



NEONATAL ASSESSMENT

Neonatal period starts at birth till 28 days following birth. Neonatal life is a period of transition from life in utero to adjustment to the external environment where he is exposed to varied conditions. The baby during this stage is still vulnerable due to the limited metabolic capacity and immaturity in organs.

According to period of gestation they are classified as:

- **Preterm:** When the gestational period is <37 weeks
- **Term:** When the gestational age is >37 weeks till 42 weeks
- **Post-term:** Gestational age >42 weeks

According to weight:

- **Low birth weight (LBW):** Birthweight <2,500 g
- **Very low birth weight (VLBW):** Birthweight <1,500 g
- **Extremely low birth weight (ELBW):** Birthweight <1000 g

According to weight for gestational age:

- **Small for gestation (SGA):** Weight <10th percentile
- **Appropriate for gestational age (AGA):** Weight from 10th to 90th percentile
- **Large for gestational age (LGA):** Weight >90th percentile.

ASSESSMENT OF GESTATIONAL AGE: THE NEW BALLARD SCORE

Gestational age of the newborn sometimes needs assessment. It is best performed within 48 hours of birth so that prematurity or postmaturity can be assessed and appropriate measures and care can be taken to avoid complications. It is applicable for newborns of gestational age 26–44 weeks. Each parameter score ranges from 2 to 5. The tool has two major components—neuromuscular maturity with 6 criteria and physical maturity, also with 6 criteria. The limitation of this scoring system is in case ELBW babies for which deviation is found to be for over 2 weeks.

NEUROMUSCULAR MATURITY

	-1	0	1	2	3	4	5
Posture	—						—
Square window (wrist)	 >90°	 90°	 60°	 45°	 30°	 0°	—
Arm recoil	—	 180°	 140°–180°	 110°–140°	 90°–110°	 <90°	—
Popliteal angle	 180°	 160°	 140°	 120°	 100°	 90°	 <90°
Scarf sign	 180°	 160°	 140°	 120°	 100°	 90°	—
Heel to ear maneuver	 180°	 160°	 140°	 120°	 100°	 90°	—



PHYSICAL MATURITY

Skin	Sticky, friable, transparent	Gelatinous red, translucent	Smooth, pink; visible veins	Superficial peeling and/or rash; few veins	Cracking, pale areas; rare veins	Parchment, deep cracking; no vessels	Leathery, racked wrinkled
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	Maturity rating
Plantar surface	Heel-toe 40–50 mm –1 <40 mm; –2	> 50 mm, no crease	Faint red marks	Anterior transverse crease only	Creases anterior $\frac{2}{3}$	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola, no bud	Stippled areola, 1–2 mm bud	Raised areola 3–4 mm bud	Full areola 5–1 mm bud	
Eye/Ear	Lids fused loosely –1 tightly –2	Lids open; pinna flat; stays folded	Slightly curved pinna; soft; slow recoil	Well curved pinna; soft but ready recoil	Formed and firm, instant recoil	Thick cartilage, ear stiff	
Genitals (male)	Scrotum flat, smooth	Scrotum empty, faint rugae	Testes in upper canal, rare rugae	Testes descending few rugae	Testes down, good rugae	Testes pendulous deep rugae	
Genitals (female)	Clitoris prominent labia flat	Clitoris prominent small labia flat	Clitoris prominent enlarging minora	Major and minora equally prominent	Majora large, minora small	Majora cover clitoris and minora	

MATURITY RATING

Score	Weeks	Gestations by Dates										
–10	20	<table border="1"> <tr> <td colspan="2"></td> <td>Weeks</td> </tr> </table>				Weeks						
		Weeks										
–5	22	<table border="1"> <tr> <th>Birth date</th> <th>Hour</th> <th></th> </tr> <tr> <td></td> <td></td> <td>am</td> </tr> <tr> <td></td> <td></td> <td>pm</td> </tr> </table>		Birth date	Hour				am			pm
Birth date	Hour											
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0	24	<table border="1"> <tr> <th>APGAR</th> <th>1 minute</th> <th>5 minutes</th> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table>		APGAR	1 minute	5 minutes						
APGAR	1 minute	5 minutes										
5	26											
10	28											
15	30											
20	32											
25	34											
30	36											
35	38											
40	40											
45	42											
50	44											

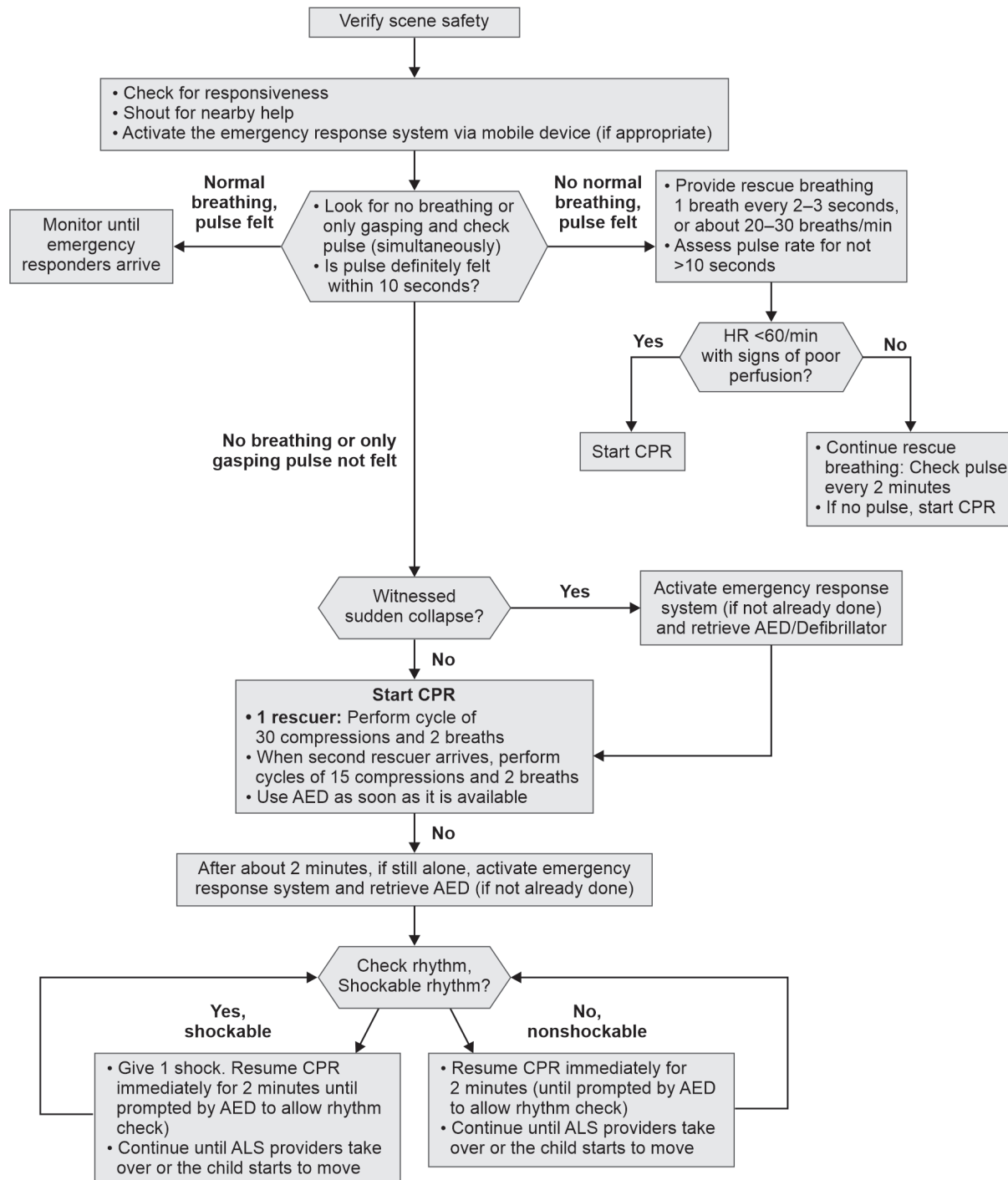
Scoring	
Gestational age by maturity rating	Weeks
Time of examination	Date _____ am Hour _____ pm
Age during examination	_____ Hours

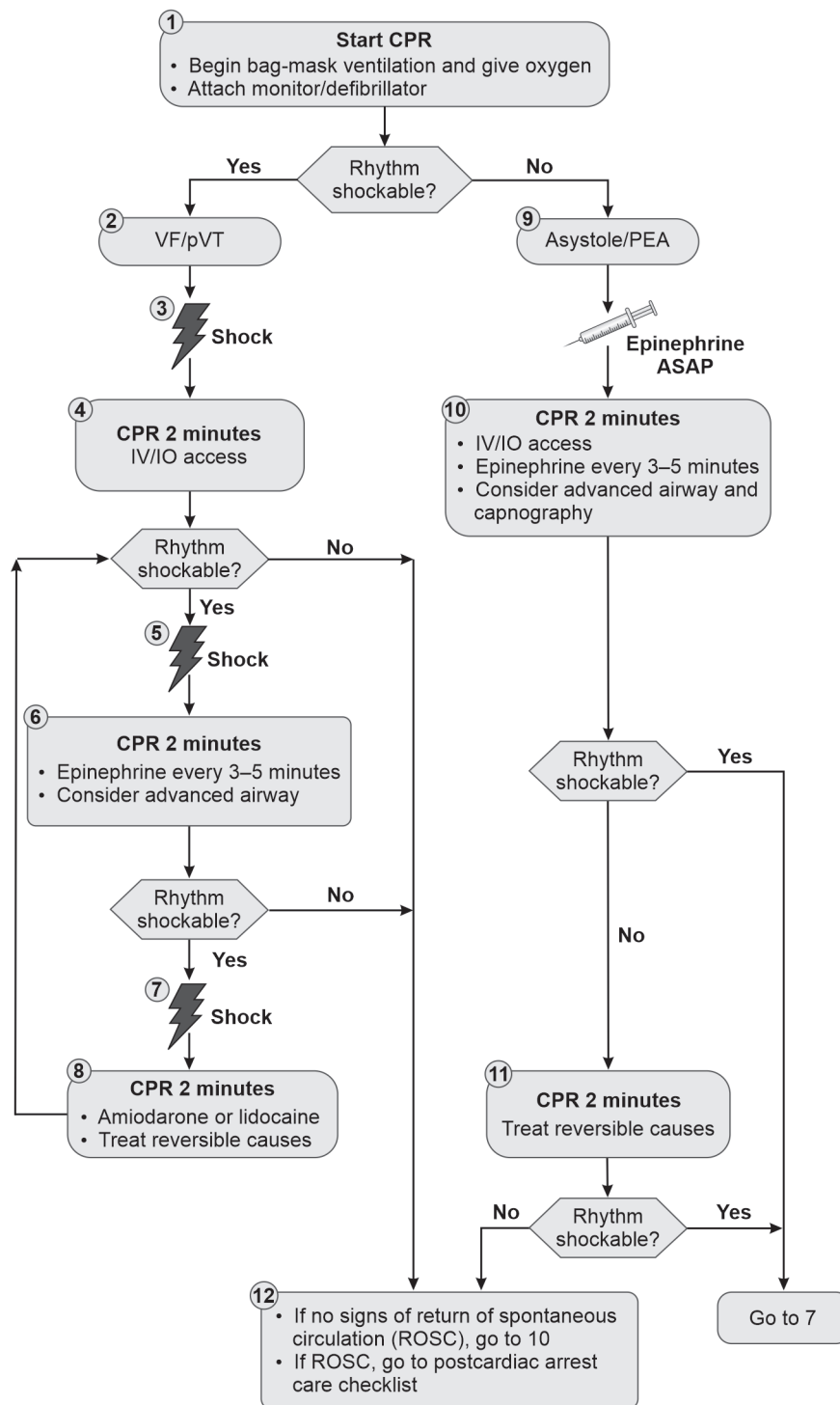


NEONATAL RESUSCITATION

PEDIATRIC RESUSCITATION ALGORITHM

Pediatric Basic Life Support Alogrith for Healthcare Providers Single Rescuer





CPR quality

- Push hard ($\geq \frac{1}{3}$ of anteroposterior diameter of chest) and fast (100–120/min) and allow complete chest recoil
- Minimize interruptions in compressions
- Change compressor every 2 minutes, or sooner if fatigued
- If no advanced airway, 15:2 compression-ventilation ratio
- If advanced airway, provide continuous compressions and give a breath every 2–3 seconds

Shock energy for defibrillation

- First shock 2 J/kg
- Second shock 4 J/kg
- Subsequent shocks ≥ 4 J/kg, maximum 10 J/kg or adult dose

Drug therapy

- Epinephrine IV/IO dose: 0.01 mg/kg (0.1 mL/kg of the 0.1 mg/mL concentration). Max. dose 1 mg. Repeat every 3–5 minutes. If no IV/IO access, may give endotracheal dose: 0.1 mg/kg (0.1 mL/kg of the 1 mg/mL concentration)
- Amiodarone IV/IO dose: 5 mg/kg bolus during cardiac arrest. May repeat up to 3 total doses for refractory VF/pulseless VT or
- Lidocaine IV/IO dose: Initial: 1 mg/kg loading dose

Advanced airway

- Endotracheal intubation or supraglottic advanced airway
- Waveform capnography or capnometry to confirm and monitor ET tube placement

Reversible causes

- Hypovolemia
- Hypoxia
- Hydrogen ion (acidosis)
- Hypoglycemia
- Hypo-/hyperkalemia
- Hypothermia
- Tension pneumothorax
- Tamponade, cardiac
- Toxins
- Thrombosis, pulmonary
- Thrombosis, coronary

Source: American Heart Association Guidelines 2020



APGAR SCORING

First examination is done at birth during which Apgar scoring is done to assess a baby's condition after birth and adaptability at birth. It was described by Dr Virginia Apgar (anesthesiologist) in 1952. It has breathing, heart rate, muscle tone, reflexes and color as its main components. It is done at 1 minute, 5 minutes and rarely at 10 minutes to see how well the baby can adapt outside the mother's womb.

Criteria/score	0	1	2
Breathing	Absent	Slow, gasping	Crying
Heart rate	Absent	Up to 100	More than 100
Muscle tone	Flaccid	In between	Fully flexed
Reflexes	Nil	Grimace	Cough, sneeze, cry
Color	Blue/pale	Peripheral cyanosis	Pink

Score from 7 to 10 is normal, 4 to 6 fairly low (need O₂) 3 and <3 — critically low (need artificial ventilation)

- Second examination is done within few hours of birth for:
 - Successful adaptation to extrauterine life
 - Screening for congenital anomalies [like tracheoesophageal fistula (TEF), spina bifida, diaphragmatic hernia, annorectal anomalies, etc.]
 - For conducting anthropometric assessment.



ANTHROPOMETRIC ASSESSMENT

Anthropometry is used to assess physical growth in children using noninvasive method to assess body size, weight, body proportion, etc., and is universally applicable. It includes measurement of weight, height/length, arm span, head circumference, chest circumference, abdominal circumference, body proportion; mid upper arm circumference and skin fold thickness.

1. **Weight:** It is the most important indicator of growth and nutritional status and is recommended by Indian Academy of Pediatrics (IAP) for use to assess the severity of malnutrition.

Pattern of increase:

- A term baby weights between 2.9 and 3.2 kg (40 weeks). Thereafter, baby loses 10% of birth weight during first three days and is regained within 10 days.

Age	Weight gain in grams/day
0–3 months	30
3–6 months	20
6–9 months	15
9–12 months	12
1–3 years	1.0

- The infants doubles his weight by 5 months, triples by one year and quadruples by 2 years.
- After 2 years weight gain till adolescence is 2–2.5 kg/year.
- Weight gain is also rapid during puberty

The following are the formulas to calculate the expected weight according to age.

Weight	Formula
3–12 months	$\text{Weight} = (\text{age in months} + 9)/2$
1–6 years	$\text{Weight} = 2 (\text{age in years}) + 8$
7–12 years	$\text{Weight} = [7 (\text{age in years}) - 5]/2$

2. **Height/length:** For children who can stand steadily (above 2 years) standing height is measured, with the shoes removed, using a stadiometer (ideally) or a stature meter with head in frankfort plane and occiput, back of knees, buttocks and heels touching the flat surface.

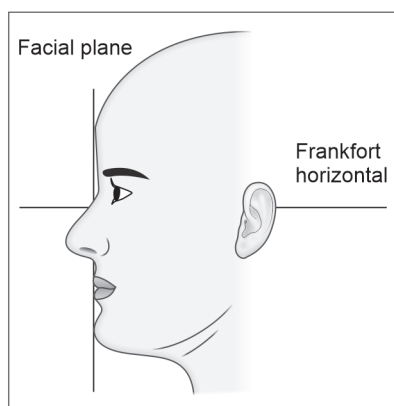


Figure 1: Frankfort plane



Figure 2: Stadiometer

For infants and children below 2 years an infantometer is used to measure the length of the child. The legs are straightened using pressure on the knees. The foot board is brought in contact with the child's feet and the length is measured.



Figure 3: Infantometer

An average Indian child has a length of about 50 cm which becomes 75 cm by 1 year and 90 cm by 2 years.

The formula to calculate expected height for children (2–12 years) is:

$$\text{Height} = (\text{age in years} \times 6) + 77$$

3. **Head circumference:** It is measured using a nonstretchable tape. It is measured over biparietal eminence and above supraorbital ridges. It about 35 cm at birth and increase by 10–12 cm during first year of life, thereafter increases by 2 cm in second year and then 0.5 cm/year till 8 years of age.

Age	Head growth per month (in cm)
0–3 months	2.0
3–6 months	1.0
6–9 months	0.5
9–12 months	0.5
1–3 years	0.2

4. **Chest circumference:** It is measured over the nipples and midway between inhalation and exhalation using a nonstretchable tape. This parameter is 2–3 cm less than head circumference at birth, becomes equal around 1 year and then is more than head circumference.
5. **Mid upper arm circumference:** It is 9–11 cm at birth and is around 16 cm by 1 year and then after the circumference increases very slowly (0.25 cm/year) so is considered constant. It can be taken as age-independent criteria to assess malnutrition and can be used to assess malnutrition from 6 to 60 months of age. A child having a mid arm circumference <12.5 cm is considered severe malnutrition. It is measured with the arm in the neutral position, the length from acromion to olecranon process is divided into three parts and is taken at the level of middle part.

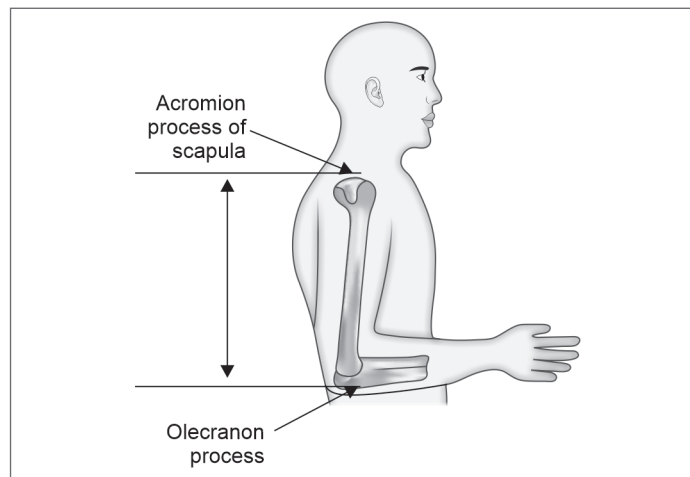


Figure 4: Mid upper arm circumference



A special tape called Shakir's tape is used, it has three zones —red, yellow and green corresponding to severity to malnutrition (normal (>13.5 cm), moderate (12.5–13.5 cm) and severe (<12.5 cm).

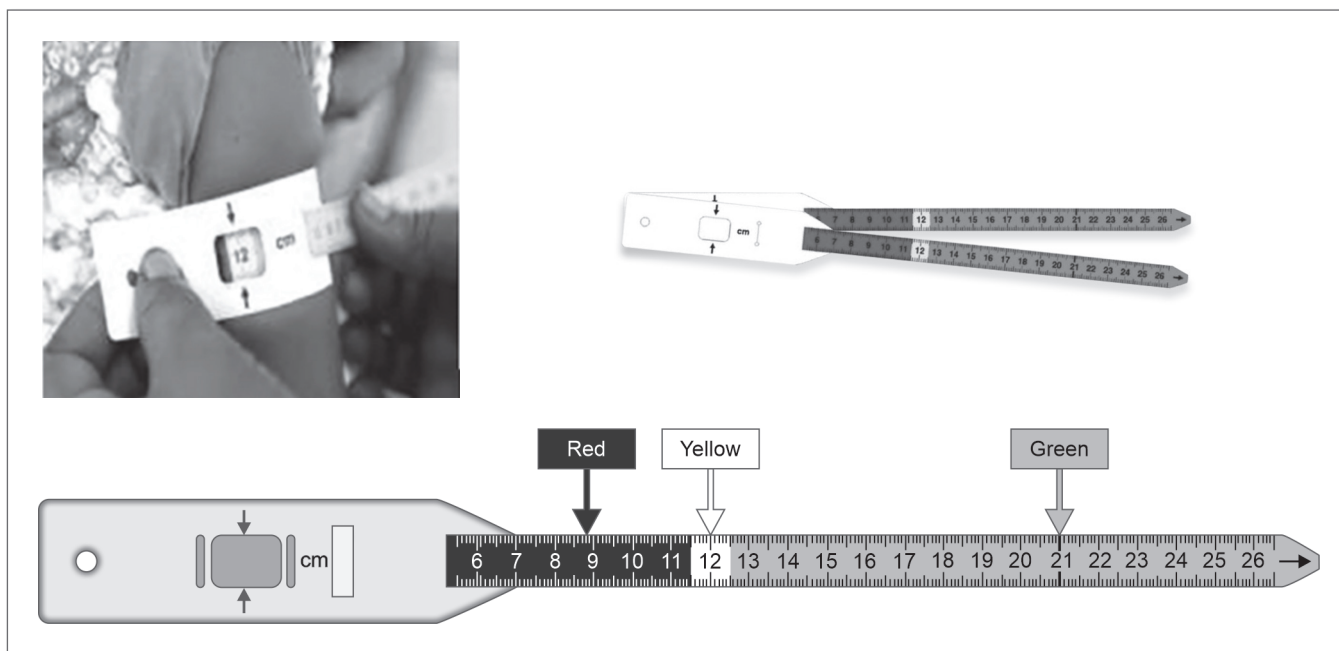


Figure 5: MUAC-Tape

6. **Arm span:** It is used sometimes as a measure to estimate height of children in condition when the child is not able to stand due to some musculoskeletal or neurological problem. It is taken as distance between the tip of middle finger of one hand and another when the arms are stretched at 90° to the body. It is less than height by 1–2 cm by the age of 10 years and then after is less than height by 3–5 cm.

INTERPRETATIONS

- When weight/age is less it is called underweight.
- When height/age is less than normal it is called stunting.
- When weight/height is less it is called wasting.
- A normal child usually follows the same percentile during his childhood.
- It mainly changes during sickness or adolescent stage.

According to **Indian Academy of Pediatrics (IAP)** Protein energy malnutrition can be identified using the following classification:

Grades of malnutrition	% age of expected weight/age
Grade I	71–80%
Grade II	61–70%
Grade III	51–60%
Grade IV	>50%
K	Denotes presence of edema

***Expected weight can be calculated as = Child's weight/ideal weight (value of 50th percentile/value calculated from the formula) × 100**

Example: A child is 3-year-old and weighs 13 kg, so we will first calculate his ideal or expected weight = 2 (age in years) + 8 = 2 (3) + 8, i.e., 14 kg

Now to assess malnutrition = $13/14 \times 100 = 92.8\%$ (i.e., the child is not malnourished)



WHO CLASSIFICATION OF MALNUTRITION

Types of PEM	% of body weight compared to standard weight	Edema	Deficiency in weight for height
Kwashiorkor	80–60	+	+
Marasmic kwashiorkor	<6	+	++
Marasmus	<60	Nil	++
Nutritional dwarfism	<60	Nil	Nil
Underweight	80–60	Nil	Nil



HISTORY COLLECTION

OBTAINING HISTORY OF ILLNESS IN A CHILD

OBJECTIVES

- History taking is the first steps toward rapport building with the child and the family.
- It gives an idea about the nature and course of illness in the child and provides with the detail of clinical problems in the child.
- It also helps frame nursing diagnoses for the child.
- Helps nurse to plan care for the child based on the problems explained by the child or the family.

METHOD AND SEQUENCE OF HISTORY TAKING

- The procedure requires private and comfortable place for the child and parents, especially when collecting information from adolescents as they are privacy conscious.
- The nurse must identify the reliable source of information which at times may be other than parents.
- The nurse must know the language known to the parents for accurate comprehension of information.
- Open-ended questions must be asked to get parents version of illness.
- History must be obtained in a nonformal way and as a part of natural conversation. Avoid addition of own interpretation as it can change the meaning of what has been said.
- Unnecessary details, probing and judgments must be avoided.

SEQUENCE

History is obtained from present health condition to past health status.

- Chief complaints for which the child is hospitalized.
- Present health complaints which the child may have for some time.
- Past health conditions include a history of any medical/surgical problem or any infection.
- Family history is important as some conditions or disease run in families and may also be preventable to some extent. Common familial conditions are thalassemia, hemophilia, metabolic disorders, etc.
- Personal details of birth, development, immunization and feeding, etc.

Chief complaints with which the child was brought to the hospital are noted in chronological order in the order of their appearance and the duration or the episode (e.g., fever for 3 days, vomiting for 2 days (7 episodes). Only significant complaints are considered some complaint are associated with main symptom (e.g., bodyache, restlessness may occur due to fever).

Apart from main complaints the aggravating or suppressing factors are also enquired, associated signs and symptoms are also asked for (For example for foul smell, abdominal pain with diarrhea, fever and vomiting and varying degree of dehydration can also occur)

Present health condition—Conditions with a long course of illness are included in this section. The time of onset of illness (when did the problem start), course taken as abrupt onset, insidious (slow and gradual) onset, severity of present illness, diurnal variations in the symptoms and treatment taken so far and effectiveness of the treatment. A negative history is also taken to rule out involvement of other systems. This is done by assessing or reviewing the major signs and symptoms related to each system.

SYSTEM-WISE MAJOR SIGNS

General condition	Growth parameters such as height, weight, head and chest circumference, activity (normal, decreased, over activity), behavior (normal, shy, aggressive, outspoken, etc.) sleep and appetite
Respiratory system	Cough, dyspnea, stridor, retractions, asthma, etc.

Contd...



GI system	Nausea, vomiting, abdominal distension, decreased or increased bowel sounds, jaundice and worm infestations
Cardiovascular system	Cyanosis, cool clammy skin, pulses (apical peripheral), palpitations, blood pressure, heart sounds and edema
Nervous system	Seizures, altered consciousness, headache, macro/microcephaly, meningeal signs and vomiting
Genitourinary system	Delayed or precocious sexual characters, menarche pain discharge, burning micturition, oliguria, polyuria, and hematuria
Hematology	Anemia, fatigue, petechiae, ecchymosis, epistaxis, inherited blood disorders

Past health history: Previous episodes of illnesses and hospitalization are enquired. Any history of surgery, its cause, description of surgical procedure and occurrence of area specific problem (endemic problems). The treatment taken, medications, their intake, amount and schedule is also important to note. Compliance with the treatment is also important to note (e.g., tuberculosis has a low compliance).

PERSONAL HISTORY

Birth history includes antenatal, natal and family history:

- Antenatal period is an important phase as the baby is still developing and is affected by maternal health condition which is also a determinant of baby's health. Maternal history of diabetes, hypertension, etc., must be noted. History of antenatal checkups and findings of various tests are important.
- Natal history—gestational age at birth gives a picture of anticipated problems. Apgar score at birth, adverse event, birthweight, resuscitation need, ICU stay duration (if any) general health status are indicators of growth potential of child.
- **Family history** of illness is important as some disorders and illnesses have a genetic tendency and the family that shares the same environment, nutritionally, economically has an equal chance of having the same problems. Life style related problems like obesity, hypertension, diabetes, etc., and habits like smoking, drinking, drug abuse are also assessed. Current illness in the family has a bearing on the child especially if it is infectious.
- Making a pedigree chart is important to have an understanding of family and if possible a three generation chart must be prepared. The commonly used symbols in a pedigree chart are as follows:

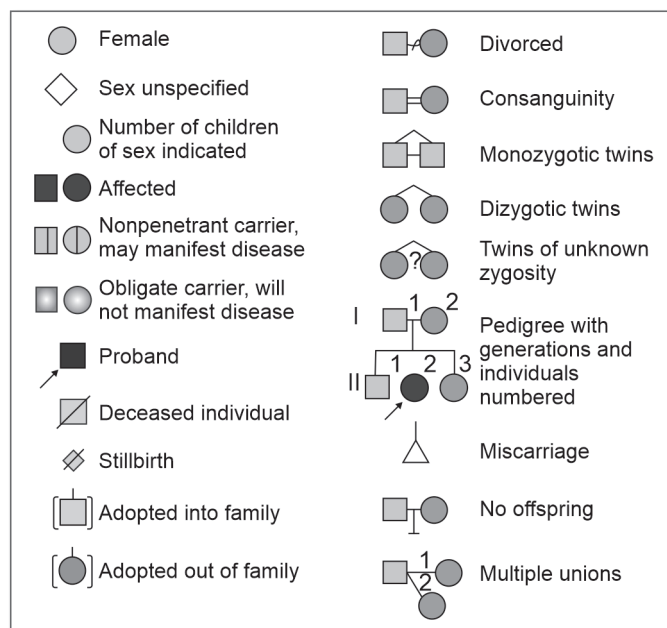


Figure 6: Pedigree chart

- **Developmental history:** Child developmental stage must match his age. Note danger signs related to age of achievement of milestones which might indicate developmental delay. DDST is a common tool used for developmental assessment.



IMMUNIZATION

Status must be completed and age and date of vaccine administration must be noted.

National immunization schedule recommends the following schedule of vaccines:

Vaccine	Timing	Dose	Route	Site
BCG	At birth or as early as possible till one year of age	0.1 mL (0.05 mL until 1 month of age)	Intradermal	Left upper arm
Hep. B	At birth or as early as possible till 24 hours	0.5 mL	Intramuscular	Anterolateral side of mid-thigh
OPV birth dose	At birth or as early as possible within 15 days of life	2 drops	Oral	Oral
OPV 1, 2 and 3	At 6 weeks, 10 weeks and 14 weeks	2 drops	Oral	Oral
fIPV	At 6 weeks and 14 weeks	0.1 mL	Intradermal two fractional dose	Intradermal: Right upper arm
PCV	At 6 weeks 14 weeks and booster 9 months	0.5 mL	Intramuscular	Anterolateral side of mid-thigh
Pentavalent 1, 2 and 3	At 6 weeks, 10 weeks and 14 weeks	0.5 mL	Intramuscular	Anterolateral side of mid-thigh
Rotavirus	At 6 weeks, 10 weeks and 14 weeks	5 drops	Oral	Oral
Measles rubella 1st dose	9–12 months (give up to 5 years if not received at 9–12 months)	0.5 mL	Subcutaneous	Right upper arm
Vitamin A 1st dose	At 9 months with measles	1 mL (1 lakh units)	Oral	Oral
DPT 1st booster	16–24 months	0.5 mL	Intra muscular	Anterolateral side of mid-thigh
OPV booster	16–24 months	2 drops	Oral	Oral
Measles and rubella 2nd dose	16–24 months	0.5 mL	Subcutaneous	Right upper arm
Vitamin 2nd – 9th dose	16 months with DPT/OPV booster then one dose every 6 months upto 5 years	2 mL (2 lakh units)	Oral	Oral
DPT 2nd booster	5–6 years	0.5 mL	Intramuscular	Ventrogluteal area
Td	10 years and 16 years	0.5 mL	Intramuscular	Ventrogluteal area

- After 9 years—HPV (up to 14 years 2 doses 1 and 6 months apart, 14 years onward 3 doses 0, 2 and 6 months apart).
- IPV is recommended to immunocompromised children and a part of postpolio eradication policy).
- Breastfeeding does not interfere with development of immunity.
- A number of vaccines can be given in combination at different sites, however there must be gap of 4 weeks between two live vaccines.

Socioeconomic status includes parent education, occupation and family income. Per capita income determination helps plan treatment and use of other modalities that can be afforded by the family. It also includes housing, drinking water source, hobbies, food habits, cooking methods used.

ANALYZING HISTORY

History collection helps the nurse reach the following:

- Nature of illness (duration, course and treatment).
- Organ systems involved in illness.
- Probable cause, aggravating and precipitating factors of illness.
- Possible complications and prognosis.



GENERAL CALCULATIONS RELATED TO CHILDREN

1. CALORIC REQUIREMENTS

Body weight	Calories requirement
0–10 kg	100 kcal/kg/day
10–20 kg	1000 kcal + 50 kcal/kg/day (for each kg)
>20 kg	1500 kcal + 20 kcal/kg (for each kg)

2. FLUID REQUIREMENTS

Body weight	Fluid	Infusion rate
>10 kg	100 mL/kg/day	4 mL/kg/hr
10–20 kg	1000 + 50 mL/for each kg above 10/day × (weight – 10)	40 mL/hr + 2 mL/kg/hr × (weight – 10)
20–30 kg	1000 + 500 + 20 mL/for each kg above 20/day	60 mL/hr + 1 mL/kg/hr × (weight – 20)

3. DRUG CALCULATION

- **Clark's rule:** Child dose = adult dose × (weight of child (in lbs) ÷ 150)
- **Young's rule:** Child dose = adult dose × (age of child ÷ [age of child + 12])

Basic Rule for Calculation

Amount to be given = desired dose ÷ dose in hand × amount available

For calculating drop rate/min = volume to be infused (in mL) ÷ time in minutes × drop factor

For a pediatric drip set the drop factor to 60 (16 for macro drip set)