

Fluids and Electrolytes

Your Curriculum

- **Describe how you assess the circulatory status of a patient on the ward**
- **Distinguish between the terms dehydration and salt and water depletion and explain how this determines approach to treatments**
- **Discuss the fluid requirements of a stable patient and how they might change as a patient becomes unwell**
- **Discuss the electrolyte requirements of a sick patient**

What we will cover today:

- **Fluid and electrolyte requirements in health**
- **Fluid compartments and their composition**
- **Prescription of fluids**
 - Who
 - How
 - What
- **Electrolytes**
 - Approach to common electrolyte derangements.

Oral intake

1.5-2L

Saliva 1.5L

Gastric Juice 1.5L

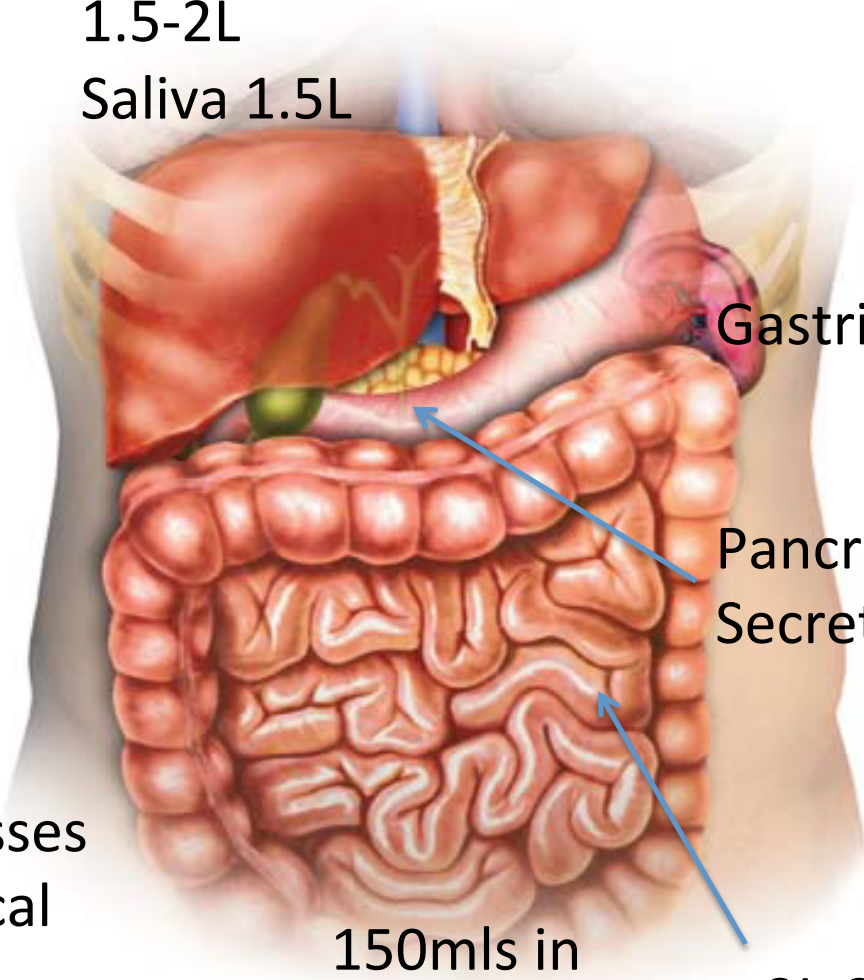
Bile 1L

Pancreatic
Secretions 1.5-2L

1.5L crosses
ileo-caecal
valve

150mls in
faeces

3L Crosses
jejunum
and ileum



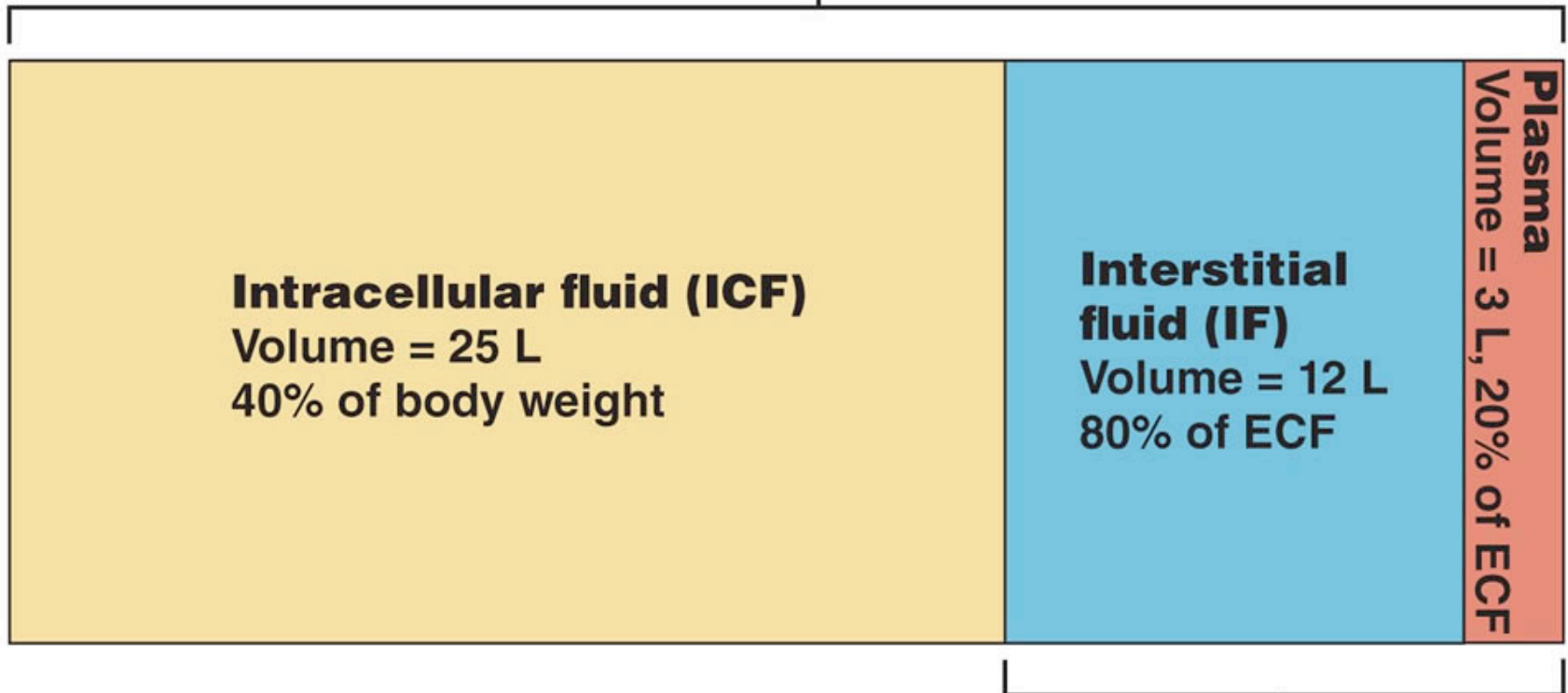
Daily water balance in health

Intake (mls)		Output (mls)	
Oral Intake	1200mls	Urine	1500mls
Food	1000mls	Insensible losses	900mls
Water from oxidation	300mls	Faeces	100mls

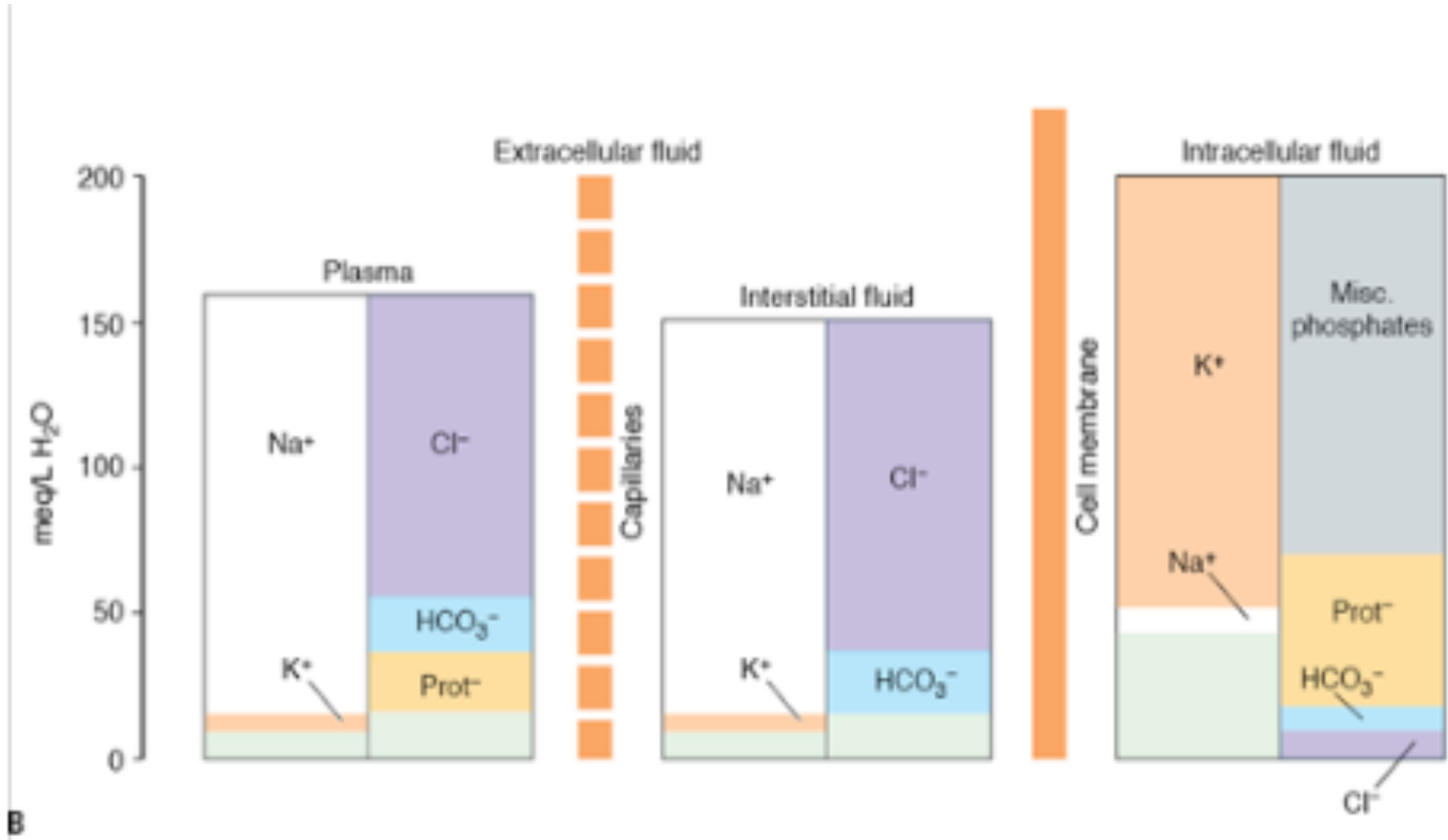
Normal Maintenance requirements

Water	25-35mls/kg/day
Sodium	0.9-1.2mmol/kg/day
Potassium	1mmol/kg/day

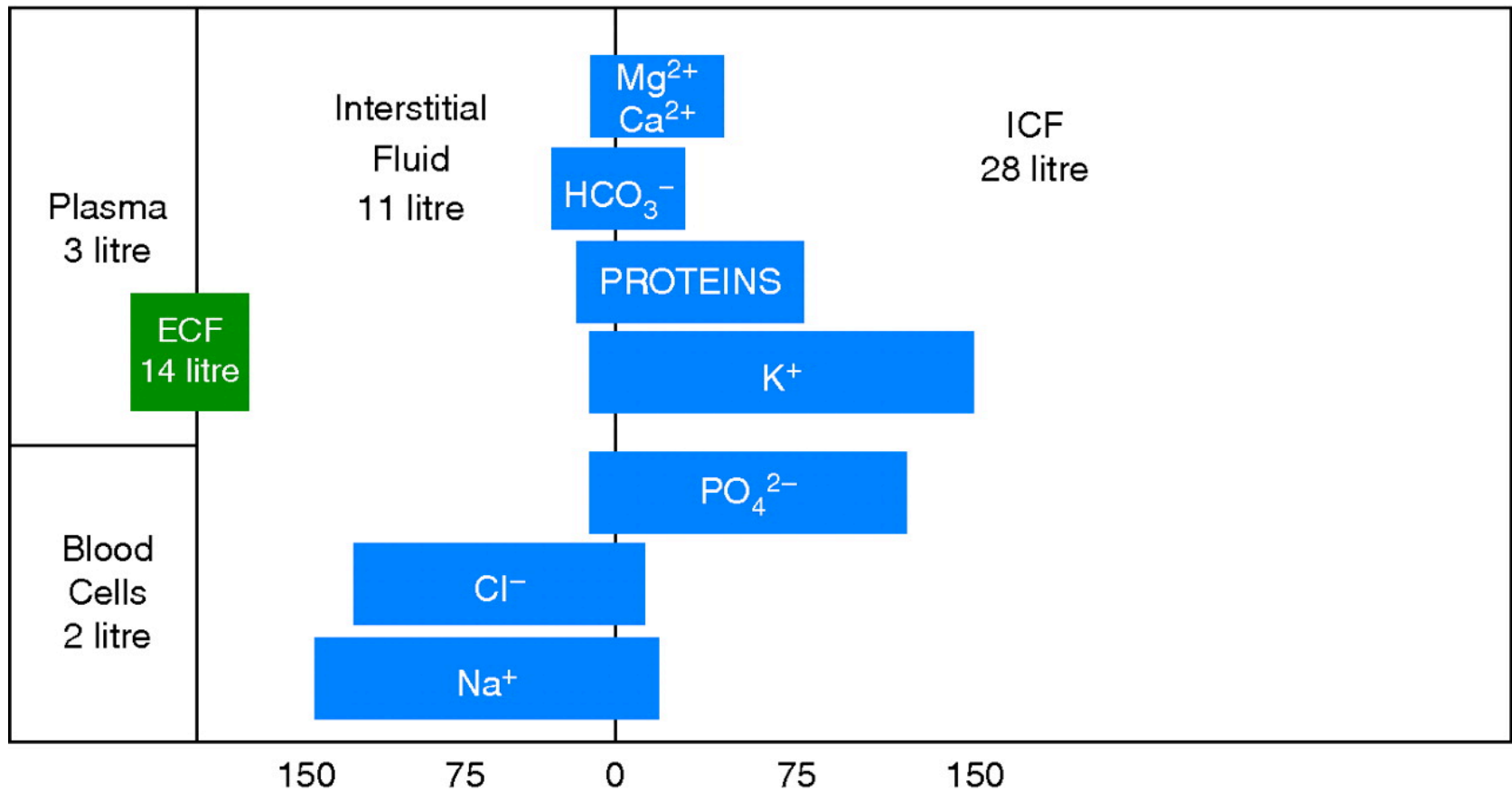
Total body water
Volume = 40 L
60% of body weight



Extracellular fluid (ECF)
Volume = 15 L
20% of body weight



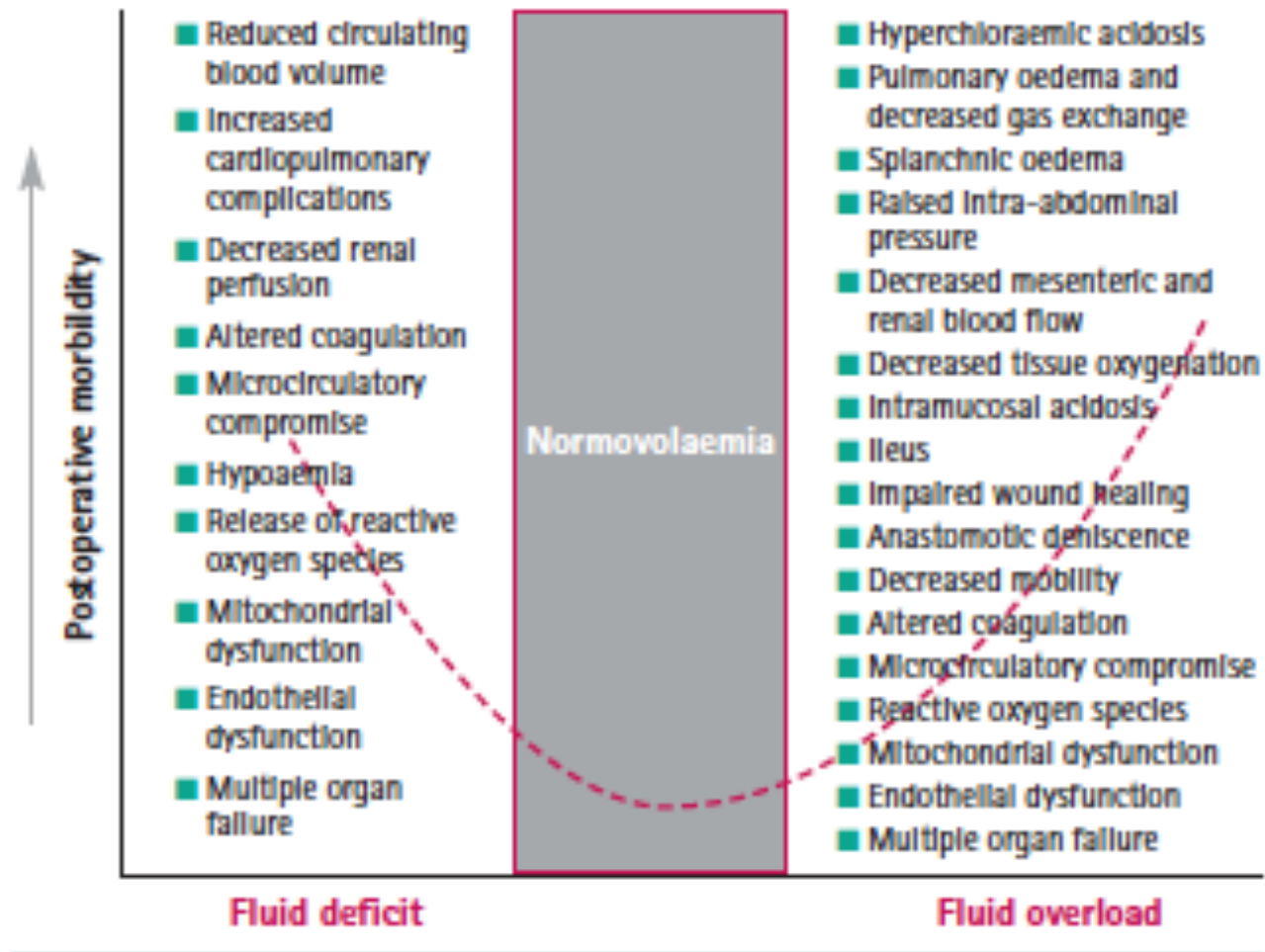
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Prescription of Fluids

What questions should you be answering?

- 1. Does the patient need any prescription at all today?**
- 2. If yes, would they be for**
 1. Resuscitation
 2. Replacement of losses
 3. Maintenance
- 3. What is the patient's current fluid and electrolyte status?**
- 4. Which is the simplest, safest and most effective route of administration?**
- 5. What is the most appropriate fluid to use and how is that fluid distributed in the body?**



Does the patient need any fluid prescribing today?



© Alamy

Does the patient need any fluid prescribing today?



Does the patient need any fluid prescribing today?



For those that do need fluids do they need

- 1. Resuscitation?**
- 2. Replacement?**
- 3. Maintenance?**

This is probably the most important question to be able to answer.....

Who needs Resuscitating?

Patients actively bleeding

- Trauma
- Surgery
- GI bleeding - variceal
- **Severe sepsis/septic shock**
- **GI losses – diarrhoea/vomiting**
- **Pancreatitis**

These patients need urgent restoration and maintenance of circulating volume to maintain the function of vital organs

Replacement Fluids

Incorporate maintenance requirements

AND

Replacement of on-going abnormal losses:

NG aspirate

Fistula output

Polyuria

Sweating/high fever

Maintenance Fluids

Restore insensible losses

Provide sufficient water and electrolytes to maintain body fluid compartments

Provide sufficient water to enable kidney to excrete waste products

Water	25-35mls/kg/day
Sodium	0.9-1.2mmol/kg/day
Potassium	1mmol/kg/day

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What is your patients current fluid and electrolyte status?

History

- Vomiting, diarrhoea, fever, drugs eg diuretics, blood loss, poorly controlled diabetes. Duration of symptoms. Passing urine?

Examination

- Capillary refill, skin turgor, BP, HR, pulse pressure, postural hypotension, peripheral or sacral oedema, weight, JVP

Bedside Tests:

- Observation charts, urine output, fluid balance charts

Investigations:

- Haematocrit, Urea, Electrolytes, Albumin, Osmolality, blood gas

Which is the simplest, safest and most effective route of administration?

Oral route whenever possible

- ORS

In acute situations or with GI dysfunction or large fluid losses intravenous is going to be the preferred route

- This should be reviewed and stopped at the earliest opportunity

What is the most appropriate fluid to use and how is that fluid distributed in the body?

WHAT IS THE IDEAL FLUID?

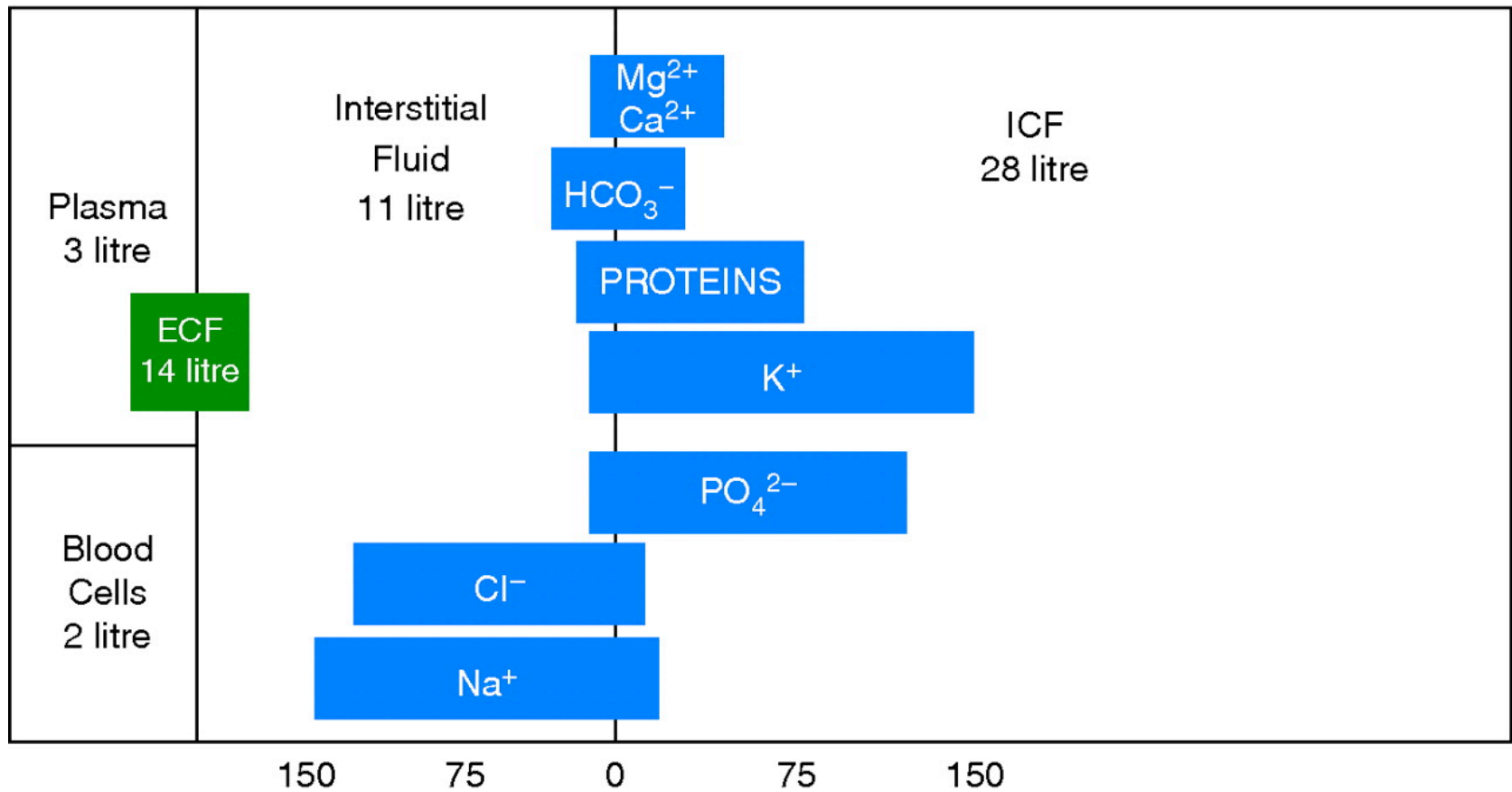
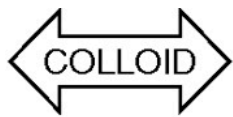
The Ideal Fluid

- Produces a predictable and sustained increase in intravascular volume
- Chemical composition as close as possible to extracellular fluid
- Is metabolised and excreted without accumulation in tissues
- No adverse metabolic or systemic effects
- Is cost-effective

**THERE IS CURRENTLY NO SUCH
FLUID AVAILABLE**

Commonly Used Crystalloids

	Plasma	0.9% saline	Hartmanns	5% Dextrose
Sodium (mmol/L)	135-145	154	131	0
Chloride (mmol/L)	95-105	154	111	0
Potassium (mmol/L)	3.5-5.3	0	5	0
Bicarbonate (mmol/L)	24-32	0	29	0
Calcium (mmol/L)	2.2-2.6	2	2	0
Magnesium (mmol/L)	0.8-1.2	0	0	0
Glucose (mmol/L)	3.5-5.5	0	0	227.8 (50g)
pH	7.35-7.45	4.5-7.0	5.0-7.0	3.5-5.5
Osmolality (mOsmol/L)	275-295	308	273	278



Volume of Infusion Required to Expand Plasma Volume by 1L

Fluid	Infused Volume (mls)	Change in interstitial fluid volume (mls)	Change in intracellular fluid volume (mls)
5% Albumin	1400 - 1500	400 - 500	
25% Albumin	250	- 750	
Hartmanns/0.9% saline	4000 - 5000	3000 - 4000	
5% Dextrose	12000 - 14000	3000 - 4000	9000 - 10000

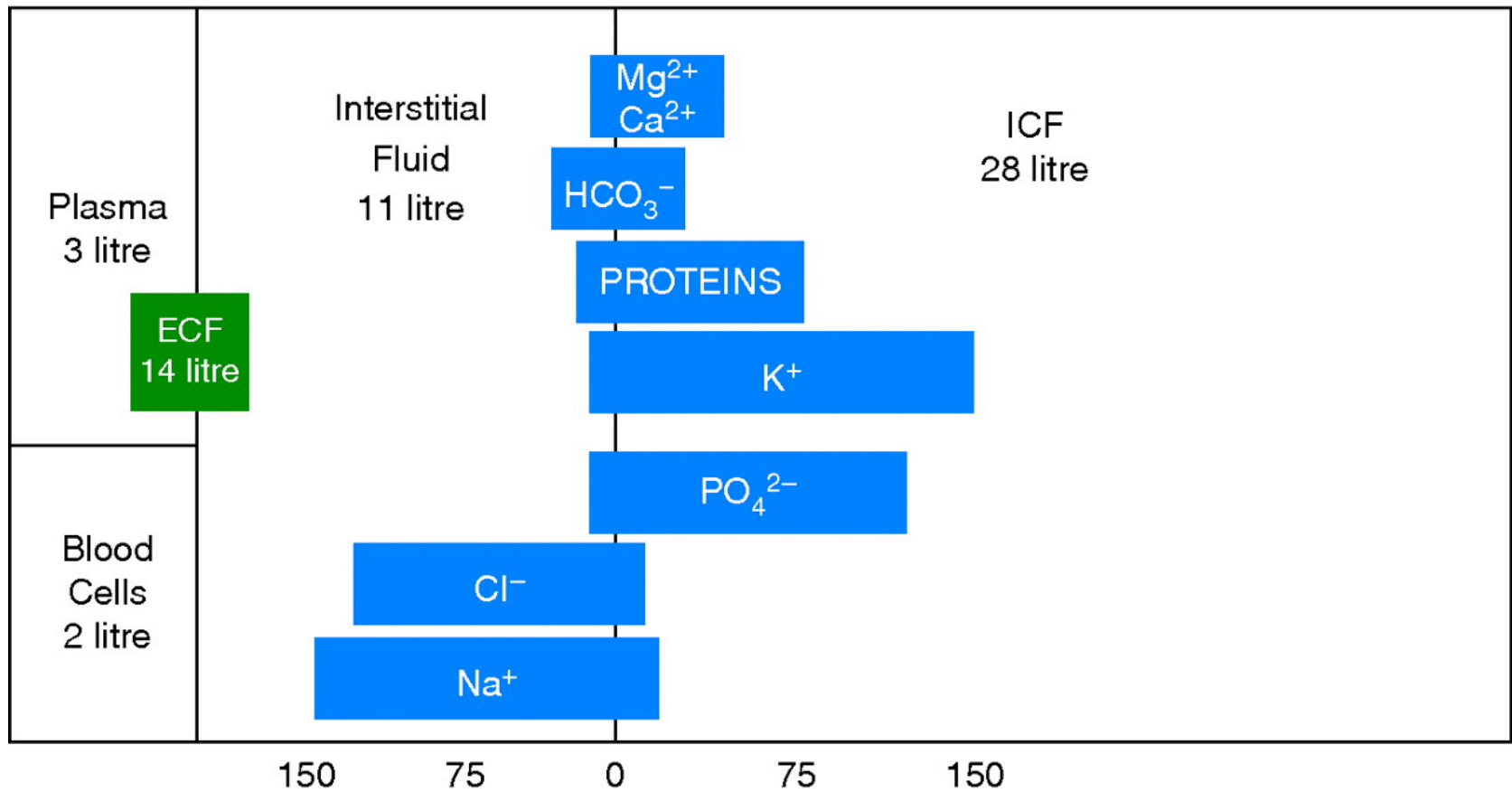
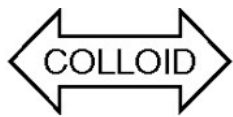
Colloids

Suspensions of molecules within a carrier solution

- Relatively incapable of crossing the healthy semipermeable capillary membrane
- Exert an osmotic effect in intravascular space causing fluid to remain within the vascular system
- Colloidal molecules take several hours to break down and so exert their effect for longer than crystalloids

Albumin is considered the reference colloidal solution

- Natural colloids: Albumin
- Synthetic colloids: Gelatins, Dextran, Starches



ELECTROLYTES

Sodium

- **135-145mmol/L**
- **Hyponatraemia – severe when Na <120mmol/L**
 - Cerebral oedema, seizures
 - Too rapid correction can also be detrimental
- **False hyponatraemia can occur**
- **Need to assess overall fluid/water balance**
- **Most commonly**
 - Excessive infusion of hypotonic solutions
 - Excessive losses – GIT or kidneys
 - Drugs
 - Syndrome of Inappropriate Anti-Diuretic Hormone
 - Addisons
 - Cerebral Salt Wasting
- **Hypernatraemia – Na >145mmol/L**
 - Net loss of hypotonic fluids from GIT or renal tract
 - Rarely primary hyperaldosteronism

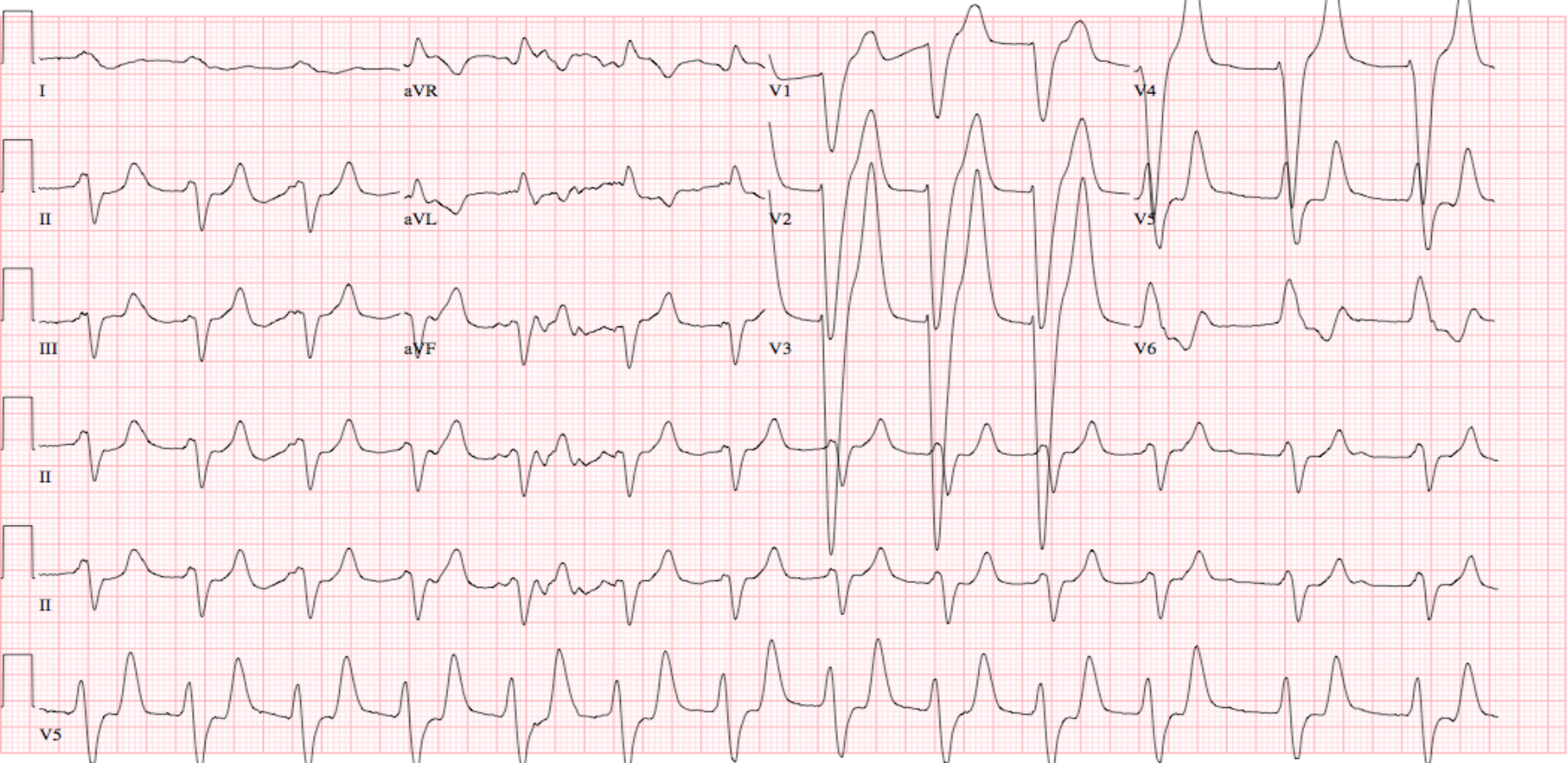
Potassium

- **Normal daily requirements 1mmol/kg body weight**
- **Acutely rising serum potassium >6mmol/L is a medical emergency**
 - Risk of cardiac arrest
 - Needs urgent treatment
- **Most Common Causes**
 - Acute kidney injury
 - Catabolic states
 - Tissue injury/damage
 - Drugs

Test ind:

Referred by:

Confirmed By: EKG DEPARTMENT



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Potassium

- **Normal daily requirements 1mmol/kg body weight**
- **Acutely rising serum potassium >6mmol/L is a medical emergency**
 - Risk of cardiac arrest
 - Needs urgent treatment
- **Most common causes of hyperkalaemia**
 - Acute kidney injury
 - Catabolic states
 - Tissue injury/damage
 - Drugs
- **Most common causes of hypokalaemia**
 - GI losses
 - Drugs (primarily diuretics)
- **Severe <2.5mmol/L**
 - Muscle weakness, paralysis, cardiac arrhythmias
 - Should be immediately replaced to >3mmol/L

Chloride

- **Main anion in ECF (95-105mmol/L)**
- **Hyperchloraemic acidosis common in Intensive Care Units**

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Chloride

- **Main anion in ECF (95-105mmol/L)**
- **Hyperchloraemic acidosis common in Intensive Care Units**
- **Hypochloraemic acidosis is mainly caused by loss of gastric fluid (ie vomiting)**

Magnesium

- **Concentration 0.7-1.2mmol/L**
- **Important component of many enzyme systems and helps maintain enzyme stability**
- **Symptomatic hypomagnesaemia <0.4mmol/L**
 - Neuromuscular irritability
 - convulsions
 - Arrhythmias
- **Usually secondary to GI losses such as chronic diarrhoea or high output stomas**
- **Oral preparations - not well absorbed. Usually needs to be replaced IV**
- **Hypermagnesaemia – almost always iatrogenic due to therapeutic use of Mg**
 - Arrhythmias
 - Acute Severe Asthma
 - Eclampsia and Pre-eclampsia