



# NURSING

**For All Nursing Exams**

**Volume - 4**



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# 1

## CHAPTER

# Pediatrics & Child Health Nursing

## Introduction to Pediatrics

### Origin of the word:

- Paedi = Child
- Iatrika = Treatment
- ICS = Branch of science

Pediatrics is a branch of medical science that provides preventive, promotive, curative, and rehabilitative services for children.

### Age Group:

- In the U.S.: Pediatrics covers **0–16 years**
- In India: Pediatrics covers **0–18 years**

Karl Meringer: “What we do for children, they will do for society.”

**Definition:** Specialized field of nursing that provides care to children during all stages of growth and development.

### Main Aspect:

- **Preventive care** is the key focus.

## Important in Pediatrics

Contribution	Name
First Pediatricians (India)	Kashyapa & Jeevika
Father of American Pediatrics	Abraham Jacobi
Father of Modern Pediatrics	Nils von Rosenstein
Father of Indian Pediatrics	Dr. George Coetho (1928)

## Pediatric Books

Book Title	Author	Significance
Little Book on Diseases of Children	Paolo Bagellardus	First pediatric book
Little Book on Children	Thomas Phaer	First pediatric book in English

## Pediatric Age Range

Country	Age Range
United States	0–16 years
India	0–18 years

## Population Below 15 Years

- Global Average → ~26%
- India → ~35%

## Nursing Booster Points

- Pediatrics = Paedi (child) + Iatrika (treatment) + ics (science).
- Pediatric Age → USA: 0–16 yrs | India: 0–18 yrs.
- Quote → Karl Meringer: “What we do for children, they will do for society.”
- Population → 35% of India’s population < 15 yrs.

- First Pediatricians (India) → Kashyapa & Jeevika.
- Father of American Pediatrics → Abraham Jacobi.
- Father of Modern Pediatrics → Nils von Rosenstein.
- Father of Indian Pediatrics → Dr. George Coetho (1928, Bombay).
- First Pediatric Book → Paolo Bagellardus: Little Book on Diseases of Children.
- First Pediatric Book in English → Thomas Phaer: Little Book on Children.
- First Children's Hospital → Hôpital des Enfants Malades, Paris.
- CHN → Main focus = **Preventive care**.

## Paediatric Growth & Development

### Intrauterine Life

- Zygote (0–2 weeks)
- Embryo (3–8 weeks)
- Fetus (9 weeks – birth)

Mnemonic: “**Z-E-F**” → 2-8-B

### Extrauterine Life

- Neonate (Birth – 28 days)
- Infant (29 days – 1 year)
- Toddler (1 – 3 years)
- Preschooler (4 – 6 years)
- School-age child (6 – 12 years)
- Adolescent (13 – 19 years)

### **Adolescence**

- Early Adolescence (12–14 years)
- Late Adolescence (15–18 years)

“**Teens = Transformation**” → Biological + Psychological + Social changes.

### **Child & Maternal Health Indicators**

#### Neonatal Mortality Rate (NMR)

**Definition:** Deaths of children under 28 days of life per 1,000 live births in the same year.

**Formula:**

$$\text{NMR} = \frac{\text{Deaths of } < 28 \text{ days}}{\text{Total live births in the same year}} \times 1000$$

#### ➤ **India Data (per 1,000 live births):**

- ✓ 2011 → **33**
- ✓ 2016 → **29**
- ✓ 2019 → **25.4**
- ✓ **2021** → **19 Latest**

#### ➤ **Facts:**

- ✓ 80% of deaths occur in **early neonates (0–7 days)**.
- ✓ **First 24 hours = highest risk.**

#### **Main Causes:**

- Prematurity / LBW, Birth asphyxia, Neonatal infection, Pneumonia, Diarrhea, Congenital malformations.
- **Mnemonic:** “3P-NBC” → Prematurity, Pneumonia, Premature birth complications, Neonatal infections, Birth asphyxia, Congenital anomalies

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## Perinatal Mortality Rate (PMR)

**Definition:** Deaths of **late fetal (>28 weeks)** + **early neonatal (<7 days)** per 1,000 births.

**Formula:**

$$\text{PMR} = \frac{\text{Late fetal deaths} + \text{early neonatal deaths}}{\text{Total live births } (\geq 1000\text{g})} \times 1000$$

- **India (2011):** 19/1000
- **Main Cause:** Prematurity
- **Tip:** Perinatal = Prenatal + Intranatal + Early Postnatal

## Post-Neonatal Mortality

Deaths of children **from 28 days to 1 year** per 1,000 live births.

## Infant Mortality Rate (IMR)

**Definition:** Infant deaths (<1 year) per 1,000 live births.

$$\text{IMR} = \frac{\text{Infant deaths } < 1 \text{ year}}{\text{Total live births in the same year}} \times 1000$$

- **India Data (per 1,000 live births):**
  - ✓ 2011 → **44**
  - ✓ 2016–17 → **42**
  - ✓ 2019 → **39**
  - ✓ 2021 → **27** Latest
- **State-wise:**
  - ✓ Highest → **Madhya Pradesh (45 in 2019)**
  - ✓ Lowest → **Kerala & Andaman Nicobar (7 in 2019)**
- **Global:**
  - ✓ Highest → **Afghanistan (110 in 2019)**
  - ✓ Lowest → **Switzerland (2/1000)**
  - ✓ USA → 5.7/1000

**Best Indicator:** IMR is the **most sensitive measure** of community health services.

## Under-5 Mortality Rate (U5MR)

**Definition:** Deaths of children <5 years per 1,000 live births.

$$\text{Maternal Mortality Rate} = \frac{\text{Maternal deaths}}{\text{Total women (15 – 49yrs)}} \times 100,000$$

- **India Data:**
  - ✓ 2011 → **57/1000**
  - ✓ 2021 → **31/1000** Latest
- **Main Cause:** Diarrhea

## Maternal Mortality Ratio (MMR)

**Definition:** Maternal deaths per 100,000 live births.

$$\text{MMR} = \frac{\text{Maternal deaths (due to pregnancy/childbirth)}}{\text{Total live births in the same year}} \times 100,000$$

- **India Data:**
  - ✓ 2011 → **254/100,000**
  - ✓ 2016 → **167/100,000**
  - ✓ 2019 → **130/100,000**
  - ✓ 2021 → **93/100,000** Latest

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➤ **Global Data:**

- ✓ 2011 → 357/100,000
- ✓ 2017 → 246/100,000

➤ **Main Cause:** Postpartum Hemorrhage (PPH)

➤ **Mnemonic:** “HAPP” → Hemorrhage, Anemia, Pre-eclampsia/eclampsia, Prolonged labor

**Trends Over Time (India)**

**Child Mortality Rates (2011–2021)**

- NMR → 33 → 19
- IMR → 44 → 27
- U5MR → 57 → 31

**Maternal Mortality Ratio (2011–2021)**

- MMR → 254 → 93
- **Total Fertility Rate (TFR):** 2.0 (2021), target = 2.1
- **Crude Death Rate:** 7.3/1000
- **Birth Rate:** 21.7/1000
- **Maternal Morbidity:** Most common cause = Anemia

**Child Health Policies**

- **ICDS (1975):** Anganwadi, 500 kcal + 12–15g protein/day, supported by UNICEF & World Bank.
- **Right to Education Act (2005):** Free compulsory education up to 14 yrs.
- **Kishori Shakti Yojana (11–19 yrs):** Adolescent girls’ empowerment via ICDS.
- **Juvenile Justice Act:** 2000, amended 2006 & 2015.

**Nursing Booster Points**

- **NMR (2021):** 19/1000 → mostly due to prematurity & LBW.
- **IMR (2021):** 27/1000 → best indicator of community health.
- **U5MR (2021):** 31/1000 → diarrhea major cause.
- **MMR (2021):** 93/100,000 → leading cause = PPH.
- Kerala = lowest IMR, Madhya Pradesh = highest IMR in India.
- Afghanistan = highest IMR globally, Switzerland = lowest.

**Developmental & Physiological Characteristics of Newborn**

**Stages of Neonatal Reactivity**

**Stage I (Birth → 30 min) = First Period of Reactivity**

- Newborn is alert, eyes open, active movements.
- Best time for initiation of breastfeeding.

**Stage II (30 min → 2 hrs) = Period of Decreased Responsiveness**

- Baby becomes dull, sleepy, ↓ activity.

**Stage III (2 hrs → 3 hrs) = Second Period of Reactivity**

- Activity increases again.
- 90% of babies pass urine or meconium.

**Classification of Newborn**

Category	Criteria
Preterm	< 37 weeks (< 259 days)
Term	37–42 weeks (259–294 days)
Post-term	> 42 weeks (> 294 days)

Normal Weight	2.5 – 3.9 kg
Low Birth Weight (LBW)	< 2.5 kg
Very Low Birth Weight (VLBW)	< 1.5 kg
Extremely Low Birth Weight (ELBW)	< 1.0 kg → requires Level III NICU

### Normal Physical Characteristics

- **Weight:** 2.5–3.9 kg (average 2.9 kg)
- **Length:** 48–53 cm (average 50 cm)
- **Head circumference:** 33–37 cm (average 35 cm)
- **Chest circumference:** ~3 cm less than head circumference
- **Abdominal circumference:** 31–33 cm
- **Mid upper-arm circumference (MUAC):** 11–13 cm
- **Upper : Lower segment ratio:** 1.8 : 1
- **Bones:** 280–300 at birth (reduce to 206 in adult)
- **Muscles:** ~650 (639 in adult)
- **Skull bones (newborn):** 5 (2 frontal, 2 parietal, 1 occipital)

### Hematological Characteristics

- **Blood volume:** 30 ml/kg body weight
- **RBC:** 6–8 million/cu mm
  - ✓ Life span: 60 days (preterm), 80 days (term)
  - ✓ Hemoglobin: 18–20 g/dl
- **Reticulocytes:** < 500/cu mm (adult = 1–2% RBCs)
- **WBC count:** 10,000–17,000/cu mm
  - ✓ Neutrophils ~40% (↓ in newborns)
  - ✓ Lymphocytes ↑ in newborns
- **Platelets:** 1.5–3.5 lakhs/cu mm
  - ✓ Lifespan: 8–12 days
  - ✓ Storage: 5 days (blood bank)

### Immunological Characteristics

- **IgG:** Transferred via placenta → main passive immunity (gamma globulin).
- **IgA:** Secretory antibody (via breast milk; alpha).
- **IgM:** Absent at birth (pentameric structure). Presence indicates intrauterine infection.

### Metabolic Characteristics

- **Blood glucose:**
  - ✓ At birth: 40–60 mg/dl
  - ✓ After 3 days: 50–90 mg/dl
- **Bilirubin:** Physiological jaundice; serum bilirubin up to 5 mg/dl in normal newborns.

### Vital Signs of Newborn

Vital Sign	Normal Range	Notes
Heart rate	110–160 bpm (avg 140)	During sleep 80–100, crying up to 180
Stroke volume	5 ml	Cardiac output ~500 ml/min
Blood pressure	Systolic 60–80 mmHg / Diastolic 25–40 mmHg	Neonatal cuff: 2.5 cm
Respiratory rate	30–60 breaths/min (avg 40)	Periodic breathing is normal
Temperature	36.5–37.5 °C	Axillary preferred

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## Nursing Booster Points

- **First 30 minutes** = best time for breastfeeding (baby alert).
- **90% babies** pass urine/meconium in **Stage III** of reactivity.
- **LBW cut-off = 2.5 kg** (WHO standard).
- **ELBW (<1 kg)** needs Level III NICU.
- **IgM absent at birth** → infection if present.
- **IMR is best indicator** of health care quality, but **NMR is best neonatal indicator**.
- **Head > chest circumference** in newborns.
- **Physiological anemia** appears at 6–8 weeks due to short RBC lifespan.
- **Newborn bones = 300**, later fuse to 206 in adults.

## Immediate Newborn Care – From Birth to Stability

### Step 1: Prepare Before Birth

- Warm, clean, draft-free delivery room ( $\geq 25^{\circ}\text{C}$ ).
- Pre-warmed towels, radiant warmer switched on.
- Suction equipment, oxygen, neonatal resuscitation kit ready.
- Resuscitation team standby for high-risk deliveries.

### Step 2: At Birth – Receive the Baby

- Receive in **pre-warmed towel**.
- Dry immediately → remove wet towel → wrap in warm dry towel.
- Place under **radiant warmer**.
- Ensure **warm chain** (cap, socks, skin-to-skin, delayed bathing  $\geq 24$  hrs).

### Step 3: Airway, Breathing, Circulation (ABC)

- **Airway:**
  - ✓ Position: Sniffing / slight extension.
  - ✓ Suction mouth → then nose (to prevent aspiration).
  - ✓ Catheter:
    - Term = 8G (blue), 60–80 mmHg, 10–15 sec
    - Preterm = 6G (light green), 40–60 mmHg,  $\leq 5$  sec
- **Breathing:**
  - ✓ 90–92% start breathing/crying within 6–30 sec.
  - ✓ If no cry → stimulate (rub back, flick soles).
  - ✓ If still apneic → start bag-mask ventilation.
- **Circulation:**
  - ✓ Assess HR (apical pulse):
    - $\geq 100$  → normal
    - 60–100 → assist ventilation
    - $< 60$  → ventilation + chest compressions

### Step 4: Apgar Score

- Assessed at **1 min & 5 min** (and 10 min if  $< 7$ ).
- Parameters: **Appearance, Pulse, Grimace, Activity, Respiration**.
- Interpretation:
  - ✓ 7–10 → Normal
  - ✓ 4–6 → Moderate distress
  - ✓ 0–3 → Severe distress (resuscitation needed)

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### Step 5: Thermoregulation

- Maintain 36.5–37.5 °C (normal newborn temperature).
- Methods:
  - ✓ Drying & wrapping, warm environment.
  - ✓ Kangaroo Mother Care (KMC) for LBW/preterm.
  - ✓ Radiant warmer or incubator if unstable.
- Avoid early bathing (≥24 hrs).

### Step 6: Umbilical Cord Care

- Clamp after **60–90 sec** (delayed clamping → ↑ iron stores).
- Immediate clamping in: preterm, HIV, twins (first baby).
- Leave 3–4 cm stump; apply sterile clamp.
- Keep dry and clean; stump falls in **7–8 days**.

### Step 7: Prophylaxis & Medications

- **Vitamin K1 injection:**
  - ✓ Term → 1 mg IM
  - ✓ Preterm → 0.5 mg IM
- **Eye prophylaxis:**
  - ✓ 0.5% erythromycin / tetracycline ointment.
  - ✓ Prevents ophthalmia neonatorum.

### Step 8: Initiate Breastfeeding & Bonding

- Initiate **breastfeeding within 30 min – 1 hr**.
- Provide **colostrum (“first vaccine”)** → rich in IgA.
- Encourage **rooming-in & skin-to-skin contact**.

### Step 9: Routine Assessment

- Vital signs: HR (110–160), RR (30–60), Temp (36.5–37.5 °C).
- Check: weight, length, head & chest circumference.
- Assess for congenital anomalies (cleft lip, polydactyly, spina bifida).
- First urination & meconium usually within 24 hrs.

### Step 10: Immunization

- At birth: **BCG, OPV-0, Hepatitis B-1**.
- Record in immunization card.

### Step 11: Screening

- Screen for **hypothyroidism, metabolic disorders, hearing defects** as per hospital protocol.

### First Nursing Role after Birth

- **Ensure initiation of respiration.**
- About **90–92% of babies start spontaneous pulmonary respiration within 6–30 seconds with a cry**, but **Apgar score does not change up to 90 seconds** in normal cases.
- **If no cry → stimulate** by:
  - ✓ Flicking soles of feet
  - ✓ Gentle back rubbing

## Assessment of Respiratory Pattern

### Normal Respiration

- **Type:** Irregular, periodic, shallow
- **Movement:** Thoraco-abdominal
- **Cry:** Present
- **No grunting, no retraction, no nasal flaring**

## Abnormal Respirations & Clinical Correlation

Pattern	Description	Seen In / Clinical Significance
<b>Nasal Flaring</b>	Early sign of respiratory distress	RDS (Respiratory Distress Syndrome)
<b>Grunting</b>	Expiratory sound due to mucus / fluid	Amniotic fluid accumulation, mucus plugging
<b>Cyanosis</b>	Bluish discoloration	Severe respiratory compromise
<b>Retractions</b>	Chest indrawing during inspiration	RDS, Pneumonia
<b>See-saw Respiration</b>	Chest and abdomen move <b>out of phase</b>	Atelectasis, Severe pneumonia
<b>Kussmaul's Respiration</b>	Regular, rapid, deep breathing	Metabolic Acidosis, DKA, CRF
<b>Cheyne-Stokes Respiration</b>	Hyperpnea alternating with apnea (20–30 sec)	Brain injury (midbrain/pons)
<b>Biot's Respiration</b>	3–4 regular breaths followed by pauses	Meningitis, Head injury
<b>Paradoxical Respiration</b>	Chest indraws on inspiration (flail chest)	Rib fractures (flail chest)

## Suctioning in Newborn

- **First Nursing Action if baby does not cry** → **Suctioning** (mouth → nose)
- **Why mouth first?**
  - ✓ Nose suction first can cause **sneezing reflex** → **aspiration**

## Catheter Sizes & Pressures

Category	Catheter Size	Color	Pressure (mmHg)	Duration
<b>Preterm</b>	6G	Light Green	40–60	5 sec
<b>Term</b>	8G	Blue	60–80	10 sec

**Position:** Sniffing / Head low (Rose position)

### **Precautions:**

- Suction only up to oropharynx (deep suction → vagus stimulation → bradycardia/dysrhythmia)
- Apply suction **on withdrawal** with rotation, not on insertion

## Complications of Suctioning

- **Bradycardia** (most common)
- **Hypoxia**
- **Bleeding** (prevented with adrenaline instillation)

## Management

- Pre-oxygenate with **100% O<sub>2</sub>**
- **Atropine** may be given to counter bradycardia

## **Mnemonic – “C–G–C–R–S” for Abnormal Respiration in Newborn**

- **C** – Cyanosis
- **G** – Grunting
- **C** – Chest Retractions
- **R** – Respiratory see-saw
- **S** – Nasal Spreading (flaring)

## Temperature Maintenance in Newborn

### Why Newborns are Prone to Hypothermia?

- **Immature hypothalamic temperature regulation center** → shivering absent
- **Thin skin, large body surface area, less subcutaneous fat**
- **Wet baby after birth** loses heat quickly
- **Labour room temperature:** should be maintained at 24°C

### Temperature Regulation Centers

Posterior Hypothalamus (Heat Gain Center)	Anterior Hypothalamus (Heat Loss Center)
↑ BMR → ↑ ATP (heat production)	↓ BMR (conserves energy)
Vasoconstriction → conserve heat	Vasodilation → heat loss
Shivering (absent in newborns)	Exposure to cold: 66–68°F
	Wet baby, cold hands, air velocity → ↑ heat loss

### Heat Loss in Newborns (Modes)

Mode	Mechanism	% Contribution
<b>Radiation</b>	Loss to cooler objects nearby	~63%
<b>Evaporation</b>	Loss via wet skin/surface	~22%
<b>Conduction</b>	Loss to cold objects in contact	~14–15%
<b>Convection</b>	Loss to surrounding air currents	~1%

### Hypothermia = Silent Killer in Newborns

- **Normal temperature range (newborn):** 36.5 – 37.5°C
- **Most common site: Axilla**
- **Contraindicated site: Oral route**
- **Most reliable: Rectal route** (insert 1.5 inch thermometer)
  - ✓ Contraindicated in **cardiac disease, piles, intestinal surgery** → risk of vagal stimulation → bradycardia

### Temperature Measurement Time

- Oral → 1–2 min
- Axilla → 1–2 min (add +1°F to reading)
- Rectum → 3–5 min (add +1°F to reading)
- There is ~2°F difference between axillary and rectal readings

### Special Thermometer

- **Tempadot thermometer** → measures **tympanic temperature** (used in frostbite patients)



### Warm Chain – Steps to Prevent Hypothermia

1. Warm delivery room
2. Warm articles & equipment
3. Warm hands of nurses/doctors
4. Warm clothes, pre-warmed towels
5. Radiant warmer (pre-warmed)
6. Warm handling techniques
7. Kangaroo Mother Care (KMC): 3–12 hrs/day

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8. Early breastfeeding (within 30 min–1 hr)
  9. Avoid early bathing (postpone  $\geq$  24 hrs after birth)
    - ✓ If mother has Hepatitis B → bathe baby after 30–60 min

### **Management of Hypothermia**

- Receive baby in **pre-warmed towel**, rub dry, replace with dry warm towel
- Cover with **mummy restraint technique + cap + socks**
- For **preterm**:
  - ✓ Use **pre-warmed radiant warmer**
  - ✓ Radiant warmer temp: **36.2°C for 2.5 kg baby**
  - ✓ Higher risk of **fluid loss** → **replace 30–40 ml/kg/day**
- For **transport** → keep in **incubator (servo-control mode)**
- In incubator, **most common heat loss method = Convection**

### **Mnemonic – “R–E–C–C” for Heat Loss in Newborn**

- **R** – Radiation (most common)
- **E** – Evaporation
- **C** – Conduction
- **C** – Convection

### **Umbilical Cord Cutting & Care**

#### **Structure of Umbilical Cord**

- **At Term**: Contains **2 umbilical arteries (deoxygenated blood) + 1 umbilical vein (oxygenated blood)**
- **Up to 4 months of intrauterine life**: **2 umbilical arteries + 2 umbilical veins**
  - ✓ **Right umbilical vein disappears** by 4 months

#### **Anomalies of Umbilical Cord**

- **Single Umbilical Artery + Single Vein** seen in:
  - ✓ Renal Agenesis
  - ✓ Maternal Diabetes Mellitus
  - ✓ Hydrocephalus
  - ✓ Polyhydramnios
  - ✓ **Down Syndrome (most common association)**
- **Absent Umbilical Cord** → **Acardia** (fatal anomaly)

#### **Umbilical Cord Cutting**

- **Delayed cord clamping**:
  - ✓ Delay **60–90 seconds after birth** (till pulsations stop)
  - ✓ Baby received **downward position**
  - ✓ **Milking of cord**: Squeeze vessels from mother → baby
    - Transfers **80–100 ml blood** → Prevents **physiological anemia**
- **Immediate cord cutting** required in:
  - ✓ **Preterm delivery** → prevents hypervolemia
  - ✓ **HIV-infected mother** → prevents cross-infection
  - ✓ **Twin deliveries** (for 1st baby → prevents 2nd baby hypovolemia)

#### **Cord Cutting Technique**

- Umbilical cord clamp placement:

- 
- ✓ **1st clamp:** 2.5 cm from baby's abdomen
  - ✓ **2nd clamp:** 5 cm from baby's abdomen
  - ✓ Cut **between clamps** using sterile cord-cutting scissors
  - Cord length left after cutting: **3–4 cm**

### Umbilical Cord Care

- Keep cord **clean and dry**
- Do **not apply substances** → only **spirit swabbing** allowed
- Cord remnant normally **falls off within 7–8 days**
- Until then → **sponge bath only**, avoid tub bath
- **If pus/discharge present** → Immediate physician notification

### Umbilical Cord as Infusion Site

- **Newborns:** Umbilical artery (best site for infusion)
- **Infants:** Scalp vein (easy access)
- **Adults:** Forearm vein (radius & ulna act as natural splints)
- In **preterm babies** → 7–8 cm of umbilical cord remnant can be used for **infusion purposes**

### Mnemonic – “DHRPD” for Single Umbilical Artery & Vein

- **D** – Diabetes Mellitus
- **H** – Hydrocephalus
- **R** – Renal Agenesis
- **P** – Polyhydramnios
- **D** – Down Syndrome

### Nursing Booster Points

- **First priority = Airway & Breathing** → check cry & respiration.
- **Mouth suction before nose** → prevents aspiration.
- **Delayed cord clamping (60–90 sec)** prevents anemia.
- **Vitamin K** prevents hemorrhagic disease of newborn.
- **Colostrum** = best natural immunity booster (IgA rich).
- **KMC** is gold standard for LBW thermoregulation.
- **Apgar <4 at 1 min** = severe asphyxia → immediate resuscitation.
- **Hypothermia = Silent killer** → always maintain warm chain.
- **90–92% babies cry within 6–30 sec**
- **Apgar score unchanged till 90 sec**
- **Order of suctioning: Mouth** → **Nose**
- **Most fractured ribs:** 6th & 7th
- **Least fractured rib:** 1st rib
- **Flail chest hallmark:** Paradoxical respiration
- **Max suction duration:** 10 seconds
- **Newborns cannot shiver** due to immature hypothalamus
- **Hypothermia = Silent killer** in newborns
- **Most common site** for temp measurement: Axilla
- **Most reliable site:** Rectum (but contraindicated in cardiac, piles, intestinal surgery)
- **Warm chain** must always be followed
- **KMC** = most natural method of thermal regulation
- **Radiation** is the most common heat loss mechanism overall
- **Convection** = most common method of heat loss in **incubator**

- **2 arteries + 1 vein = Normal Umbilical Cord** at term
- **Single artery + vein → Down Syndrome, renal agenesis**
- **Delayed clamping (60–90 sec)** prevents physiological anemia
- **Immediate clamping** needed in preterm, HIV+, twins
- Cord falls off in **7–8 days**
- **Best infusion site newborn → Umbilical artery**
- **Umbilical cord anomaly with no cord → Acardia** (non-viable)

## APGAR Score

SCORE	0 points	1 point	2 points
Appearance (Skin color)	Cyanotic / Pale all over	Peripheral cyanosis only	Pink
Pulse (Heart rate)	0	<100	100-140
Grimace (Reflex irritability)	No response to stimulation	Grimace or weak cry when stimulated	Cry when stimulated
Activity (Tone)	Floppy	Some flexion	Well flexed and resisting extension
Respiration	Apneic	Slow, irregular breathing	Strong cry

## Components of APGAR

- Appearance (skin color)
- Pulse / Heart Rate → Best parameter and most critical
- Grimace (reflex irritability)
- Activity (muscle tone)
- Respiration (effort)

## Timing of APGAR

- First assessment: at **1 minute after delivery**
- Second assessment: at **5 minutes after birth (most reliable)**
- If needed: again at **10 minutes**

## APGAR Scoring Table

S.N.	Characteristics	0	1	2
1	Appearance (Skin Color)	Whole body cyanosed / central cyanosis	Body pink, extremities cyanosed (acrocyanosis)	Entire body pink
2	Pulse (Heart Rate)	Absent or <60 bpm	<100 bpm but >60 bpm	>100 bpm
3	Grimace (Reflex Irritability)	No response	Mild grimace	Cries well
4	Activity (Muscle Tone)	Flaccid / paralysis	Some flexion of extremities	Active movement / full flexion
5	Respiratory Effort & Rate	Absent	Irregular / abnormal	Good cry / regular breathing

## APGAR Score Interpretation

- **8–10** → Mild depression or normal (Routine care sufficient)
- **4–7** → Moderate depression → Management: provide oxygen, maintain temperature, airway clearance
- **0–3** → Severe depression → Immediate resuscitation required
- Symmetrical ascending paralysis → Guillain-Barré Syndrome (GBS)
- Asymmetrical flaccid paralysis → Poliomyelitis
- Acrocyanosis → Body pink, extremities blue
- Central cyanosis → Both body and umbilicus blue

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## **Example Cases**

- Newborn with acrocyanosis + crying, hypoactive muscle tone, HR >100 bpm → Score = 8 (1+2+2+1+2)
- Newborn with HR >100 bpm, full flexion, pink body, and good cry → Score = 10 (2+2+2+2+2)

## **Nursing Booster Points**

- Best single parameter = Heart Rate
- Best overall assessment = 5-minute APGAR
- Acrocyanosis is common and not critical if HR and cry are normal
- Score ≤3 → Resuscitation always required

## **Neonatal Resuscitation (CPR)**

### **Chest Compression : Ventilation Ratio**

- Neonates: 3:1 (90 compressions : 30 ventilations per min)
- Compression: 1.5 sec | Ventilation: 0.5 sec
- Compression site: Lower 1/3rd of sternum
- Method: 2-finger or encircling thumb method
- Depth: 0.5–0.75 inch (1–1.5 cm) in neonates | 1.5 inch in children
- Pulse check: Brachial artery (5–10 sec)
- Indications: Birth asphyxia (most common), LBW babies

### **Sequence of Neonatal CPR – TABC**

**T – Temperature:** Prevent hypothermia (warm chain)

**A – Airway:** Position in sniffing or head-low position, suction mouth → nose

**B – Breathing:**

- Assess spontaneous breathing (within 60 sec)
- If not breathing: Oxygen via nasal cannula/mask (1–2 L/min for neonate, 8–10 L/min O<sub>2</sub> hood)
- If ineffective → Positive Pressure Ventilation (PPV) with ambu bag (21% O<sub>2</sub>)
- Contraindication for PPV: Diaphragmatic hernia
- If no improvement → Endotracheal intubation
  - ✓ Preterm: Tube size 2.5–3 mm, depth = 6 + wt (kg) cm (≈ 8 cm)
  - ✓ Term: Tube size 3.5 mm, depth = 8.5–9 cm
  - ✓ Non-cuffed tube (cricoid cartilage acts as cuff)
- AMBU bag capacity: Neonate 450 ml, Child 750 ml, Adult 1200 ml
- Ventilation pressures: PIP 20–25 cm H<sub>2</sub>O | PEEP 5 cm H<sub>2</sub>O
- Caution: 100% O<sub>2</sub> >1 hr → Risk of retrolental fibroplasia (blindness)

**C – Circulation:**

- Start compressions if HR < 60 bpm or absent
- Ratio: 3:1
- Rate: 90 compressions/min
- Site: Lower 1/3 sternum
- Method: 2-thumb encircling technique
- Defibrillation (rare in neonates): Paddle size 3.5–5 cm, Current 2–4 J/kg, Pressure 10–15 lb

### **Oxygen Saturation Targets (Preductal)**

- 1 min: 60–65%
- 2 min: 65–70%
- 3 min: 70–75%

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- 5 min: 80–85%
  - 10 min: 85–95%
  - Normal newborn SpO<sub>2</sub>: 95%

### **Drugs Used in Neonatal Resuscitation**

- **Adrenaline (1:10,000)**
  - ✓ IV (umbilical vein): 0.01–0.03 mg/kg
  - ✓ Intratracheal: 0.05–0.1 mg/kg diluted in 2 ml NS
- **NaHCO<sub>3</sub>**: 3–4 mEq/kg if severe acidosis
- **Naloxone 0.1 mg/kg**: For respiratory depression due to maternal opioid overdose (antidote for morphine)

### **Duration of Resuscitation**

- Continue CPR up to 10 min; if no response → declare death
- In adults: CPR up to 30–45 min before declaring death

### **Nursing Booster Points**

- Neonatal CPR ratio: 3:1 (different from adults = 30:2)
- Compression depth: 0.5–0.75 inch (1–1.5 cm) in neonates
- Best pulse check site: Brachial artery
- Most common cause of neonatal CPR: Birth asphyxia
- PPV contraindicated in diaphragmatic hernia
- Use non-cuffed ET tube in neonates (cricoid acts as cuff)
- Risk of blindness if exposed to 100% O<sub>2</sub> >1 hr

### **Routine Care of Newborn**

- **Identification band**: Male – Blue, Female – Pink
- **Foot impression**: Right foot

### **Eye Care**

- Assess for infection
- **Term baby**: Eyelids open
- **Preterm baby**: Eyelids closed
- **Ophthalmia Neonatorum**
  - ✓ Cause: Neisseria gonorrhoeae
  - ✓ Management: Silver nitrate 1% ointment / Erythromycin 0.5% (best) / Azithromycin 1% drops
  - ✓ Delay eye prophylaxis for 1 hour → promotes mother–baby bonding
- **Important Q**: Main cause of Pelvic Inflammatory Disease (PID) = Neisseria gonorrhoeae

### **Breastfeeding**

- Initiated within 30 min – 1 hr after birth
- If cesarean delivery → start within 4–6 hrs
- If delay → provide pacifier to stimulate sucking reflex

### **Blood Glucose**

- Normal: 40–60 mg/dl at birth

### **Vitamin K Prophylaxis**

- Deficiency common in chronic diarrhea
- Newborn gut is sterile → no flora to convert Vit K1 to Vit K2 → risk of bleeding

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### ➤ **Vitamin K injection**

- ✓ Preterm: 0.5 mg IM
- ✓ Term: 1 mg IM (1 ml)
- ✓ Best site: Vastus lateralis muscle (thigh)

### ➤ **Role of Vitamin K:**

- ✓ Essential for synthesis of clotting factors II, VII, IX, X
- ✓ Most important = Factor II (Prothrombin), synthesized in liver

### **Nursing Booster Points**

- Identification band color: Blue (male), Pink (female)
- Main cause of Ophthalmia Neonatorum = Neisseria gonorrhoeae
- Delay eye drops for 1 hr → bonding
- Breastfeeding normally within 30 min – 1 hr
- Vitamin K prevents Hemorrhagic Disease of Newborn (HDN)
- Normal BGL = 40–60 mg/dl

## **Growth and Development**

**Growth** – Increase in size, shape, weight of body/organs (Quantitative, measurable, fixed time, physical growth, cephalocaudal → distal to proximal).

**Development** – Skill and physiological maturation (Qualitative, not measurable, lifelong process, cephalocaudal & proximodistal).

**IQ Formula:**  $\text{Mental Age} \div \text{Chronological Age} \times 100$  (Normal = 90–110, Alfred Binet).

### **Weight**

- At birth: 2.5–3.9 kg (average 2.9 kg).
- Physiological weight loss: 5–15% (avg 10%) within 7 days (due to immature kidney, fluid loss, meconium passage, evaporation). Regained by 10 days.
- Weight gain: 20–25 g/day (1st 6 months), 15 g/day (next 6 months).
- **How to Measure:** Use infant weighing scale (naked or light clothing, before feed). Weigh same time daily if monitoring.

### **Milestones:**

- Birth: 2.5–3.9 kg
- 5–6 months: Doubles (≈5–6 kg)
- 1 year: Triples (≈9 kg)
- 2 years: 4× birth weight
- 3 years: 5×
- 6 years: 6×
- 7 years: 7×
- 10 years: 10×

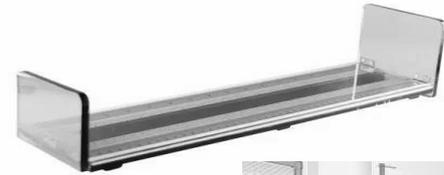
### **Monitoring:**

- 1 yr – monthly
- 2 yr – every 2 months
- 3 yr – every 3 months
- **Best indicator of nutrition & fluid balance = Weight**

### **Length / Height**

- At birth: 48–53 cm (avg 50 cm)
- 3 months: 60 cm

- 9 months: 70 cm
- 12 months: 75 cm (1.5× birth length)
- 4–4.5 yrs: 100 cm (double birth length)
- 13–15 yrs: triple (≈150 cm)
- Adult: Male 170 cm, Female 165 cm
- Infant (<2 yrs): Infantometer (baby supine, head fixed, legs stretched).
- Child/adult (>2 yrs): Stadiometer (barefoot, upright, heels & occiput touching wall).



**Johnson's Formula (2–12 yrs):** Height = Age (yrs) × 6 + 77 cm

### Head Circumference (HC)

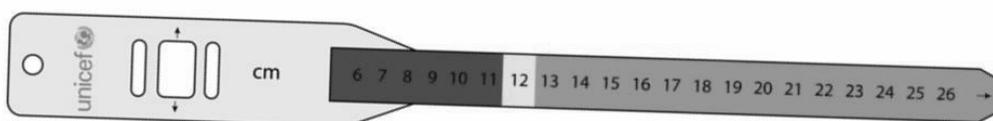
- At birth: 33–37 cm (avg 35 cm)
- Growth: +2 cm/month (first 3 months), +1 cm/month (next 3 months), up to 45 cm at 1 year
- 2 yrs: 48 cm
- 12 yrs: 52 cm (adult size)
- Abnormal: +1 cm/week = Hydrocephalus, +1 cm/month = Microcephaly
- **How to Measure:** Place non-stretchable measuring tape around most prominent part of occiput and just above eyebrows (supraorbital ridge).
- **Brain growth:** 90% complete by 3 yrs → HC monitoring crucial till 3 yrs.

### Chest Circumference (CC)

- At birth: 30–32 cm (≈3 cm less than HC)
- At 6 months: 43 cm
- At 1 year: HC = CC (45 cm)
- **How to Measure:** Tape around chest at nipple line during end expiration.
- Abnormal shapes:
  - ✓ Barrel chest – Rickets, emphysema, pneumothorax
  - ✓ Pigeon chest – Rickets

### Mid Upper Arm Circumference (MUAC)

- At birth: 11–12 cm
- 1 yr: 15–16 cm
- 2 yrs: 17–18 cm
- 12 yrs: 20–21 cm
- <12.5 cm → indicates malnutrition.
- **How to Measure:** Use Shakir's tape at midpoint between acromion (shoulder) and olecranon (elbow) on left arm, arm relaxed at side.



**Tool:** Shakir tape.

**Green (>13.5 cm):** Normal nutrition

**Yellow (12.5–13.5 cm):** At risk of malnutrition / moderate malnutrition

**Red (<12.5 cm):** Severe Acute Malnutrition (SAM)

Best nutrition indicator: weight > MUAC.

### Upper : Lower Segment Ratio

- At birth: 1.8 : 1
- 3 yrs: 1.3 : 1
- 12 yrs: 1 : 1 (adult ratio)

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➤ **How to Measure:**

- ✓ Upper segment = vertex → symphysis pubis.
- ✓ Lower segment = symphysis pubis → sole of foot.
- Midpoint: At birth = 1–2 cm above umbilicus, 3 yrs = at umbilicus, 12 yrs = symphysis pubis.

**Abdominal Circumference & Capacity**

- At birth: 30 ml
- Infant: 90 ml
- Adult: 1.5–2 L
- **How to Measure:** Place tape around abdomen at level of umbilicus

**Ossification Centers**

**At birth – 5 centers:** distal femur, proximal tibia, calcaneus, cuboid, talus.

- Wrist: 3 centers at 2 yrs.
- First ossified bone in fetus: clavicle (5th week).
- Bone origin: mesoderm (except skull = ectoderm).

**Screening test:** Guthrie test for Phenylketonuria (heel prick).

**Teeth Eruption**

**Primary (20 teeth):**

- First tooth: Lower central incisor – 6 months
- Upper central incisor – 8 months
- Upper lateral incisor – 9 months
- Lower lateral incisor – 10 months
- First molar – 12–14 months
- Canine – 16–17 months
- Second molar – 24–30 months (all 20 teeth by 2.5 yrs)
- Shedding begins at 4–5 yrs, completed by 13 yrs

**Permanent (32 teeth):**

- First permanent molar: 6 yrs
- Incisors: 7–8 yrs
- Canines & premolars: 12 yrs
- Second molar: 12 yrs
- Third molar (wisdom tooth): 18–23 yrs

**Other Notes:**

- Natal teeth: present at birth
- By 3 yrs child can brush teeth
- All primary teeth replaced by 13 yrs

**Nursing Booster Points**

- Best indicator of nutrition = Weight
- Brain grows 90% by 3 yrs → HC most important early measure
- Weight milestones: Double at 5 mo, Triple at 1 yr, 4× at 2 yrs
- Height doubles at 4 yrs, triples by adolescence
- MUAC < 12.5 cm → undernutrition
- First tooth eruption: Lower central incisor at 6 months
- First permanent tooth: 1st molar at 6 yrs



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## Developmental Milestones

Developmental milestones are special achievements that indicate a child's **physical growth**, **neuromuscular maturity**, and **social well-being** at particular ages. These guide pediatric assessment and help nurses track normal and abnormal development.

### Infancy (0–12 Months)

#### **1–2 Months**

- Recognizes mother (1 month)
- Social smile (2 months)
- Regards bright-colored objects at 20 cm
- Cries when hungry
- Turns head when hungry
- Lifts chin momentarily (by 6 weeks)
- **Language:** Turns head toward sound

#### **2–3 Months**

- Complete head holding (3 months)
- Cooing sounds (3 months)
- Enjoys talking with people
- Follows moving objects

#### **4–5 Months**

- Sits with support
- Brings objects to mouth
- Joins hands to play
- Laughs loudly (4 months)

#### **5–6 Months**

- Enjoys mirror images
- Transfers objects from one hand to another
- Rolls from prone to supine
- Stranger anxiety begins (6–7 months)
- **Language:** Monosyllabic sounds (pa, ma, da, ka)

#### **7–9 Months**

- Resists toys being taken (7–8 months)
- Sits without support (7–8 months)
- Pincer grasp (9 months)
- Creeping (crawls on abdomen) – 9 months
- Standing with support – 9 months
- **Language:** Bisyllabic words (papa, mama)

#### **9–10 Months**

- Understands emotions (anger, anxiety)
- Waves bye-bye
- Crawls on hands and knees with stomach off floor (10 months)

#### **12 Months**

- Stands without support
- Walks with support