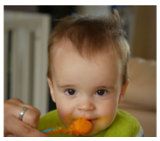
DEVELOPMENT

Nutrition / Feeding

WHO recommends exclusive **Breastfeeding** in first 6/12 of life

- Inadequate BF (due to poor supply, difficulty latching, pain/discomfort) can lead to malnutrition
- Overfeeding occurs more often with bottle-fed babies

<6 months
Exclusively Breast Feed



6-8 months
Purees
Iron + zinc

8-10 months
Finger food

12 months
Family meal

Benefits of Breastfeeding?

1) Antibody (IgA) to protect newborn against infection
2) Reduced risk of sudden infant death syndrome
3) Reduce Breast and ovarian cancer risk

When and How much should babies be fed?

- 150mL/kg/day which is initially split between feeds every 2-3 hrs → then to 4 hrs → feeding on demand
  - **Pre-term or underweight babies** require more
- In first week of life:
  - 60mL/kg/day on day 1
  - 90mL/kg/day on day 2
  - 120mL/kg/day on day 3
  - 150mL/kg/day after day 4
- **WEANING** -transition from milk to normal food
  - **Begins around 6/12 old**
  - **Purees (e.g. pureed fruits, baby rice) → normal diet** (*supplemented with milks and snacks by 1 yo*)

<12 months
No Honey
(infant botulism)

<1 years
No cows milk
(iron deficiency)
< 2 years
No lite milk
(energy requirements)

<3 years
Airway sized objects
(choking hazard)

Never
No caffeinated /
Carbonated drinks
(just don't)

What weight is normal?

- **Breast-fed babbies normally lose ≤ 10% of weight by day 5→ regained by day 10**
  - *Formula fed babies normally lose ≤ 5% of weight by day 5*
- XS Weight loss mainly due to dehydration, underfeeding
- Wt gained (**weight doubles in first 2 years**)
  - 30g /day (until 3 months)
  - 20g /day (until 6 months)
  - 10g/day (until 12 months)
  - 2kg/year (from 2 years to puberty) – **rebound adiposity** (↑BMI) from aged 5-7yo

Fe deficiency in cow's milk. Why?

- High casein and Calcium in cow's milk interacts with digestive enzymes and cause poor absorption

Neurological development

- Rapid myelination in first 2 years
- Increased brane pruning until adolescence – rewiring and plasticity → brain stop growing at 25 yo

Growth Charts

What Factors that affect growth?

1. **Genetics** (e.g. tall parents = tall children)
2. **Environment /SES**
3. **Nutrition** (breastfed vs non-breastfed)
4. **Biological** causes (e.g. LGA due to GDM or maternal obesity) → high risk of Met Syn
5. **General health** (e.g. infections, feeding issue, chronic diseases.e.g CKD, CLD long-term meds, developmental delays)

How often monitor growth?

- Infant (0-1) = > 5 wt recordings
- Child (1-2) = > 3 wt recordings
- Child (≥2) = annual
- < 2nd percentile → GP review
- < 0.4th percentile → paeds review

Why no single measurements?

Need serial measurements over time to evaluate growth pattern

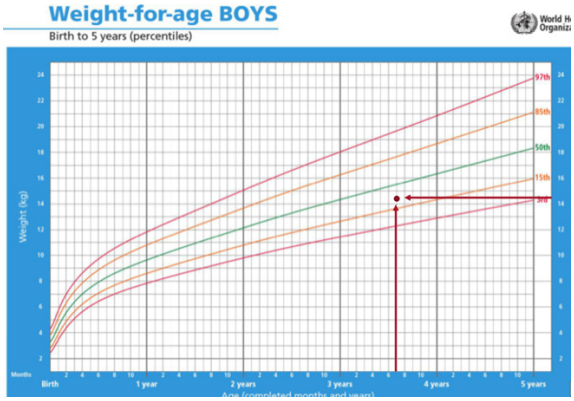
- single measurements ONLY give information about overall size
- Review in 2-4 weeks

What to do if overweight > 85th ?

- Healthy lifestyle discussion – promote family support, dietary control and involve dietician
- Refer to GP, paeds and dietician
- Beware of **bullying, IGT, T2DM, CVD and arthritis**

What to do if wt/ht/BMI falls below 3rd ?

- NOT uncommon for healthy babies to have initial dip in wt percentiles in early months of life
- Check feeding habits
- Beware WHO charts based on healthy mothers exclusively BF > 4/12



Children go through 3 ***phases of growth***:

- **First 2 years →** rapid growth driven by **nutritional factors + insulin**
- **From 2 years to puberty → thyroxine and growth hormone**
- **During puberty → rapid growth spurt by sex hormones + growth hormones**

RED FLAGS

1) Horizontal / vertical trend line
2) DO not wean BM (as higher concentration of calories) than food

Age: 3yrs
Birthday: 1st April
Today: 1st November
Weight: 14.5 Kg

Record as:

- A dot on the chart
- In the notes write:
  '14.5 kg (15-50th centile)'
- Label the chart.

CORRECTING FOR PREMATURITY:

- **Check child's birthday and today's date**
  E.g. *plot 3 years and 7 mths*
- **Correct for prematurity (until 2nd B'day)**
- Corrected age = actual - # of weeks premature

*Nb: Infant born at 32 wks and now 4 mths old, would actually be corrected for 2 mths

PATIENT DISCUSSION ABOUT PREMATURITY

- INCORRECT to compare pre-term baby to term child at 50th percentile
- Maintaining growth in **same proportion across length, weight and BMI is normal even if lowest percentile**
- Feeding practises
- Parental height
- Social history

WHO charts

		Girls	Boys	Centiles
0 - 24 months	WHO (2006)	Head circumference	Head circumference	3rd - 97th
		Weight for age	Weight for age	3rd - 97th
		Length for age	Length for age	3rd - 97th
2 - 18 years	CDC (2000)	Weight for age	Weight for age	3rd - 97th
		Height (stature) for age	Height (stature) for age	3rd - 97th
		BMI for age	BMI for age	3rd - 97th

Table 2: Recommended growth charts for use in Australia

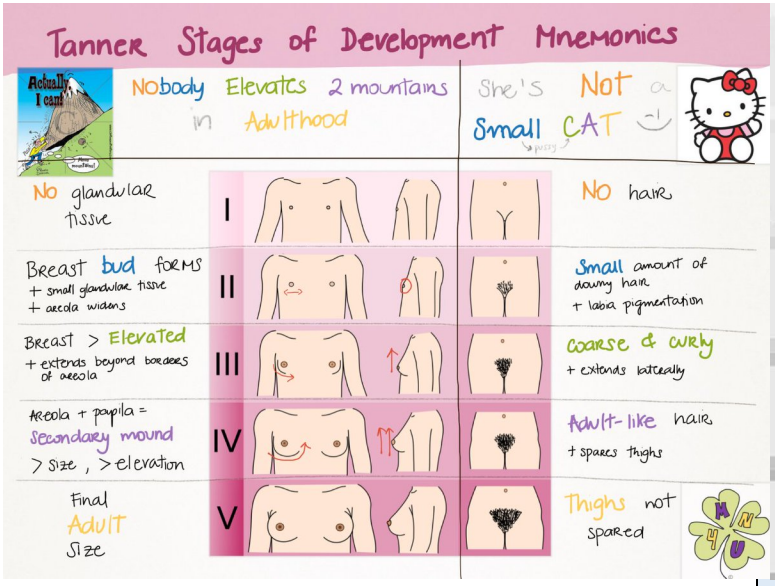
Main issue:

- focuses on ideal growth = unfair to developed nations
  - incorrect indication of their growth
- **weight for age**
  - 80% of infant lose some weight after birth due to increased metabolism
  - % birthweight lost more useful measure (> 10% below birthweight at 2 weeks → unrecognized illness)

Advantages of using WHO charts:

- WHO growth charts recommended to monitor growth of all infants regardless of:
  - Feeding type
  - SES
  - Ethnicity
- WHO charts reflect growth of **ideal** children who were exclusively or predominantly breastfed for at least 4 months and still breastfeeding at 12 months.
  - Exc. smoking mothers
  - breastfeeding as the biological norm
- **CDC charts** based on cross-sectional survey of formula-fed infants focusing on the size of a group of infants **NOT** actual growth reflected by WHO longitudinal charts

Tanner staging



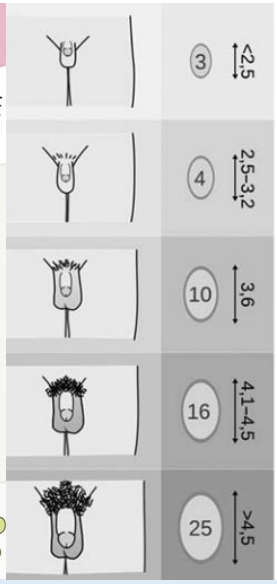
<10yo

10-11yo

11-13yo

13-14yo

>14yo



Stage I: prepubertal; testicular than 4 cc in volume and 2.5 cm dimension

Stage II: enlargement of scrotu testes; scrotal skin reddens and in texture; growth of testes to greater in volume

Stage III: enlargement of penis first); further growth of testes

Stage IV: increased size of peni growth in breadth and developn glans; testes and scrotum large skin darker

Stage V: adult genitalia

General age 8-14 yo

1) BOOBS – palpable breast budding
2) PUBES – pubic hair
3) GROW - accel. Growth
   a. Peak height velocity = 8-10 yo (later for boys)
   b. Peak weight velocity = 12-14yo (later for boys)
4) FLOW -menarche (usu. 2 years after puberty starts)

*BODY FAT increases **linearly with age**

General age 9-15 yo

1) Testicular enlargement (> 4mL)
2) penis lengthening and widening
3) Darkening of scrotum and Increased scrotal vol
4) Pubic hair
5) Growth (accel) + voice deepens

*BODY FAT increases until 12yo then decreases

DELAYED PUBERTY

	Hypergonadotrophic hypogonadism	Hypogonadotrophic hypogonadism
Type	Peripheral - dysfn gonads	Central - dysfn pituitary gland
LH/FSH	**High**	**Low**
TT/E2	**Low**	**Low**
Cause	• **Gonad damage** (e.g. torsion, cancer, infection – mumps) • Congenital absence of gonads • Klinefelter (47XXY) • Turner's (45XO)	• **Damage to HT and pi**t (trauma, RT, surgery) • Kallman (anosmia) • **Endocrine** = GH def, hypothyroidism, HyperPrL • **Chronic disease** (e.g. CF, IBD) • XS exercise/dieting • Constitutional delay in growth and development (CDGD) – temporary delay in puberty but reaches adult potential
Rx	• **Reassurance if CDGD** • **Replacement sex hormones (E2 -girls, TT for boys)**	

General Ix

Bloods

- FBC + ferritin (anaemia)
- EUC (CKD)
- Anti-TTG/EMA (coeliac)

Hormone panel

- Early AM FSH/LH
- TFT
- GH test + IGF-1 Assay
- Serum prolactin

Genetic testing

- Klinefelter
- Turner's

Imaging

- XR wrist/hand – bone age (for CDGD)
- Pelvic USS - ovary absence
- MRI brain – pituitary tumour, olfactory bulbs - Kallman

Failure to Thrive / Short Stature

	Lower limit (< 3rd percentile)	Upper limit (> 97th percentile)
Weight (nutritional issue)	**Failure to thrive (FTT)** **Factor:** Weight stunted *before* height **Cause:** **1) Inadequate intake (malnutrition – most common)** ➢ Maternal malabsorption (if BF) ➢ **Fe def. anaemia** ➢ Family or parental problems ➢ Neglect or poverty (***marasmus, kwashiorkor)*** **2) Difficulty feeding** ➢ Poor suck (? CP) ➢ Cleft lip or palate ➢ Genetics (facial dysmorphia) ➢ Pyloric stenosis **3) Malabsorption** ➢ Cystic fibrosis ➢ Coeliac ➢ IBD ➢ Chronic diarrhoea ➢ Cows' milk intolerance **4) Increased energy req.** ➢ **Hyperthyroidism** ➢ Chronic disease (CHD, CF) ➢ Malignancy ➢ Chronic infection (HIV, CVID) **5) Cannot process nutrition** ➢ Inborn error of metabolism ➢ T1DM ➢ Steroids usage (stunted growth)	**Obese children = tall for age and come from overweight families.** ● **↔ intake** = ↑ oral uptake ● **Endo** (hypothyroid, acromegaly, Cushing's, PCOS, T2DM) (**short and fat children**) ● **Meds** (e.g. steroids, antipsychotics) ● **Immobility (**SUFE → painless hip limp) **General Signs of malnutrition** ➢ Reduced SC fat (esp. buttocks) ➢ Reduced muscle mass / proximal myopathy ➢ Lanugo ➢ FTT – stunted growth ➢ Poor wound healing ➢ Sparse hair +/- Keratosis ➢ Malaise + fatigue
Height (endocrine issue)	**Failure to grow (FTG)** **Factor:** **Short stature = Height stunted** *before* weight • ***Boys***: (mother height + fathers height + 14cm) / 2 • ***Girls***: (mothers height + father height – 14cm) / 2 **Cause:** • Familial short stature • **Constitutional delay in growth & development** → delayed bone age • ***Malnutrition →*** *marasmus, kwashiorkor* • ***Genetics*** (e.g. Turner's Noonan's, Down's -T21) • ***Endocrine*** (hypothyroid, GH deficiency, adrenal adenoma, Cushing, pituitary disease) • ***Chronic diseases*** → coeliac, IBD, CHD, CKD, • ***SKM*** **dysplasias →** (achondroplasia, juvenile idiopathic arthritis) • Steroids usage (stunted growth)	***Genetic*** ● FHx of overweight/obesity ● ***Klinefelter*** (tall, thin, small testes, gynacomastia) ● ***Marfan's*** *(high arched palate, arm span > height + valvular dysfunction MVP, arrythmia* ● ***Homocystinuria*** *(marfanoid appearance, learning difficulties, lens dislocation, OP, VTE)* ***Endo*** ● ***Gigantism*** (XS GH) ● ***Thyrotoxicosis (****MND, Grave's)*
Head circumference (largest – repeat x3)	**Microcephaly** ● ***Malnutrition*** ● ***Infection***: TORCH, meningitis, encephalitis, HIE ● ***Teratogens***: alcohol, RT, hydrantoin ● ***Genetic***: Rett's syndrome (↓speech + motor skills), aneuploidies (T13, 18, 21)	**Macrocephaly** ● ***↑SoL*** = mass (medulloblastoma), abscess, ICH ● ***Hydrocephalus*** (main) ● ***SKM abnormality*** – Rickets (vit d def), achondroplasia, Paget's ● ***Metabolic*** **– Tay Sach's** (lysosome storage – cherry red spot macula), **Hunter's** (mucopolysaccharide – shot, coarse facial features)

Investigations and management of FTT and short stature:

Standard Ix for POOR wt gain:	**Standard Ix for Short stature:**
➢ *FBC – anaemia* ➢ *Fe, B12, folate, Vit D studies* ➢ *UA – UTI* ➢ Coeliac screen (anti-ttg, anti-EMA antibodies) ➢ Sweat test (Cystic fibrosis) ➢ Daily wt, height and head circumference ➢ Review dietary habits	➢ FBC = anaemia → crohn, coeliac ➢ EUC, LFT ➢ TSH, T3/4 → acq. Hypothyroid ➢ Coeliac screen (anti-ttg, anti-EMA antibodies) ➢ Karyotype ➢ IGF-1 assay ➢ **X-ray L hand/wrist** for bone age: o Mild = CDGP o Sig. delay = GH def, hypothyroid
General Mx to improve wt	***General Mx to solve short stature***
MDT approach ➢ Regular reviews ➢ *Breastfeeding issue* o "lactation consultant" o supplement BM with formula milk as top-ups o continue expressing when not breastfeeding to encourage lactation ➢ *Inadequate nutrition issue* o Regular structured mealtimes and snacks o Dietician review o Offer energy dense foods or nutritional supplemental drinks ➢ Last resort → NGT feeding	**Identify cause** ➢ Rx cause accordingly **For CDGP** ➢ Reassure parents that CDGP is **normal variant** of development o Monitor growth over time ➢ Leads to short stature during childhood but normal height by adulthood ➢ Puberty is delayed and growth spurt during puberty lasts longer

Developmental Milestones

RED FLAGS TO SUGGEST DEVELOPMENTAL DELAY

Lost of any developmental milestone is a red flag!!

5 months
- Unable to hold object

12 months
- Cannot sit up unsupported

18 months
- Not standing independently
- No words
- No interest in others

2 years
- Not walking independently

2.5 years
> not running

Investigating Developmental Delay

	Developmental Screening Tests	***Standardised Developmental Tests***	***Early intervention***
Purpose	**Sensitivity** – Is there likely a problem? • Completed 1st	**Specific** – Exactly what centile are they on? • Time-consuming	Help children 'Catch Up' and improve Developmental Outcomes especially during the **sensitive period [before it's too late]**
Test	**Ages & Stages Questionnaires (ASQ3) = 30Q over 5 domains** • (1) communication, (2) gross motor,(3) fine motor, (4) problem solving and (5) personal-social • Need to match questionnaire to child's age corrected for any prematurity if , 2yo • Different languages • 1mth -5 ½ years	***Griffiths Assessment (overall dev)*** • **Language + comm** (expressive, receptive) • **Eye/hand coordination** (fine motor skills, dexterity and visual perception skills) • **Personal, social, emotional - independence** • **Gross motor** =postural control, balance and gross body coordination ***Bailey's Developmental Assessment →for infants and toddlers*** • **cognitive, language, motor, adaptive behaviour and social-emotional**.	**Movement issues** – Physio + OT **Language / Social issues** – Speech therapy + OT **Intellectual** – Early education
Involved	GP, Child and Family Nurse May be performed by parents	• Developmental Paediatrician • Psychologist	***Referral by:*** Parent, EC Nurse, Teacher, Allied Health, Doctor

Developmental Delay

- Check current developmental stage
- Ages of key milestones

Global Developmental Delay

- Can cause any specific delay

Prenatal (teratogens vs genetic)

Genetic
- Down's
- Edward
- Patau
- Fragile X

EtOH/drugs
- Fetal alcohol
- NAS - opiates

TORCH infections
- Toxoplasmosis
- Rubella
- CMV
- HSV – cold sores

Perinatal (hypoxia)

Xtreme Premmie
- << 37 wks

Hypoxia
- HIE – irreversible brain damage

Neonatal hypoglycaemia
- GDM mothers
- LGA
- SGA – low stores
- Chronic disease or infection (↑usage)
- Vomit/diarrhoea

ICH
- Risks = premmie + abnormal labour
- Dx within first few days

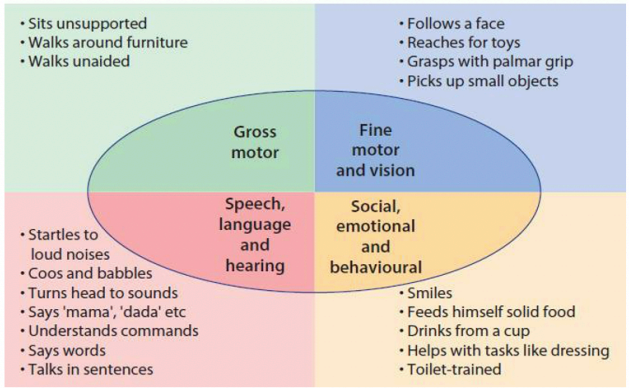
Postnatal (injury)

Infection
- Meningitis
- encephalitis

Trauma - head
- HIE – irreversible brain damage
- Hypoxia

Metabolic disorders
- Lipids
- CHO
- Urea cycle

Some key developmental milestones in infants and young children



Motor Delay

- **How mobile?**
- **Hand dominance?**
- **Balance problems**
- **Behavioural problems**

Rett Syndrome (usu 6/12 -2 yo)
- Developmental **regression (previously well)**
- Progressive loss in speech + motor
- Coordination loss – recurrent falls

Cerebral palsy (gross + fine)
- Muscle weak, stiff, atonic
- Poor feeding, abnormal posture
- *80% spastic, dyskinetic (involuntary), ataxic* (hypotonic)
- 10% due to HIE or any pre-, peri- and post natal brain insult

DDH (gross)
- Identified at birth
- May present later with limp
- RF: 1st born, male, breech, FHx, LGA (macrosomia), oligohydramnios

Spina bifida (gross + fine)
- Weakness and paralysis of lower limbs
- Require casts or walkers

Ataxia (gross +fine)
- Secondary to XS drug ingestion, post-infectious cerebellitis
- Uncoordinated walking and balance

Muscular dystrophy (Fine)
- Progressive muscle weakness (begins proximally) – clumsy, waddling gait
- Onset 2-3 years → wheelchair by 9-12 yo
- FHx + gower's sign

Dyspraxia (Fine)
- Cannot do skilled voluntary movement
- RF: pre-term, substance abuse during pregnancy, FHx of dyspraxia

Language/social Delay

- **Senses** = hearing, vision
- **Vocalisation & articulation**
- **Comprehension** - follows commands, responds to voice
- **Non-comprehension** = pointing, gesture, facies (smiles, laughs)
- **Social response** = reaction to new situations, tantrums, playing, gestures

Hearing/Sight

Sensorineural deafness
- Irreversible e.g. CF, cong. CMV
- 80% genetic
- **Rx: Amplify w/ hearing aids/cochlea**

Conduction deafness
- Mild/mod/transient
- Flat tympanogram
- Middle ear disease (chronic otitis media)
- Congenital rubella
- **Rx: Grommets, bone conduction aid**

Articulation issue (dysarthria)
- Birth defect (cleft palette)
- Vocal cord palsy vs laryngomalacia

Vision impairment (gross + fine motor)
- **Genetic** – cataract, albinism, retinal dystrophy, retinoblastoma (Rb1)
- **Perinatal** – congenital TORCH, ROP, HIE, Cerebral damage
- **Post-natal** – trauma, infection (meningitis, encephalitis), juvenile idiopathic arthritis, lazy eye (amblyopia)

Social/behavioural delay

Autism
- Fixation on one-topic or routines (repetitive behaviour)
- Anti-social → (prefers own company, no friends)
- Limited gestures / expressions
  - Poor eye contact,
  - Assoc. seizures, mental health, poor feed

ASPERGERS = MILD AUTISM = NO delay in language

ADHD
- **"bad behaviour" – Dx at school**
- XS activity - Hyperactive, inattention,
- Disorganised, Impulsive (prone to tantrums)
- M > F
- **Rx: parental education, specialised behavioural program at school.**
- **Rx: Ritalin, dexamphetamine**

Child neglect
- Detached bond

Conduct disorder
- Bullies, threatens, intimidates
- Aggressive
- Cruel to people/animals

Oppositional defiant disorder
- Loses temper
- Argues with adult + defies request
- Deliberately annoys others

Obsessive compulsive disorder
- Obsessions (intrusive thoughts)
- Compulsions (Repetitive behaviours)
- XS washing/cleaning/checking

Specific **Learning disability**

- **1st sign noticed by teacher, parent or guardians (e***.g. absenteeism, visual/audio impairment or existing ADHD, autism*
- **Dx of exclusion** ➔ Intrinsic impairment of below expected cognitive ability in specific area using YARC or SWRT scores (comprehension + reading test*)*

	Preschool	Primary	High school	Solutions
Dyslexia (*most common*)	Delayed speech and language	Slow laboured reading	Poor reading fluency	➢ Buddy reading ➢ slower pace /reading rate ➢ simplify questions
Dysgraphia	Avoids writing tasks	Slow effortful writing	Brief writing	➢ Use assistive tech e.g. spellcheck ➢ oral assignment to substitute written assignments
Dyscalculia	Cannot count	Negative attitude to maths	Trouble w/ mental maths	➢ Allow calculator usage + simpler math problems ➢ Provide list of steps to calculate
Dyspraxia (aka DCD – developmental co-ordination disorder)				Delayed gross and fine motor skills (mostly in males)
Auditory processing disorder				Difficulty processing auditory information
Non-verbal learning disability				Difficulty processing non-verbal information
Profound and multiple learning disability				Difficulties across multiple areas

Developmental Delay: H+E + Investigations

History (risk factors)

Maternal Hx

- **spontaneous miscarriage** – chr translocation / rearrangement) ,
- **Previous stillbirths, SIDs** ⟶ inborn error of metabolism
- **Teratogen exposure** e.g. anti-epileptics, antidepressants, warfarin, roaccutane, alcohol, nicotine and illicit drugs

Ante-natal

- FAS,
- Maternal chickenpox, TORCH

Peri-natal (NICU/SCU?)

- pre-term, HIE, IVH,

FHx,

- parental consanguinity,
- Hx of neurological disorders,
- Hx of learning or developmental problems

Child` RF:

- Early childhood meningitis
- Autism
- Epilepsy

Examination

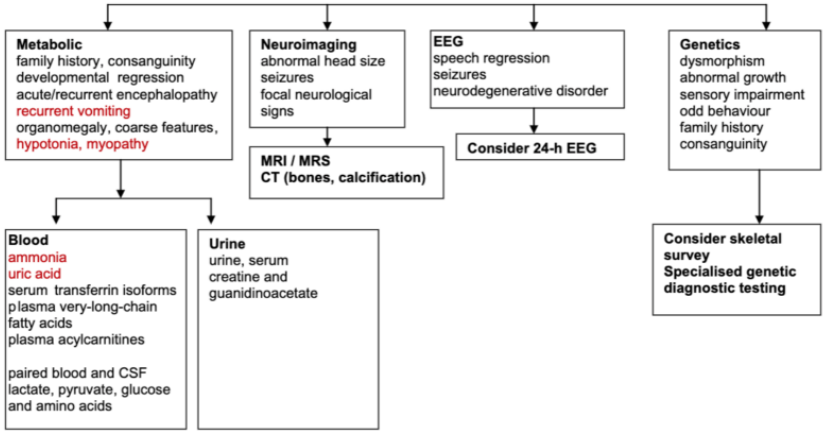
- Growth parameters
- Neurocutaneous stigmata
- Dysmorphism
- Features of storage disorders, eg. Organomegaly, corneal clouding
- Visual examination
- Neurological signs
- Hearing assessment

First line Investigations

Full blood count
Ferritin
Vitamin B12
Urea and electrolytes
Creatine kinase
Lead
Thyroid function tests
Urine metabolic screen (includes amino and organic acid analyses and glycosaminoglycans screen)
Molecular karyotype - array CGH
DNA for Fragile X

Second line

Consider referral to neurologist or metabolic or genetic specialist for further investigations which may include:



MDT approach

- Social workers
- Schools
- Educational psychologists
- Paediatricians, GPs and nurses
- Occupational therapists
- Speech and language therapists

Consent to Treatment

To have capacity a patient (even with a disability or developmental delay) must demonstrate the ability to:

- ***Understand*** the decision that needs to be made
- ***Retain*** the information long enough to make the decision
- ***Weight up*** the options and the implications of choosing each option
- ***Communicate*** their decision

Refer to:

- ***Gillick competence (case-by-case basis)***– voluntary informed consent from mature minor < 16 (but usu. older than 13yo) → can choose to have treatment but cannot refuse life-saving treatment
  - ***Doctors must be satisfied no coercion or pressure***
- ***Child protection services –*** *any suspected abuse – neglect, sexual, emotional, physical, financial, identity*