT FOR AGE

155 MILLION
CHILDREN WORLDWIDE



**CHILD
WASTING**

LOW WEIGHT FOR AGE

52 MILLION
CHILDREN WORLDWIDE



**CHILD
OVERWEIGHT**

HIGH WEIGHT FOR AGE

41 MILLION
CHILDREN WORLDWIDE



**ADULT
OVERWEIGHT
& OBESITY**

BMI \geq 25

2 BILLION
ADULTS WORLDWIDE

Fe

MICRONUTRIENT DEFICIENCY

Iron, folic acid, vitamin A, zinc, iodine below healthy thresholds | **AFFECTING 2 BILLION PEOPLE**



NONCOMMUNICABLE DISEASES

Diabetes, heart disease, and cancers
1 IN 12 PEOPLE WORLDWIDE HAS DIABETES

Adapted from International Food Policy Research Institute (IFPRI), 2016 and 2017.

What is Micronutrient Deficiencies?

- Micronutrient deficiency (MND) is a **lack of essential vitamins and minerals** required in small amounts by the body for proper growth and development
- The five common micronutrient deficiency includes:
 - vitamin A
 - Iodine
 - Iron
 - Zinc
 - Folate



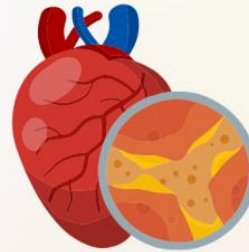
Common Chronic Diseases Associated with Micronutrient Deficiencies



Cancer



Thyroid disease



Cardiovascular disease



Type 2 Diabetes



Osteoporosis



Depression



Cognitive Impairment



Nutritional Assessment



- General clinical assessment:
- Unintentional weight loss >10% in the last 3 months
- Baseline or deterioration prior to admission
- Body composition
- Muscle mass and strength
- Malnutrition:
- BMI <18.5
- Comorbidities.
- Function of the gut

Refeeding syndrome

Background:

- Refeeding syndrome was first described during world war II.
- Prisons of war, concentration camp survivors, and victims of famine.
- Unexpected morbidity and mortality during nutrition repletion.
- **Schnittker – Japanese prisoners of war**
 - Heart failure
 - Peripheral edema
 - Neurological disorders
 - 1 of 5 died within the next few days

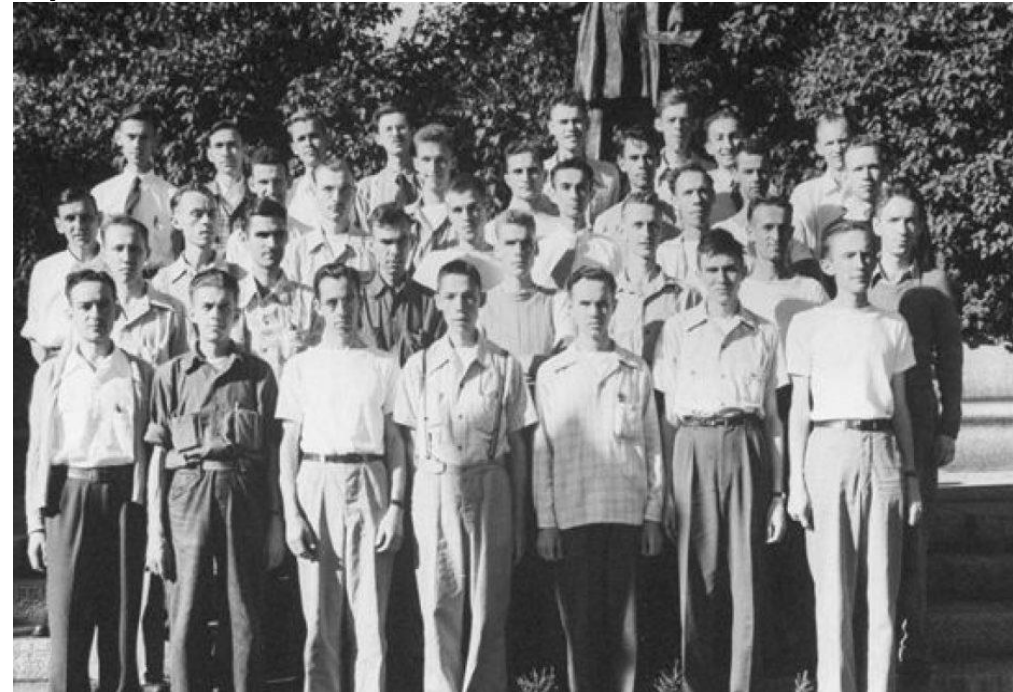


ASPEN Consensus recommendations for refeeding syndrome 2020

Refeeding syndrome

1944: Keys et al; Minnesota Starvation Experiment

- Severe emotional distress
- Depression
- Social withdrawal
- Impaired concentration
- Decreases in metabolic rate
RR and HR
- Oedema in their extremities



ASPEN Consensus recommendations for refeeding syndrome 2020

Refeeding syndrome

- Definition:
- Refeeding syndrome is a set of **metabolic and electrolyte alterations** occurring due to reintroduction of calories through **oral, enteral and parenteral nutrition** after a period of **consistent reduction of energy intake or starvation** in individuals pre-existent malnutrition and/or in a catabolic state.
- **Hypo K⁺, Mg²⁺, PO₄ and thiamine deficiency: hallmark**

Classification

- **Mild** - a decrease in any 1, 2, or 3 of serum phosphorus, potassium, and/or magnesium levels by 10% to 20%
- **Moderate** - a decrease in any 1, 2, or 3 of serum phosphorus, potassium, and/or magnesium levels by 20% to 30%
- **Severe** - a decrease in any 1, 2, or 3 of serum phosphorus, potassium, and/or magnesium levels by >30% and/or organ dysfunction resulting from a decrease in any of these and/or due to thiamine deficiency (severe).
- occurring within 5 days of a reintroduction of calories

Incidence

- Critically ill patients (nutrition held for 48 hours) → 34% chance of hypophosphatemia
- Severe hypophosphatemia has a mortality of 18.2% compared to 4.6% in those without
- 0.43-18% in all hospitalized patients
- South Africa – 12.5% - 200 ICU needed.



Population at risk



- Eating disorders: anorexia nervosa
- Mental health disorders
- Alcohol and substance-use disorders
- Malabsorption
- Starvation in protest, famine and migration
- Child abuse and starvation
- Military recruits
- Athletes
- Renal failure/hemodialysis
- The critically ill
- Malignancy
- CAN HAPPEN WITH OVERWEIGHT PATIENTS!

Starvation & Refeeding

Hypokalaemia

Hypomagnesaemia

Hypophosphataemia

Thiamine deficiency

Salt & water retention –
oedema

Glycogen stores utilised

↓ Insulin production &
↑ Glucagon secretion

Gluconeogenesis =
Protein catabolism &
mobilisation of lipid

Protein, fat, mineral,
electrolyte & vitamin
depletion – sodium &
water intolerance

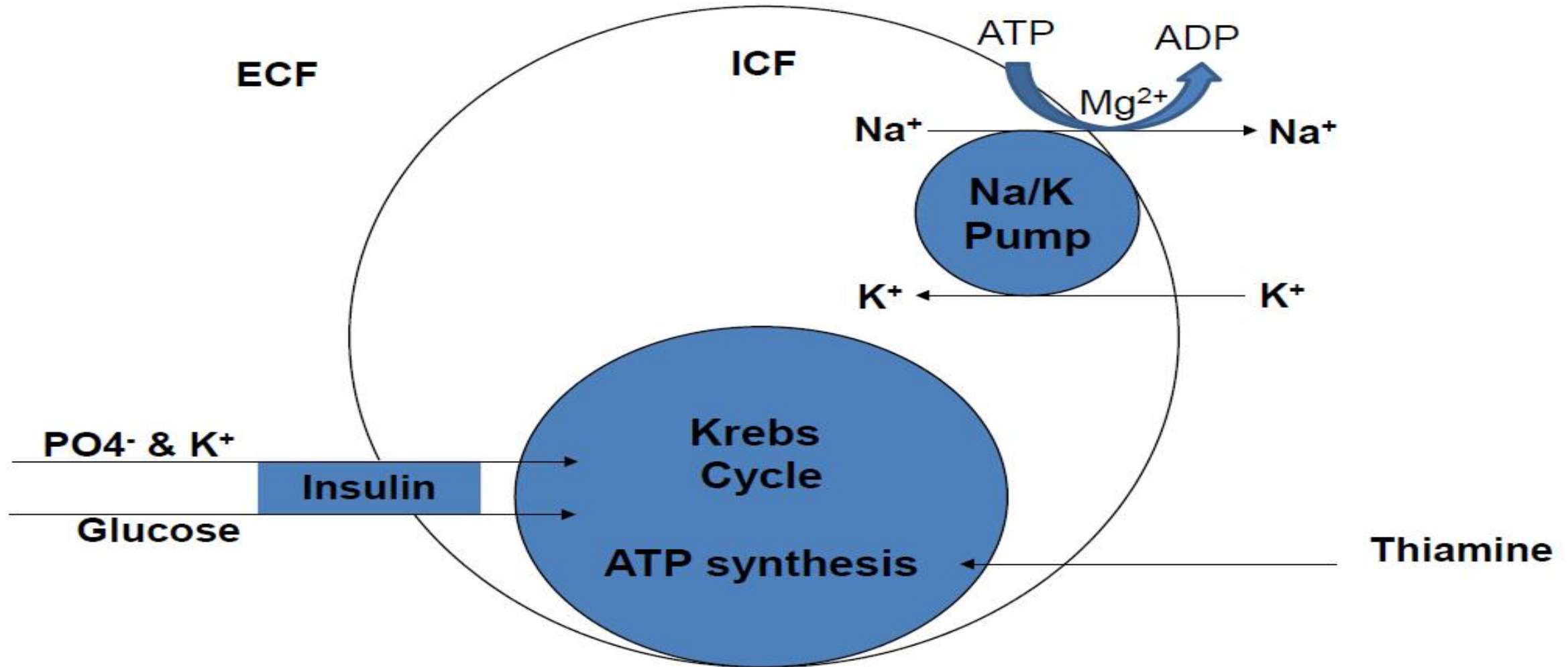
↑ Glucose uptake
↑ Uptake of
 K^+ , Mg^{2+} & PO_4^-
↑ Utilisation of
Thiamine

↑ Insulin
secretion

Refeeding
CHO main source of energy
(anabolism)

**Refeeding
syndrome**

Refeeding Syndrome



	Moderate Risk: 2 Risk Criteria Needed	Significant Risk: 1 Risk Criteria Needed
BMI	16–18.5 kg/m ²	<16 kg/m ²
Weight loss	5% in 1 month	7.5% in 3 months or >10% in 6 months
Caloric intake	None or negligible oral intake for 5–6 days OR <75% of estimated energy requirement for >7 days during an acute illness or injury OR <75% of estimated energy requirement for >1 month	None or negligible oral intake for >7 days OR <50% of estimated energy requirement for >5 days during an acute illness or injury OR <50% of estimated energy requirement for >1 month
Abnormal prefeeding potassium, phosphorus, or magnesium serum concentrations ^a	Minimally low levels or normal current levels and recent low levels necessitating minimal or single-dose supplementation	Moderately/significantly low levels or minimally low or normal levels and recent low levels necessitating significant or multiple-dose supplementation
Loss of subcutaneous fat	Evidence of moderate loss	Evidence of severe loss
Loss of muscle mass	Evidence of mild or moderate loss	Evidence of severe loss
Higher-risk comorbidities (see Table 4)	Moderate disease	Severe disease

Initial risk determination for RFS

Minor risk factors (A)

- BMI <18.5 kg/m²
- Unintentional weight loss >10% in the preceding 3–6 months
- Very little or no nutritional intake for >5 days
- History of alcohol or drug abuse

Major risk factors (B)

- BMI <16 kg/m²
- Unintentional weight loss >15% in the preceding 3–6 months
- Very little or no nutritional intake for >10 days
- Low levels of serum potassium, phosphate or magnesium prior to feed

Very high risk factors (C)

- BMI <14 kg/m²
- Weight loss >20%
- Starvation >15 days

Minor risk = 1 risk factor A

High risk = 2 risk factors A or 1 risk factor B

Very high risk = 1 risk factor C

Clinical consequences

	Cardiac	Respiratory	Neuro- muscular
Phosphate	Altered myocardial function, Arrhythmia, congestive heart failure	Acute ventilatory failure	Lethargy, weakness, seizures, confusion, coma, paralysis, rhabdomyolysis
Potassium	Arrhythmia, cardiac arrest	Respiratory distress	Paralysis, weakness, rhabdomyolysis
Magnesium	Arrhythmia, tachycardia	Respiratory depression	Ataxia, confusion, muscle tremors, weakness, tetany
Thiamine	Congestive heart failure & lactic acidosis		Wernicke-Korsakoff syndrome, muscle weakness

Hypophosphatemia	Hypokalemia	Hypomagnesemia	Thiamin Deficiency	Sodium Retention
Neurological	Neurological	Neurological	Encephalopathy	Fluid overload
Paresthesias	Paralysis	Weakness	Lactic acidosis	Pulmonary edema
Weakness	Weakness	Tremor	Nystagmus	Cardiac
Delirium	Cardiac	Muscle twitching	Neuropathy	decompensation
Disorientation	Arrhythmias	Changed mental	Dementia	
Encephalopathy	Contraction changes	status	Wernicke's syndrome	
Areflexic paralysis	Respiratory failure	Tetany	Korsakoff psychosis	
Seizures	Gastrointestinal	Convulsions	Wet and dry beriberi	
Coma	Nausea	Seizures		
Tetany	Vomiting	Coma		
Cardiac	Constipation	Cardiac		
Hypotension	Other	Arrhythmias		
Shock	Rhabdomyolysis	Gastrointestinal		
Decreased stroke volume	Muscle necrosis	Anorexia		
Decreased mean arterial		Nausea		
Pressure		Vomiting		
Increased wedge pressure		Constipation		
Pulmonary				
Diaphragmatic weakness				
Respiratory failure				
Dyspnea				
Hematologic				
Hemolysis				
Thrombocytopenia				
Leukocyte dysfunction				



Initiating Caloric Intake in refeeding Syndrome



- Initiate caloric intake with 100–150 g of dextrose or 10–20 kcal/kg for the first 24 hours; advance by 33% of goal every 1-2 days.
- In moderate to high risk of RS with low electrolyte levels, holding the initiating or increase of calories until electrolytes are supplemented and/or normalized.
- NB; Caution should be applied when infusing IV dextrose constituted medications in cases moderate to severe risk for RS.
- No recommendations regarding fluid/sodium/protein restriction.

Electrolyte Management in Refeeding Syndrome

- Check serum K^+ , Mg^{2+} , and PO_4 before initiation of nutrition.
- Monitor every 12 hours for the first 3 days in high-risk patients.
- Replete low electrolytes
- If electrolytes become difficult to correct or drop precipitously, decrease calories/grams of dextrose by 50% and advance the dextrose/calories by approximately 33% of goal every 1–2 days based on clinical presentation.
- Cessation of nutritional support may be considered when electrolyte levels are severely or life-threateningly low or dropping precipitously.

	Potassium	Magnesium	Phosphate
Mild deficiency	<p>3.1–3.5 mmol/L Oral replacement with 20 mmol (as KCl or other salts) OR i.v. replacement with 20 mmol KCl over 4 to 8 h. Check levels the next day.</p>	<p>0.5–0.7 mmol/L Oral replacement with 10–15 mmol MgCl₂ or Mg-citrate or Mg-L-aspartate Oral Mg should be given in divided doses to minimize diarrhea (absorption process is saturated at about 5–10 mmol Mg)</p>	<p>0.61–0.8 mmol/L Oral replacement with 0.3 mmol/kg/day PO₄ (divided doses to minimize diarrhea) OR i.v. replacement with 0.3 mmol/kg/day PO₄ (as K₃PO₄ or Na₃PO₄) over 8–12 h. Check levels the next day.</p>
Moderate deficiency	<p>2.5–3.0 mmol/L i.v. replacement with 20–40 mmol KCl over 4–8 h. Check levels after 8 h; if not normal, give an additional 20 mmol KCl.</p>		<p>0.32–0.6 mmol/L i.v. replacement with 0.6 mmol/kg/day PO₄ (as K₃PO₄ or Na₃PO₄) over 8–12 h. Check levels after 8–12 h and repeat infusion if necessary (max. of 50 mmol PO₄ in 24 h).</p>
Severe deficiency	<p><2.5 mmol/L i.v. replacement with 40 mmol KCl over 4–8 h. Check levels after 8 h; if not normal, give an additional 40 mmol KCl.</p>	<p><0.5 mmol/L i.v. replacement with 20–24 mmol MgSO₄ (4–6 g) over 4–8 h. Reassess every 8 to 12 h.</p>	<p><0.32 mmol/L Same replacement therapy as for moderate deficiency.</p>



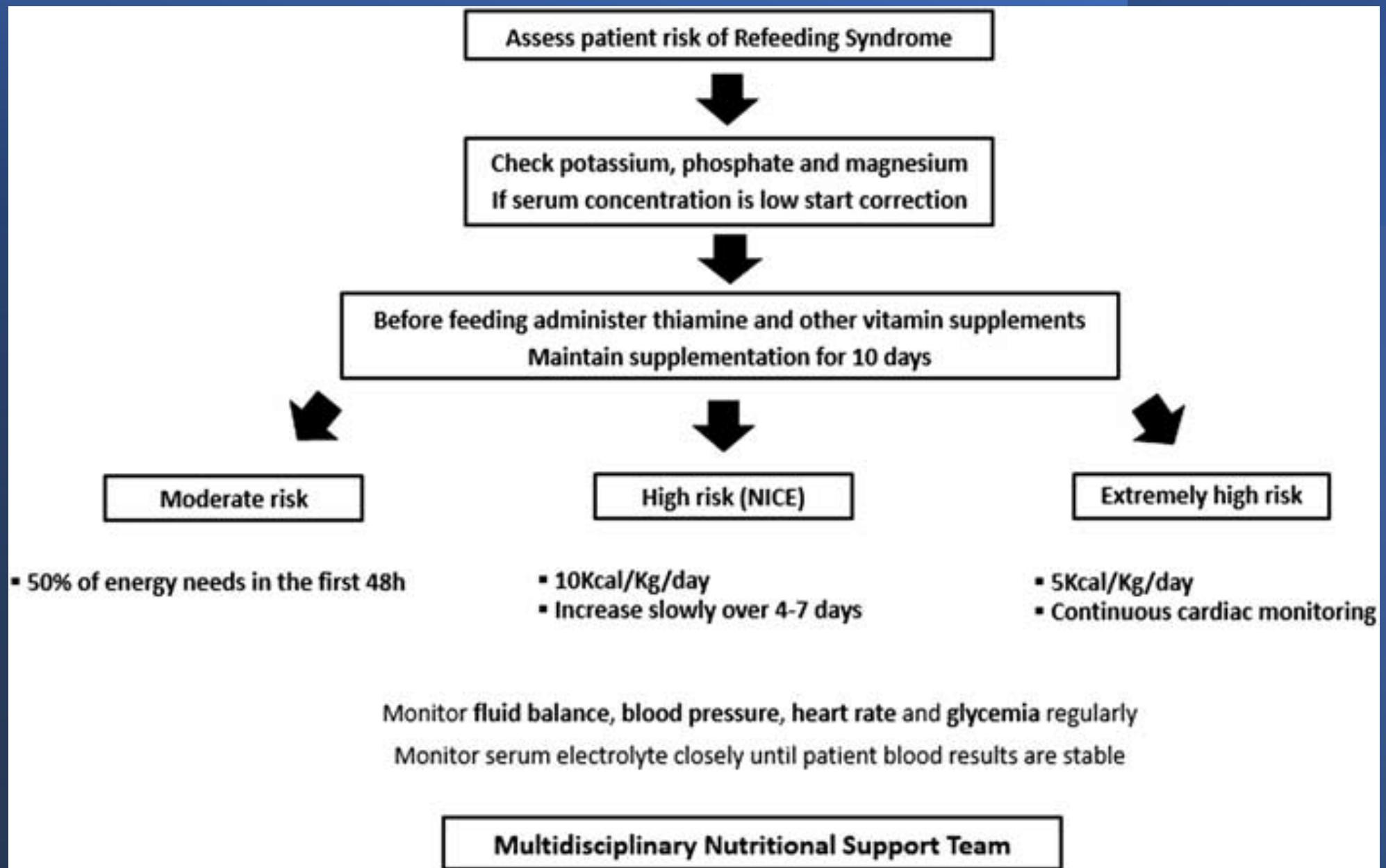
Thiamine + MV Supplementation in Refeeding Syndrome



- Supplement thiamine 100 mg before feeding or before initiating dextrose-containing IV fluids in patients at risk.
- Supplement thiamine 100 mg/d for 5–7 days or longer in patients with severe starvation, chronic alcoholism, or other high risk for deficiency and/or signs of thiamine deficiency.

Management of Wernicke-Korsakoff Syndrome

- Wernicke's preventative treatment (any patient in withdrawal): thiamine 100-250 mg IM/IV x 1 dose.
- Wernicke's acute treatment: thiamine 500 mg IV BID/TID x 72 h, then reassess.
- Korsakoff's: IV treatment as for Wernicke's followed by thiamine 100 mg PO TID x 3-12 months.





Conclusions

- Multidisciplinary team approach
- Identify at-risk patients early
- Anticipate complications and prevent them
- Correct electrolytes early
- Don't forget thiamine!