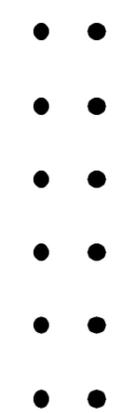
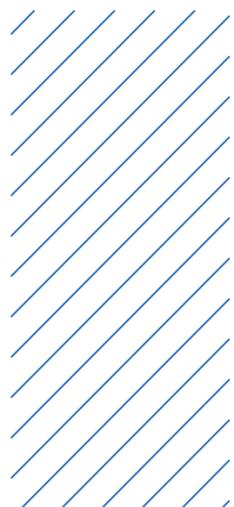
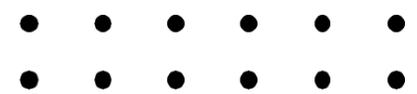
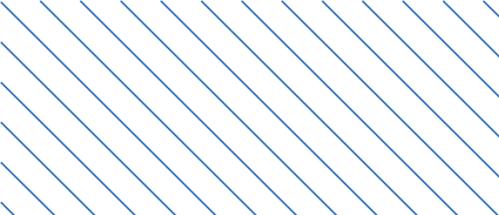


I.V FLUIDS



Done by :
Ghaith abu sallal
Hamzeh Nawafleh
Mosab Shgayrat
Baraa bani baker
Eman Al Shwawreh
Ahmad Aldina





Content

1. TBW & fluid compartments
2. Fluids input & output
3. Osmolarity & tonicity
4. I.V fluids types
5. I.V fluids indications
6. Blood products
7. Hypovolemia & hypervolemia
8. Maintenance and Deficit
9. Equipment of I.V therapy

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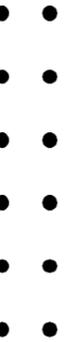
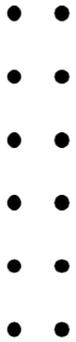
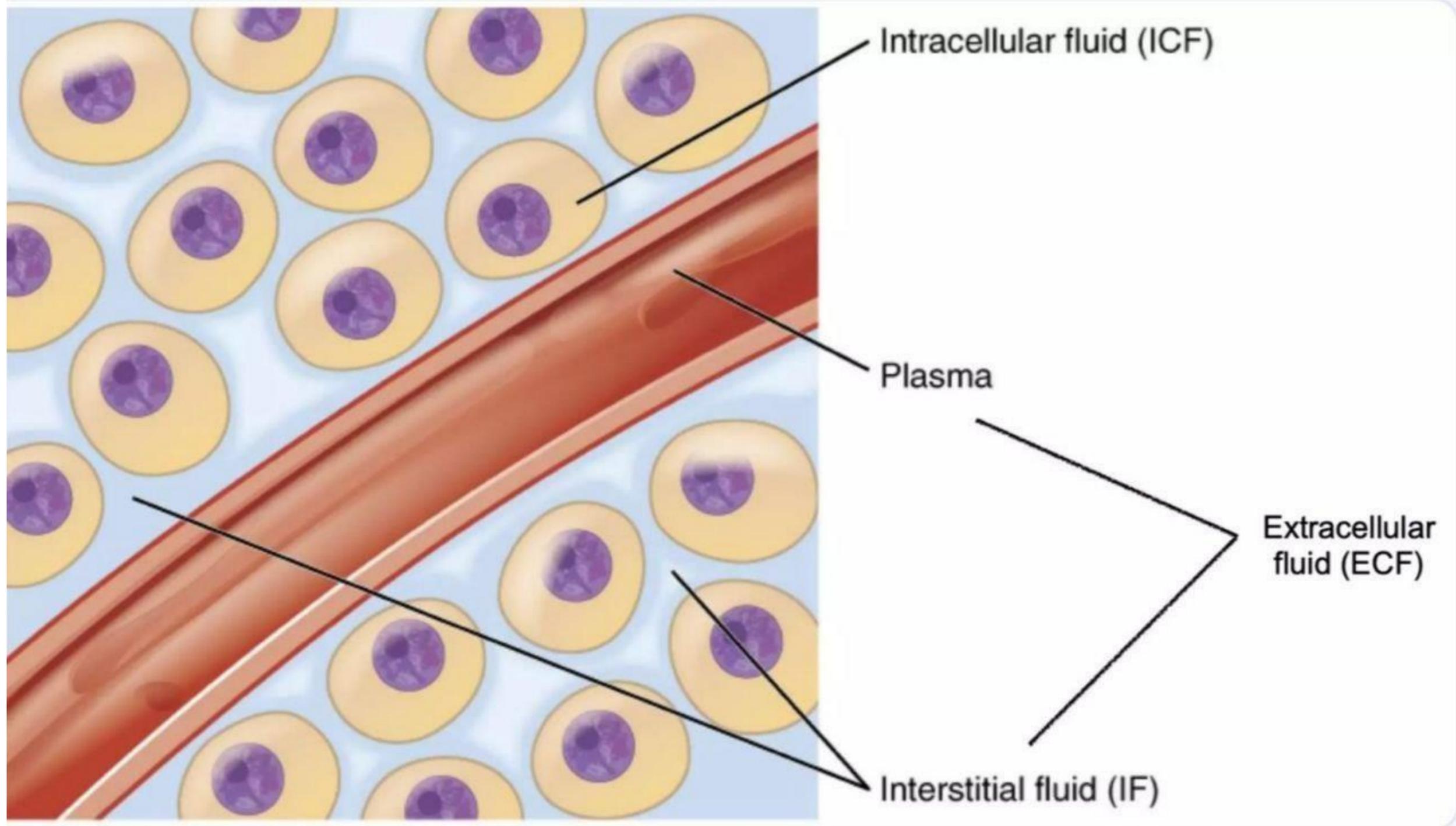
What are IV FLUIDS ?

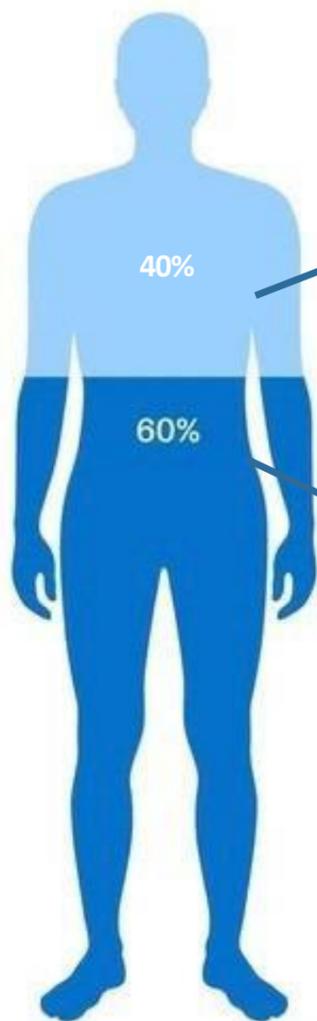
- ❑ IV fluids are specially formulated liquids that are injected into a vein to prevent or treat dehydration



Total body water

- ❑ highest percentage of TBW is found in **newborns**, with approximately 80% of their total body weight composed of water.
- ❑ The body of a healthy 70 kg male contains about **42 litres** of water. That is, total body water constitutes about **60%** of his total body weight.





40%
non-water

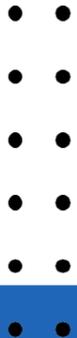
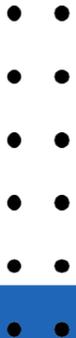
60%
water

1/3
extracellular

2/3
intracellular

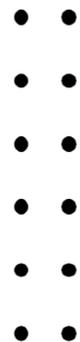
1/4
plasma

3/4
interstitial



Fluid Input

- The normal daily input-of water(oral intake) is about **2000 ml** of water
- an additional **200-300 ml** per 24 hours is provided endogenously by oxidation of carbohydrate and fat (i.e. metabolic water). This is consistent with daily water losses (output).



Fluid Output

- A healthy individual loses fluid and electrolytes by **three routes**:
via the kidneys, via the gastrointestinal tract, and by evaporation from the skin and respiratory tract(**insensible water loss !**)



Fluid Output

- Daily water loss averages **2000-2500 mL** and is typically accounted for by
 - **1500 mL** in **urine**,
 - **Insensible losses :**
 - **400 mL** in **respiratory** tract evaporation
 - **400 mL** in **skin** evaporation
 - **100 mL** in **sweat**
 - and **100 mL** in **feces**.

Fluid Output

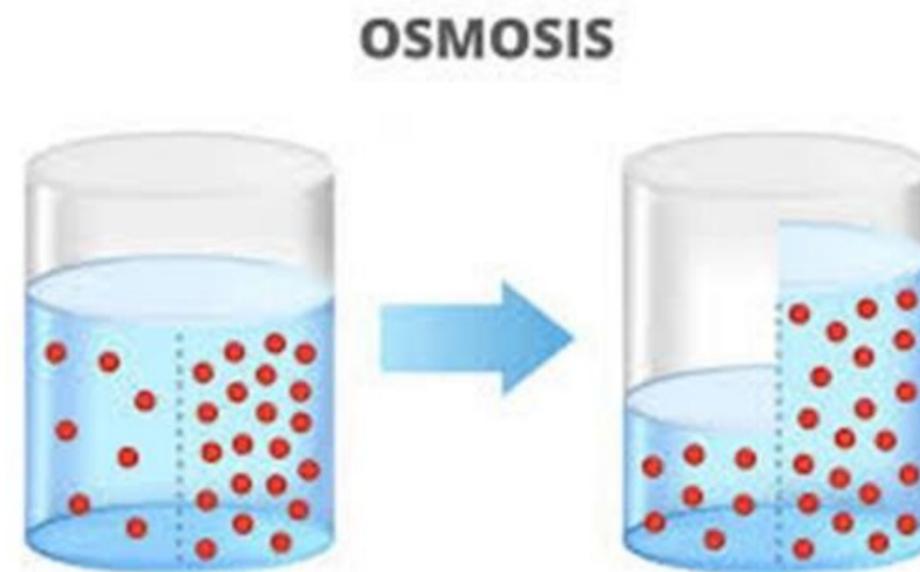
- ❖ **Invisible losses increase in some Pathologic states like :** -
Burn(destroy of skin layers) -Fever
- ❖ **Pyrexia** increases water loss from the skin by approximately **200 ml/day for each 1 °C** rise temperature.
- ❖ **Hyperventilation** increases insensible water loss via the respiratory tract



Osmolarity & Tonicity

Osmosis: simple diffusion of water from high conc. of water to low conc. of water across semi permeable membrane.

- The distribution of fluid between the intra- (the **plasma**) and extravascular compartments (**interstitial fluids**) is dependent on the oncotic pressure of plasma and the permeability of the endothelium. The plasma oncotic pressure is determined by the presence of colloid particles, of which albumin is the most important .

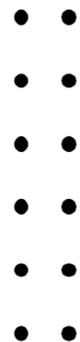


Osmolarity of solution is equal to number of osmoles per liter of solution.

Normal range of osmolarity in plasma is about 280-295 milli-osmoles per liter.

calculation of plasma osmolarity

- osmolality of extracellular fluid is determined primarily by sodium and chloride concentrations. The following equation is a calculation of the serum osmolality;
- **Osmolality = 2 sodium + glucose/18 + BUN (blood urea nitrogen) / 2.8**



$$\text{Plasma osmolarity} = 2[\text{Na}^+] + \frac{\text{Glucose}}{18} + \frac{\text{BUN}}{2.8}$$



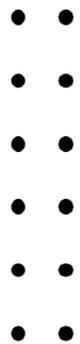
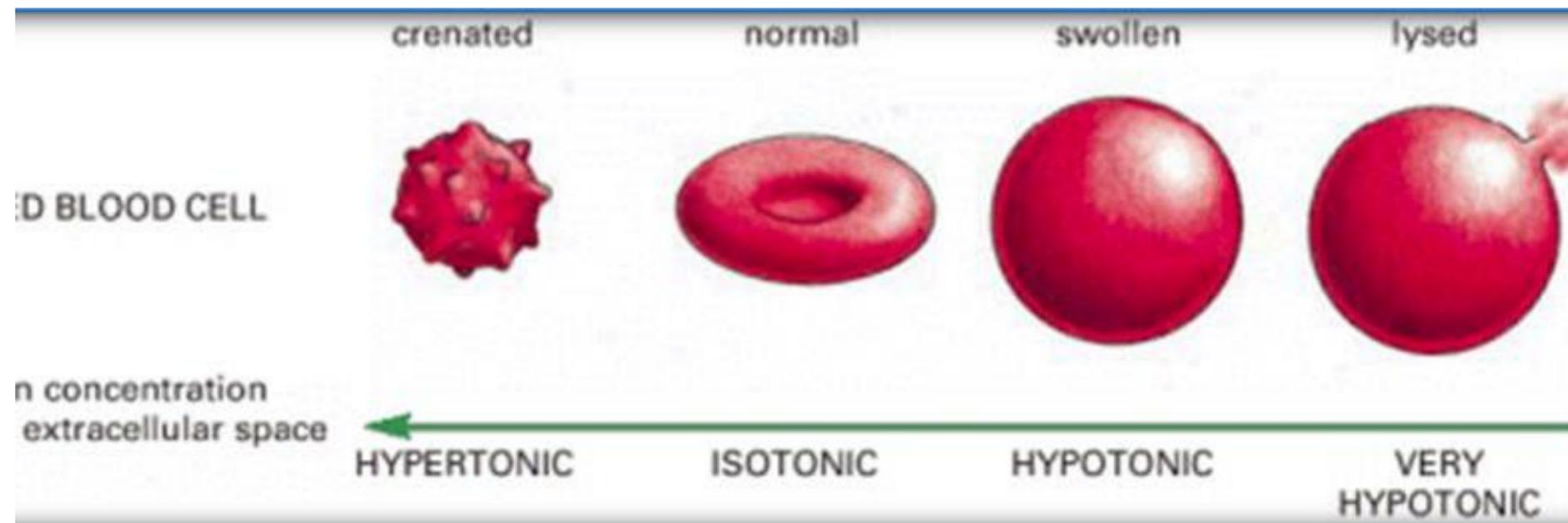
NOTE: Sodium is the largest determinant of plasma osmolarity



Tonicity is the total conc. of solutes which make an osmotic force across a membrane.

- The term tonicity is used to describe the osmolarity of a solution relative to **plasma (280-295)**.

- Isotonic (osmolarity of a solution ~ to **plasma**)
- hypertonic (osmolarity of a solution > to **plasma**)
- hypotonic (osmolarity of a solution < to **plasma**)





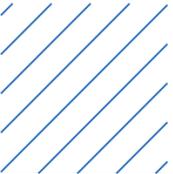
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Intervenors fluids:

IV fluids, or intravenous fluids, are sterile liquids administered directly into a patient's bloodstream through a vein using an intravenous (IV) catheter. They are used to:

- 1.Rehydrate:** Replace lost fluids due to dehydration, vomiting, or diarrhea.
- 2.Electrolyte balance:** Correct imbalances of electrolytes like sodium, potassium, and calcium.
- 3.Nutritional support:** Provide nutrients, such as glucose or vitamins, when a patient cannot eat.
- 4.Medication delivery:** Administer medications directly into the bloodstream for immediate effect.

IV fluids come in various types, including isotonic, hypotonic, and hypertonic solutions, each serving different medical needs.



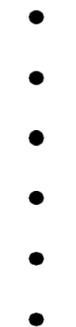
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• • Intervenor fluids type:

- • IV fluids can be classified based on their tonicity, composition, and purpose:

1. Based on Tonicity

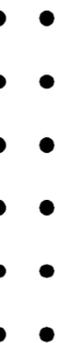
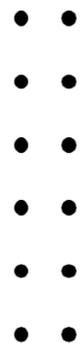
- **Isotonic Solutions:** Have the same osmolarity as blood plasma, They help maintain fluid balance without shifting fluids in or out of cells, Examples include:
 - Normal Saline (0.9% Sodium Chloride) / Lactated Ringer's Solution / Dextrose 5% in Water (D5W)
- **Hypotonic Solutions:** Have a lower osmolarity than blood plasma, They cause fluid to move into cells, helping with hydration, Examples include:
 - 0.45% Sodium Chloride (Half Normal Saline) / Dextrose 2.5% in Water
- **Hypertonic Solutions:** Have a higher osmolarity than blood plasma, They draw fluid out of cells, which can be useful in certain medical conditions, Examples include:
 - 3% Sodium Chloride / Dextrose 10% in Water



Intervenors fluids type (2):

2. Based on Composition:

- **Crystalloids:** Solutions containing small molecules that can easily cross cell membranes. Common examples include saline and dextrose solutions.
- **Colloids:** Solutions containing larger molecules (like proteins) that do not easily cross cell membranes. They are used to expand blood volume. Examples include:
 - Hydroxyethyl starch (HES)
 - Albumin

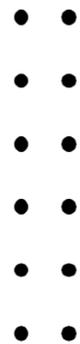


Intervenors fluids type (3):

3. Based on Purpose:

- **Maintenance Fluids:** Used to maintain fluid balance in patients who are unable to eat or drink.
- **Replacement Fluids:** Used to replace lost fluids and electrolytes due to surgery, illness, or dehydration.
- **Nutritional Fluids:** Provide essential nutrients and calories to patients who cannot eat, often used in total parenteral nutrition (TPN).

Each type of IV fluid has specific indications and should be chosen based on the patient's clinical condition.



Intervenors fluids type (4):

4. Types of IV Fluids Based on Clinical Uses:

- **Preoperative Fluids:** Used to prepare patients before surgery to ensure fluid balance.
- **Emergency Fluids:** Used in emergencies such as trauma or bleeding, where rapid fluid replacement is required.
- **Supportive Fluids:** Used to support the patient during treatment, such as in chemotherapy cases.

5. Indications for Using IV Fluids

- • **Dehydration:** To prevent dehydration from vomiting or diarrhea.
- • **Injuries:** To compensate for lost fluids due to injury or surgery.
- • **Diabetes:** In diabetes cases, fluids may be used to regulate glucose levels.
- • **Critical Conditions:** Such as organ failure or shock, where vital functions need immediate support.
- •

Types

Three main types

- Crystalloids
- Colloids
- Blood products



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• Normal Saline (NaCl)

0.9% Normal Saline

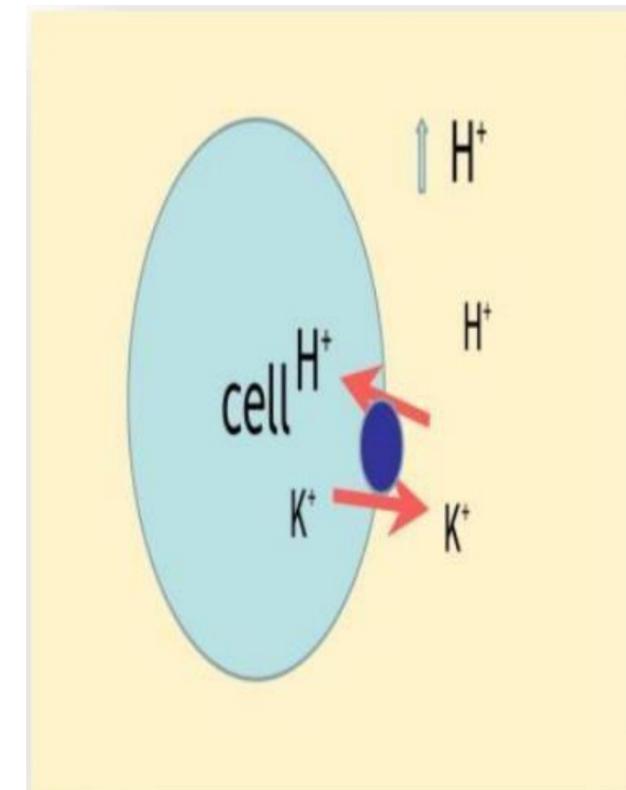
- Approximately same osmolarity as plasma
- $[Na] = [Cl] = 154 \text{ mmol/liter}$
- total osmolarity = 308 mOsmol/liter vs. 285 mOsm/L plasma
- isotonic
- 25% remains in intravascular space
- Used for volume replacement
- Hypovolemic shock
- Septic shock

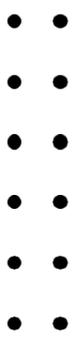
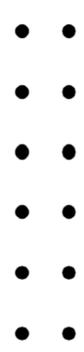
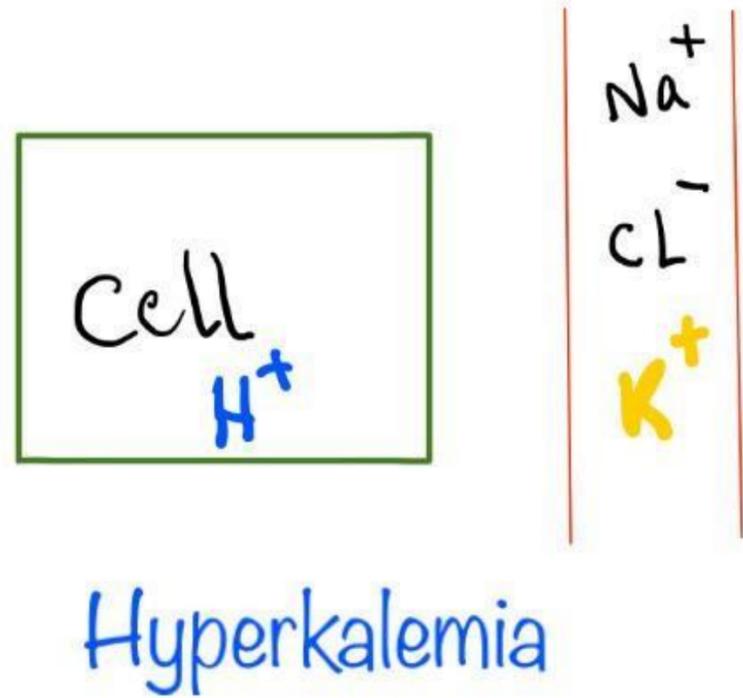
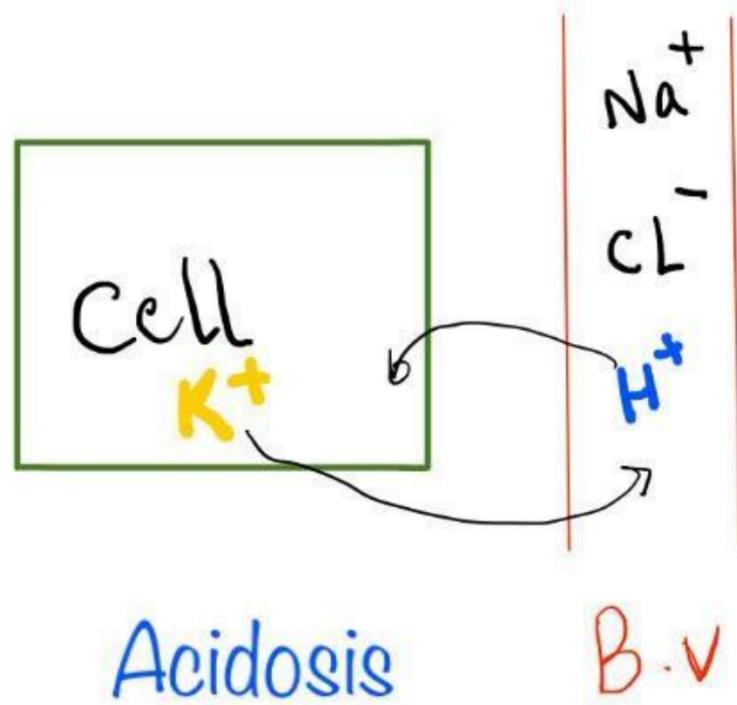
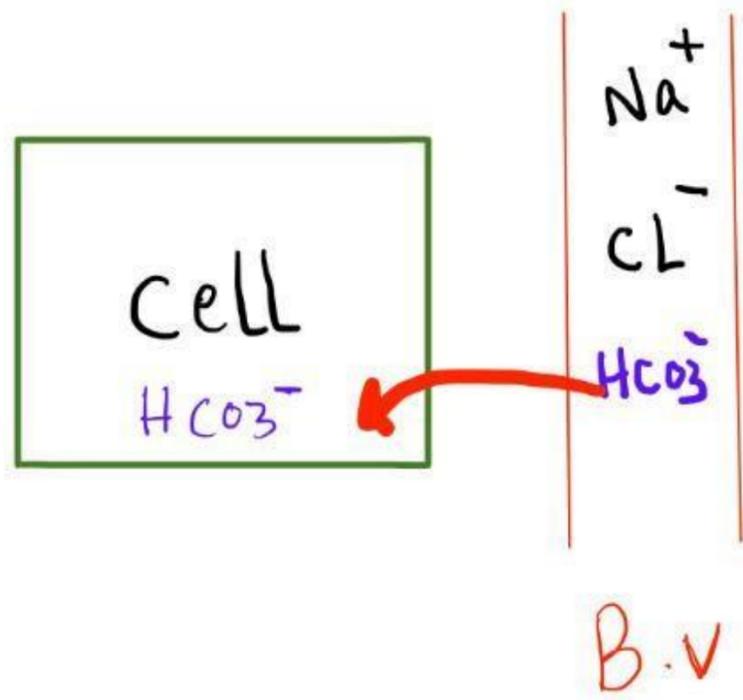
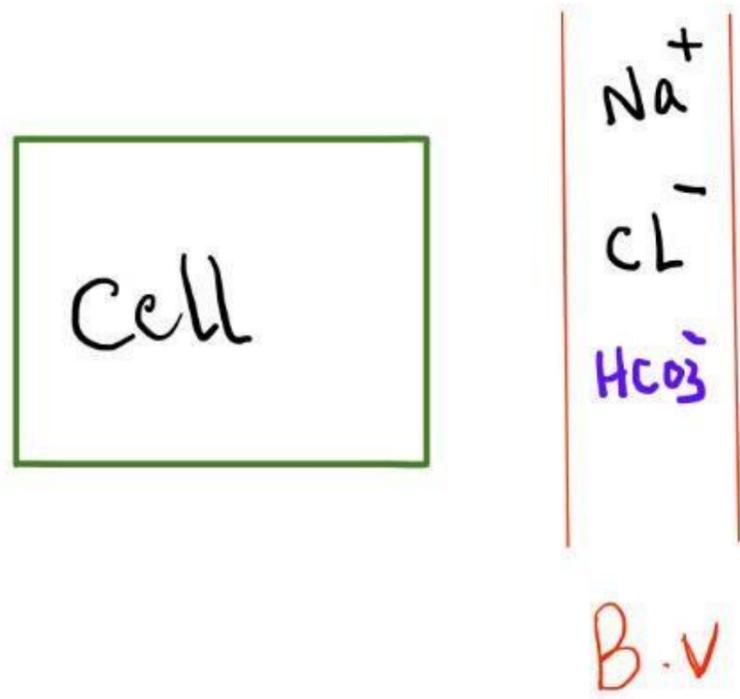


Normal Saline

Normal Saline Results in influx of chloride ions (Cl)

- Causes shift of bicarbonate ions (HCO_3) into cells
- Causes acidosis (pH)
- Acidosis \rightarrow potassium shift out of cells
- T serum potassium
- "Hyperchloremic metabolic acidosis"
- contraindications:
CHF, CKD, Liver cirrhosis





Half Normal Saline

- 0.45% Normal Saline
- $[Na] = [Cl] = 77 \text{ mmol/liter}$
- total osmolarity = 154 mOsmol/liter vs. 285 mOsm/L plasma
- Hypotonic solution concentration of sodium chloride

Does not remain intravascular



LACTATED RINGER

Sodium, chloride, potassium, calcium, and lactate.

- "Balanced fluid"
- Isotonic: osmolarity 286 mOsm/L
- 25% remains in intravascular space
- Lactate metabolized to bicarbonate
- Acts as buffer in acidotic states
- Most common use: trauma resuscitation



Indications & Contraindications

Indications:

- •First-line replacement therapy in the perioperative period.
 - •Fluid resuscitation after a blood loss due to trauma, surgery, or a burn injury.
 - •Replace GI tract fluid losses.
 - •Metabolic acidosis.
-

Indications & Contraindications

Contraindications:

- Poor liver function. (affect lactate metabolism → Lactic acidosis)
 - Hyperalkalosis
 - Citrated blood transfusions
 - (Clumping of red cells if it is co-administered with blood products)
-

DEXTROSE SOLUTION 5%

Dextrose solution 5% (5 g of dextrose/100 ml water) does not contain any electrolytes.

The dextrose is rapidly metabolized in the body, such that dextrose solution is equivalent to administering water; which distributes rapidly and evenly throughout the entire body fluid compartments.

It is also useful for replacing water deficit, in patients with hypernatremia.



Hypertonic Saline

Hypertonic Saline

- Hypertonic: ~900 mOsm/liter
- Draws fluid out of tissues into vascular space
- ICF \longrightarrow ECF
- Used in two circumstances:
 1. Elevated intracerebral pressure
 2. Severe hyponatremia



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Hypervolemia

- Causes:
 - Heart failure
 - Cirrhosis
 - Nephrotic syndrome
- Clinical features:....
 - Weight gain
 - Pitting edema
 - Elevated jugular venous pressure
 - Pulmonary edema
- Treatment:
 - Diuretics



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Hypovolemia

- Causes:
 - Vomiting/diarrhea
 - Poor oral intake
 - Third spacing/fluid leak: sepsis, trauma
- Clinical features:
 - Decreased urine output
 - Dry mucous membranes
 - Poor skin turgor
- Treatment:
 - Oral intake
 - IV fluids



Maintenance and Deficit

Maintenance of fluid

Maintenance fluids address the patient's physiological needs. (4-2-1 rule)

(4ml/kg for the first 10kg) + (2ml/kg for 11-20kg) + (1ml/kg for every kg above 20) = hourly rate

Deficit

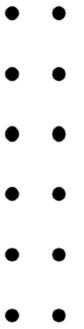
Deficit = normal maintenance fluid rate x number of hours starved

In the first hour of surgery 50 % of the deficit should be replaced, and 25 % during each of the second and third hours

Example:

Calculate the hourly maintenance fluid rate for a 70kg patient who is NPO (4ml x 10kg) + (2ml x 10kg) + (1ml x 50kg)

40ml + 20ml + 50ml = 110ml/hr



Maintenance and Deficit

Example:

Calculate the hourly maintenance fluid rate for a 50 kg patient who is NPO for 8 hours

→ first calculate the maintenance:

$$(4\text{ml} \times 10\text{kg}) + (2\text{ml} \times 10\text{kg}) + (1\text{ml} \times 30\text{kg}) = 40\text{ml} + 20\text{ml} + 30\text{ml} = 90\text{ml/hr}$$

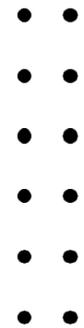
→ deficit :

$$(90 \text{ ml} * 8) = 720 \text{ ml}$$

Maintenance of electrolytes:

Na⁺: 3 mEq/kg/day, K⁺ : 1 mEq/kg/day

e.g. Calculate a 50 kg patient's maintenance requirements • Fluid = 40 + 20 + 30 = 90 mL/hour = 2160 mL/day

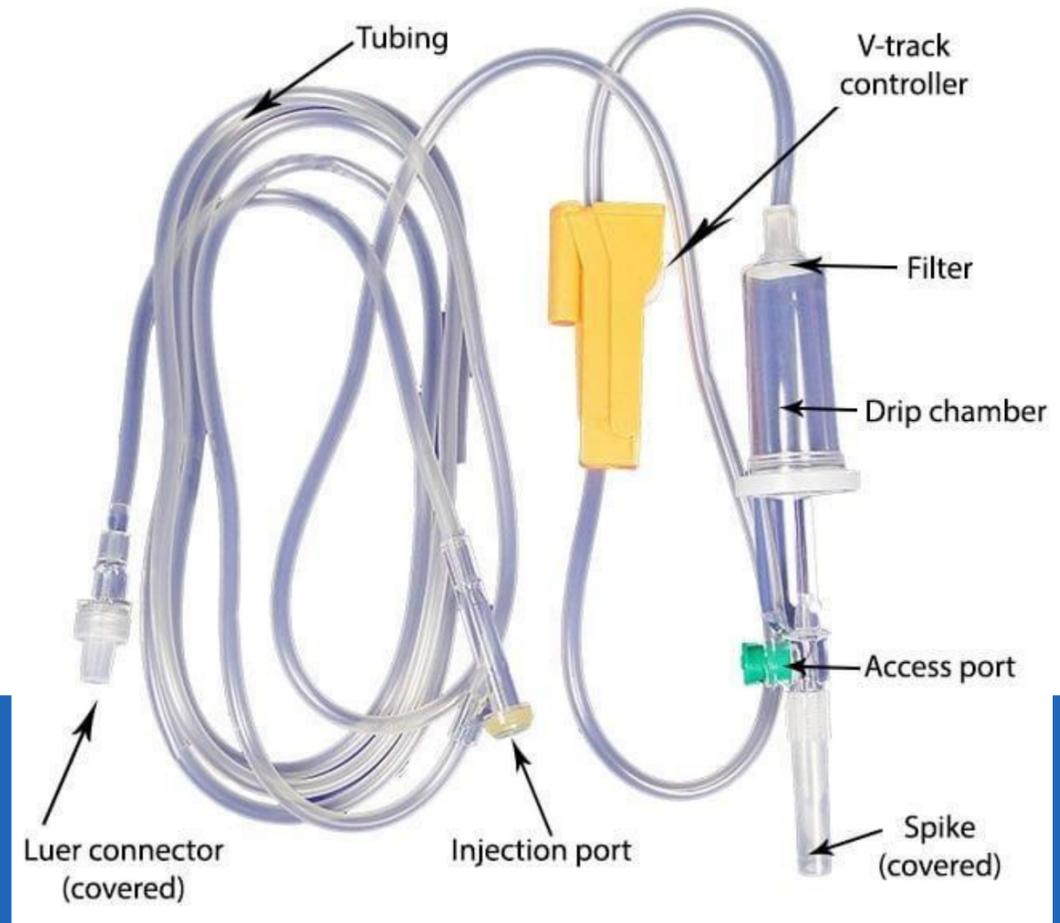
- Na⁺ = 150 mEq/day
 - K⁺ = 50 mEq/day
- 
- 

Equipment of I.V. therapy

1. Solution containers.



2. I.V. administration sets.



3- IV CANNULA:

- Present day IV cannula are available from sizes 14 gauge to 26 gauge with universal color coding for easy recognition of IV cannula. Smaller the gauge, wider is the cannula and has higher flow rate.

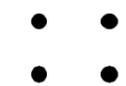
1. orange color

- 14 Gauge.
- 2 mm diameter.
- 300 ml/min flow rate.



2. grey color

- 16 Gauge.
- 1.6 diameter.
- 150-180 ml/min flow rate.



**14-16 G used in situations requiring rapid fluid transfusion like trauma

Colour
Orange

Gauge
14G

Typical Flow Rate
300ml/min

Diameter
2mm.

Typical Usage

Mainly used in:

- Trauma, high risk Surgery
- For rapid infusion, of whole blood, blood components or viscous fluids

Colour
Grey

Gauge
16G

Typical Flow Rate
160-180ml/min

Diameter
1,6mm

Typical Usage

Mainly used in:

- Trauma, or surgery when high volume fluids required quickly
- For rapid infusion, of whole blood, blood components or viscous fluids

• • • •
• • • •
3. Green color:

- 18 gauge.
- 1.2 mm diameter.
- 80 ml/min flow rate.

4. Pink color:

- 20 gauge.
- 1 mm diameter
- 55 ml/min flow rate.

5. Blue color

- 22 gauge.
- 0.8 mm diameter
- 30-35 ml/min flow rate.



• • • • • •
• • • • • •

****18-20 G size used in normal adult**

Colour Green
Gauge 18G
Typical Flow Rate 80ml/min
Diameter 1.2mm
Typical Usage Mainly used in: <ul style="list-style-type: none">• Total parenteral nutrition (TPN)• Large volume of crystalloid fluids

• • • • • •
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****pink is most commonly used**

Colour Pink
Gauge 20G
Typical Flow Rate 55ml/min
Diameter 1mm
Typical Usage Mainly used in: <ul style="list-style-type: none">• Multi-purpose• For hydration IV medication, blood sampling

• • • • • •
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****22 G used preferred in pediatric**

Colour Blue
Gauge 22G
Typical Flow Rate 33ml/min
Diameter 0.8mm
Typical Usage Mainly used in: <ul style="list-style-type: none">• Chemotherapy, elderly patients, Paediatrics, slow infusions

• • • • • •
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6. Yellow color:

- 24 gauge.
- 0.7 mm diameter.
- 20 ml/min flow rate.



7. Violet:

- 26 gauge.
- 0.6 mm diameter.
- 15 ml/min flow rate.



**Infants and neonates size: 24-26 G

Colour
Yellow

Gauge
24G

Typical Flow Rate
20ml/min

Diameter
0.7mm

Typical Usage

Mainly used in:

- Short-term infusions
- Frail patients, elderly patients, paediatric patients

Colour
Purple

Gauge
26G

Typical Flow Rate
15ml/min

Diameter
0.7mm

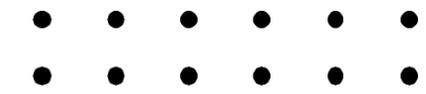
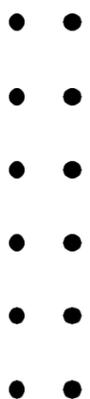
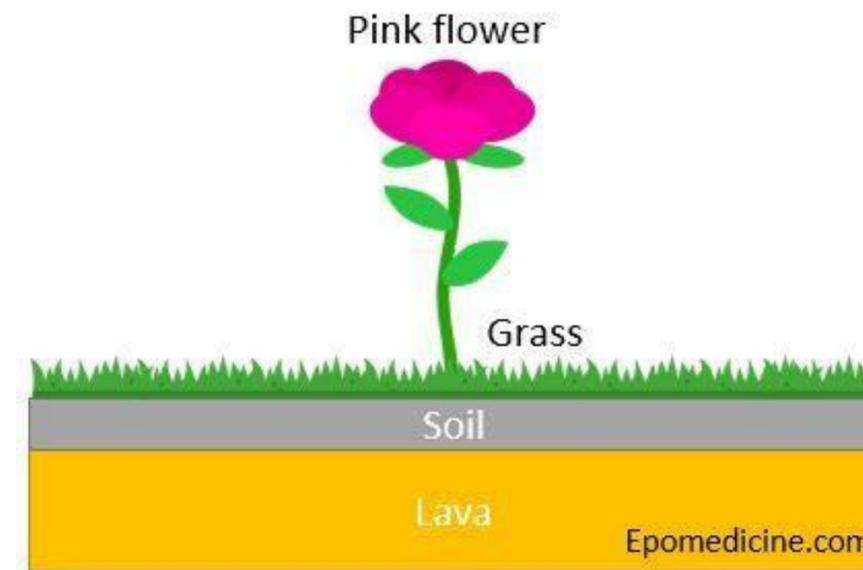
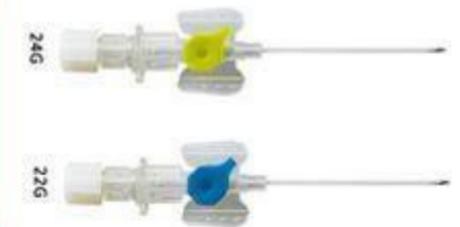
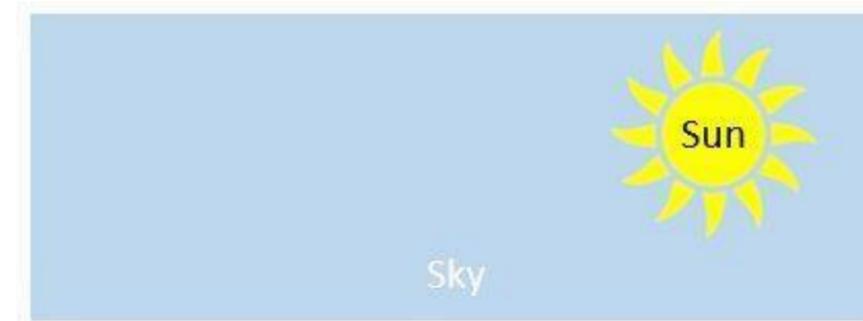
Diameter
0.6mm

Typical Usage

Mainly used in:

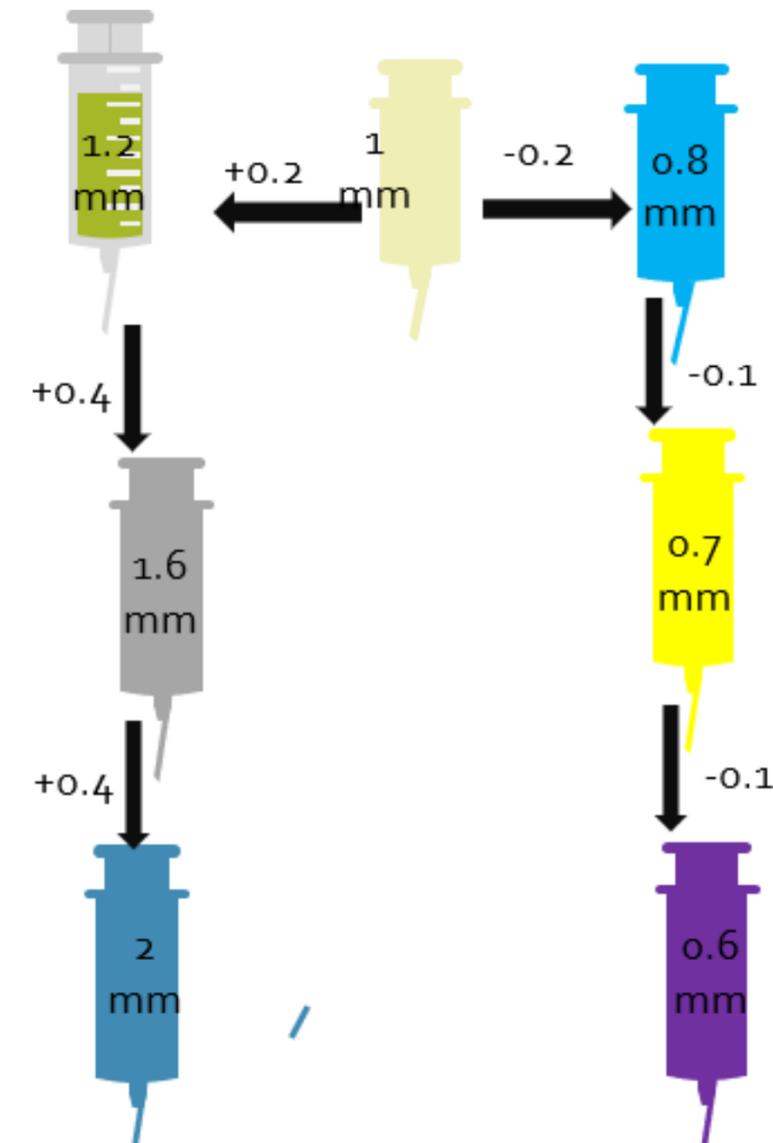
- Paediatric – neonates

1. The earth has magma inside (**orange color**) - 14 G
2. There is soil on surface (**grey color**) - 16 G
3. Grass has grown on the soil (**green color**) - 18 G
4. Pink flower has grown above the grass (**pink color**) - 20 G
5. Above is the blue sky (**blue color**) - 22 G
6. The sun is in the sky (**yellow color**) - 24 G

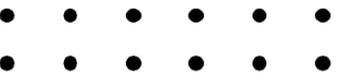
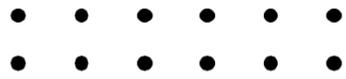


External diameter of cannula :

- Remember the pink (20 G) cannula is **1mm** in diameter. For cannula next to pink: 1 ± 0.2 mm
- 18 G (green): 1.2 mm
- 22 G (blue): 0.8 mm
- For cannula smaller "gauge" than 18 G:
 - 16 G (grey): $1.2 + 0.4 = 1.6$ mm
 - 14 G (orange): $1.6 + 0.4 = 2$ mm
- For cannula larger than 22 G:
 - 24 G (yellow): $0.8 - 0.1 = 0.7$ mm
 - 26 G (purple): $0.7 - 0.1 = 0.6$ mm



<i>Color</i>	<i>Gauge</i>	<i>External diameter (mm)</i>	<i>Length (mm)</i>	<i>Flow rate (mL/min)</i>
Orange	14	2.0	45	300
Gray	16	1.6	45	150
Green	18	1.2	45	80
Pink	20	1.0	33	55
Blue	22	0.8	25	25
Yellow	24	0.7	19	15
Violet	26	0.6	19	14



THANKS!

