MMed and DCH Lectures

Failure to thrive

March 1, 2021

Prof Trevor Duke

Failure to thrive

Primary malnutrition

Chronic illness

Genetic / syndromic

- Inadequate energy intake
- Inadequate absorption
- Increased energy utilisation
- Psychosocial factors

Often multiple contributing causes to failure to thrive

FTT has a big impact on development

Inadequate energy intake	Inadequate absorption	Increased energy utilisation	Genetic / syndromic	Psychosocial factors
Breast feeding difficulties	Chronic diarrhoea	Chronic illness, e.g. tuberculosis, HIV	Skeletal dyplasia, e.g. achondroplasia	Adoption
Inadequate complimentary feeding	Environmental enteropathy	Urinary tract infection	Chromosomal abnormality	Neglect
↓Volume of feeds	Helminth infestation	Congenital heart disease		Domestic violence
↓Number of feeds	Coeliac disease	Diabetes mellitus		Orphan
Lack of dietary diversity	Cow milk protein intolerance	Hyperthyroidism		Chronic illness in parents
Prolonged exclusive breast feeding	Chronic inflammatory bowel disease			Maternal depression
Anorexia of chronic disease, e.g. tuberculosis, HIV	Antibiotic associated diarrhoea			Poor carer understanding of nutrition
Structural causes e.g. cleft palate	Immunodeficiency			Poverty
Error in infant formula dilution				Attachment issues

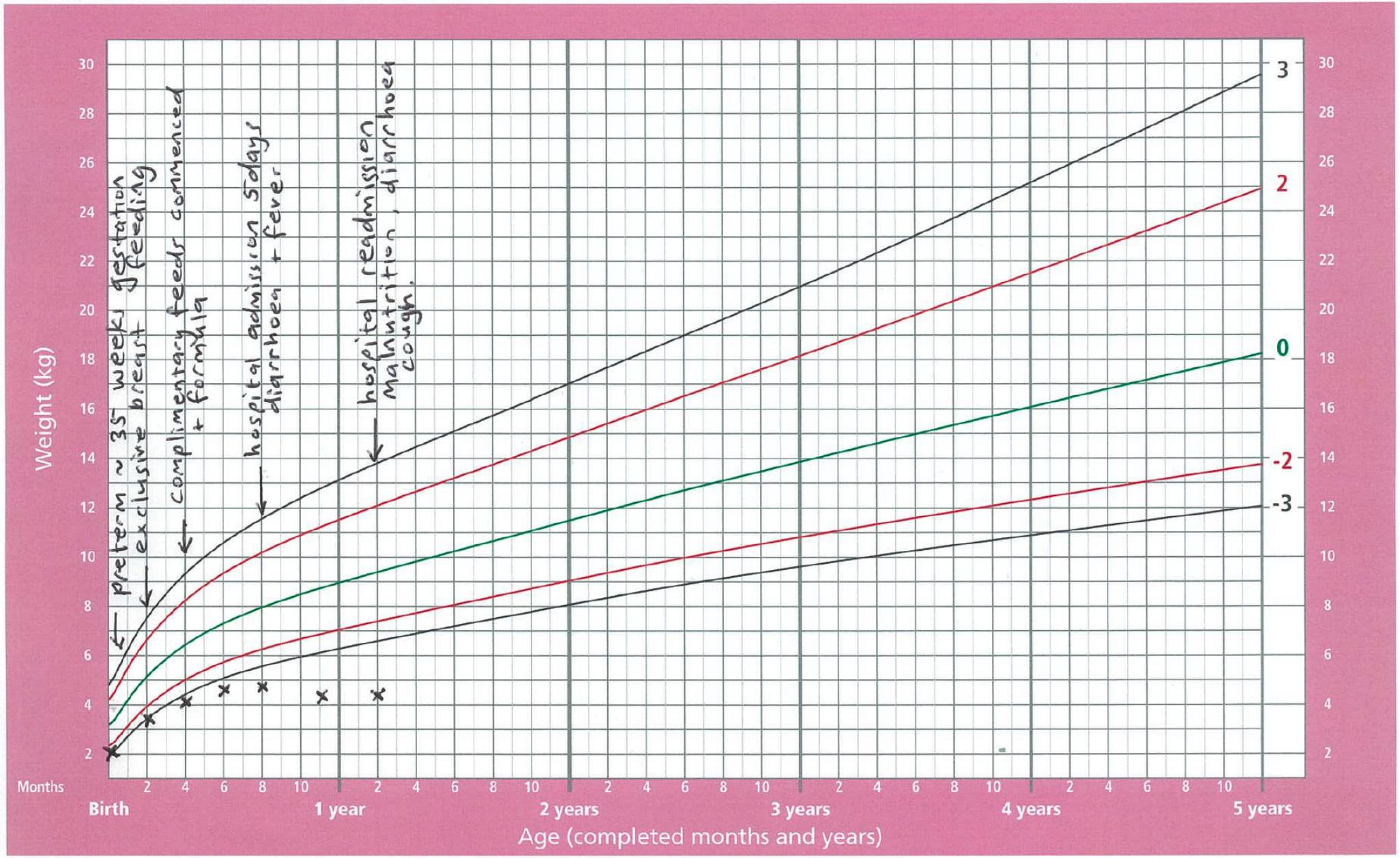
Red flags

- When a child is failing to thrive…
  - weight gain is affected first, but if the problem persists
  - length is also affected
  - head circumference only affected if FTT very severe and prolonged
- Weight for age crossing centiles
- *Losing* weight
- Developmental delay

Weight-for-age GIRLS

Birth to 5 years (z-scores)

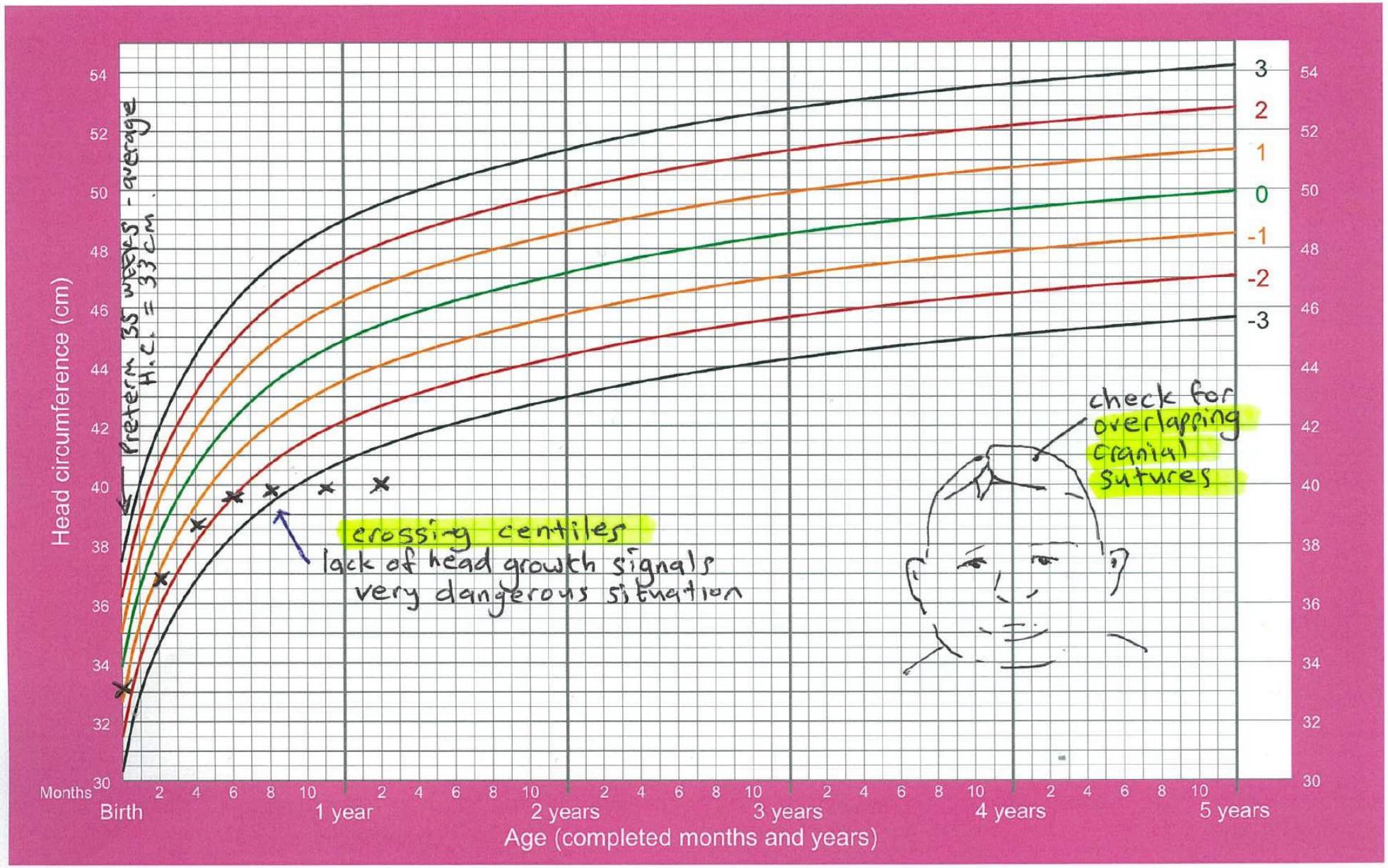
World Health Organization



Head circumference-for-age GIRLS

World Health Organization

Birth to 5 years (z-scores)



A nutritional history

- Longitudinal (time-line)
  - From birth
  - Frequency, duration of breast-feeding
  - Age complimentary feeds were introduced
- Cross sectional
  - “In a typical day / week what does your child eat”
  - A 3-day feed diary
- Systems review (nutritional)
  - Vomiting, diarrhoea, malabsorption
  - Cough, fever, lethargy, irritability

Examination

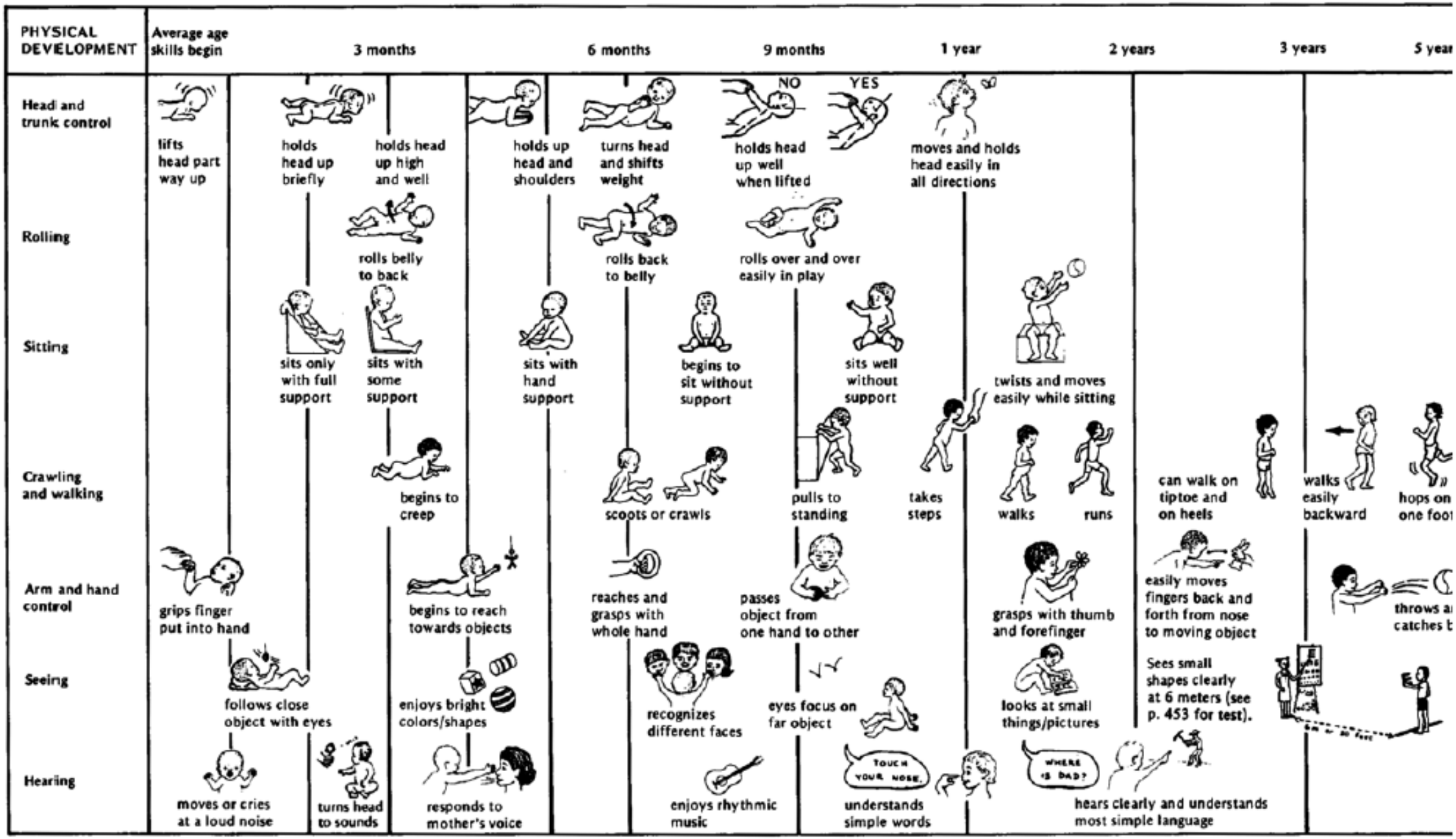
- Signs of malnutrition – wasting (muscle bulk of buttocks, thighs), oedema, prominent ribs, MUAC, sparse hair, bony face
- Dysmorphic features
- Mental state – interaction with mother, eye contact, withdrawn behavior, hypervigilance, anxiety
- Evidence of chronic disease
- Candidiasis – immune deficiency
- Direct observation of feeding – intensity of demanding food, techniques of feeding, coordination of suck and swallowing (video feeding)
- Developmental assessment

Developmental delay a part of FTT

- Gross motor
  - Poor muscle bulk and tone → generalized weakness, immature truncal posture, head lag
- Mental state
  - Apathy, irritability, anxiety, depression
  - Withdraw from social contact
  - Gaze aversion, lack of interest in social overtures

Domains of development

- Gross motor
  - Head and truncal control
  - Rolling
  - Sitting
  - Crawling
  - Walking
- Fine motor
  - Arm and hand control
- Vision
- Hearing
- Socialisation



Gross motor

Fine motor

Hearing & vision

The child's socialization and the parent-infant interaction are closely linked

- Parent – infant interaction
  - Does the parent appear to enjoy caring for the child?
  - Are they engaged or disengaged?
  - Are they coercive (force feeding)?
  - Do they appear frustrated or upset?
  - Do they handle the child gently or roughly?
  - Do they have eye contact, and play?

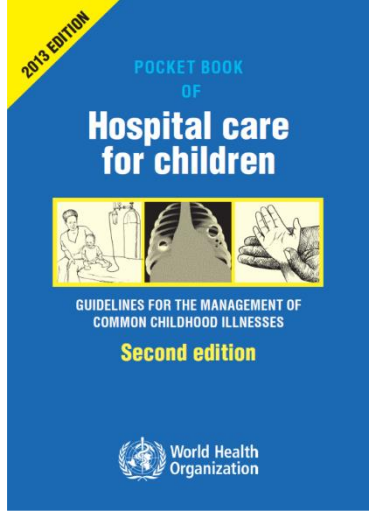
- "In-depth psychosocial evaluation is important in all cases of failure to thrive."

Am J Dis Child 1981;135:848-851

Investigations

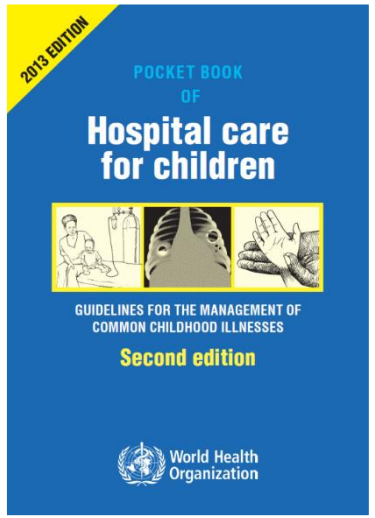
- If no specific signs or symptoms of organic disease, then investigations have a low yield
- Most FTT is non-organic
- Rule out TB / HIV by clinical signs and symptoms
- Investigations for severity or complications of severe malnutrition

Management of all sick children



- Triage
- Emergency treatment
- History and examination
- Laboratory investigations, if required
- Main diagnosis and other diagnoses
- Treatment
- Supportive care
- Monitoring
- Plan discharge
- Follow-up

The management of severe malnutrition

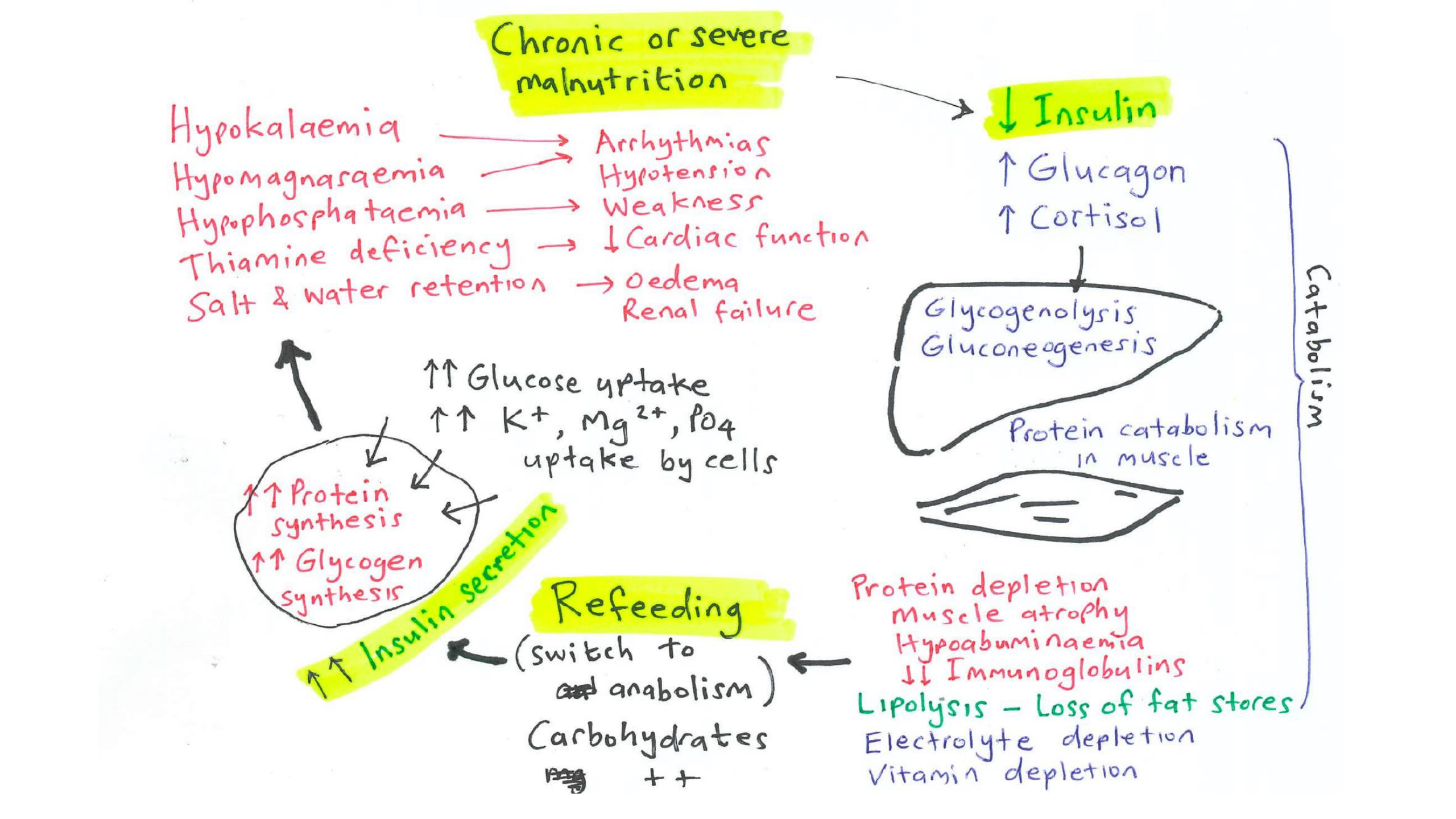


	Stabilization		Rehabilitation
	Days 1–2	Days 3–7	Weeks 2–6
1. Hypoglycaemia	→		
2. Hypothermia	→		
3. Dehydration	→		
4. Electrolytes	→	→	→
5. Infection	→	→	
6. Micronutrients	no iron →	→	with iron →
7. Initiate feeding	→	→	
8. Catch-up growth		→	→
9. Sensory stimulation	→	→	→
10. Prepare for follow-up		→	→

Refeeding syndrome

First described among people released from concentration camps after WWII

- Oral feeding of grossly malnourished people → diarrhoea, heart failure, coma, convulsions


Chronic or severe malnutrition
↓ Insulin
↑ Glucagon
↑ Cortisol
Glycogenolysis
Gluconeogenesis
Protein catabolism in muscle
Catabolism
Hypokalaemia → Arrhythmias
Hypomagnasaemia → Hypotension
Hypophosphataemia → Weakness
Thiamine deficiency → ↓ Cardiac function
Salt & water retention → Oedema
Renal failure
↑↑ Glucose uptake
↑↑ K+, Mg2+, PO4 uptake by cells
↑↑ Protein synthesis
↑↑ Glycogen synthesis
↑↑ Insulin secretion
Refeeding
(switch to anabolism)
Carbohydrates
++
Protein depletion
Muscle atrophy
Hypoabuminaemia
↓↓ Immunoglobulins
Lipolysis – Loss of fat stores
Electrolyte depletion
Vitamin depletion

Refeeding syndrome

Catabolism (starvation)

- ↓ Insulin
- ↑ Glucagon, Cortisol (stress hormones)
- Energy comes from breakdown of body protein, fats, mobilization of liver glycogen → glucose → ATP (energy)
- Wasting (muscle mass), oedema (hypo-proteinaemia), loss of fat stores, hypoglycaemia

With refeeding

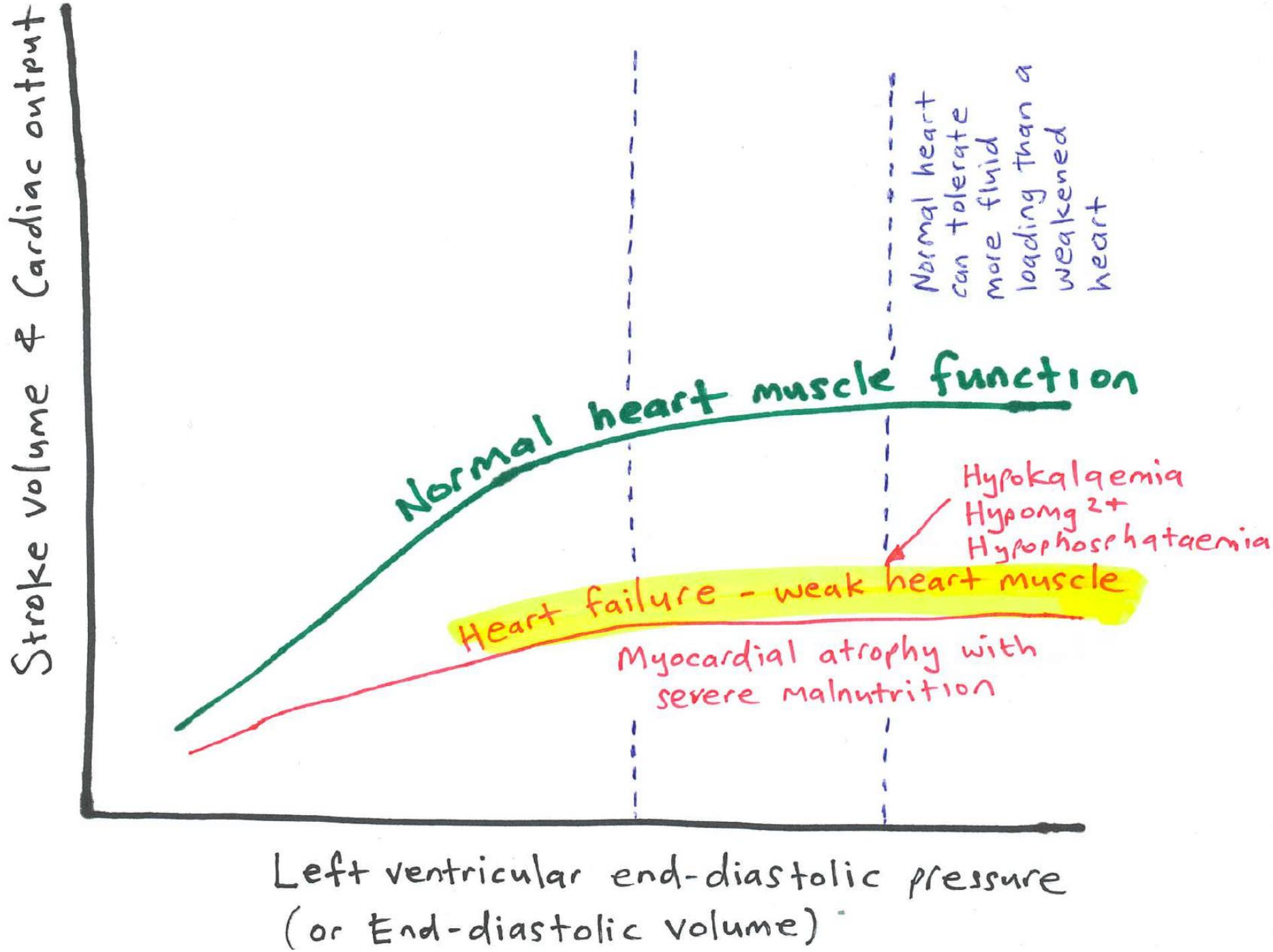
- ↑ Insulin → anabolism → protein synthesis, glycogen storage
- Insulin drives glucose into cells, and K+, Mg++, phosphate, thiamine to make protein

→ ↓↓ thiamine, K+, PO4, Mg

Refeeding

- Under conditions of anabolism (↑ insulin)
  - Glucose, K^{+}, Mg^{++}, PO_4^{--} moves into cells
  - Protein synthesis occurs (ATP and 2-3 DPG produced ↑↑, uses phosphate)
  - Thiamine moves into cells as a co-factor for carbohydrate metabolism

- Prevention
  - Follow WHO guidelines for management of severe malnutrition
  - F75 (75 kcal / 100ml) – low carbohydrate to begin with
  - Supplemental K^{+}, Mg^{++}, PO_4^{-}
  - Avoid fluid overload

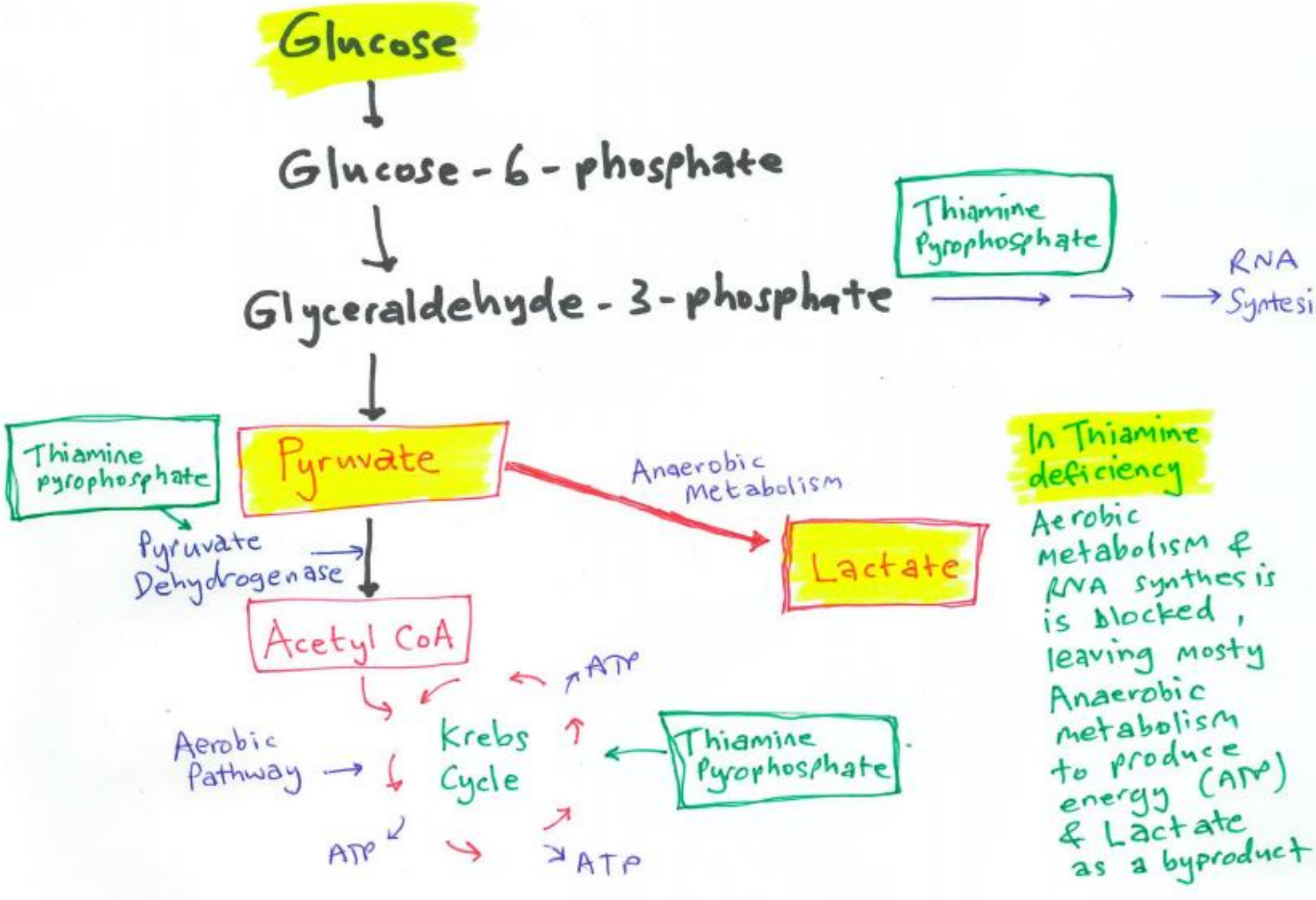

Stroke volume & Cardiac output
Normal heart can tolerate more fluid loading than a weakened heart
Normal heart muscle function
Hypokalaemia
Hypomg2+
Hypophosphataemia
Heart failure - weak heart muscle
Myocardial atrophy with severe malnutrition
Left ventricular end-diastolic pressure
(or End-diastolic volume)

Thiamine (B1) deficiency

- Necessary for protein synthesis
- Cofactor in the Krebs (TCA) cycle for ATP (energy) generation of aerobic metabolism
- In thiamine deficiency, pyruvate cannot enter the Krebs cycle, so converted to lactic acid → lactic acidosis
- *If you only give glucose* without thiamine, more pyruvate is converted to lactic acid → **worsening lactic acidosis**
- Pulmonary hypertension in infancy (link with pneumonia, malnutrition, hypoxaemia, heart failure)

Thiamine deficiency

- Breast fed babies of mothers who are thiamine deficient
- Malnourished children
- Polished (washed) rice
- Betel nut – anti-thiamine activity
- Tea, coffee


Glucose
Glucose - 6 - phosphate
Glyceraldehyde - 3 - phosphate
Thiamine Pyrophosphate
RNA Syntesi
Thiamine pyrophosphate
Pyruvate
Anaerobic Metabolism
Lactate
Pyruvate Dehydrogenase
Acetyl CoA
ATP
Aerobic Pathway
Krebs Cycle
Thiamine Pyrophosphate
ATP
ATP
In Thiamine deficiency
Aerobic metabolism & RNA synthesis is blocked, leaving mosty Anaerobic metabolism to produce energy (ATP) & Lactate as a byproduct

Management of *failure to thrive*

- Holistic
- Refeeding syndrome
- Establish desired feeding pattern in hospital that can be reproduced at home
- Written feeding plan
- Psychosocial support for mother and family
- Development support
- Follow-up – growth, development, vaccines, behavioral problems

Inadequate energy intake	Inadequate absorption	Increased energy utilisation	Genetic / syndromic	Psychosocial factors
Breast feeding difficulties	Chronic diarrhoea	Chronic illness, e.g. tuberculosis, HIV	Skeletal dyplasia, e.g. achondroplasia	Adoption
Inadequate complimentary feeding	Environmental enteropathy	Urinary tract infection	Chromosomal abnormality	Neglect
↓Volume of feeds	Helminth infestation	Congenital heart disease		Domestic violence
↓Number of feeds	Coeliac disease	Diabetes mellitus		Orphan
Lack of dietary diversity	Cow milk protein intolerance	Hyperthyroidism		Chronic illness in parents
Prolonged exclusive breast feeding	Chronic inflammatory bowel disease			Maternal depression
Anorexia of chronic disease, e.g. tuberculosis, HIV	Antibiotic associated diarrhoea			Poor carer understanding of nutrition
Structural causes e.g. cleft palate	Immunodeficiency			Poverty
Error in infant formula dilution				Attachment issues