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CRRT PRE vs. POST Replacement Solution: A Guide to Understanding

Learning Objectives

- Discuss the use and benefits of CRRT Replacement Solution
- Differentiate the differences and benefits of PRE vs. POST replacement solutions

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"Only because they (kidneys) work the way they do has it become possible for us to have bones, muscles, glands and brains. Superficially, it might be said that the function of the kidney is to make urine; but in a more considered view one can say that the kidneys make the stuff of philosophy itself."

—Homer Smith "From fish to philosopher“(1953)

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Role of Solutions in CRRT

- All CRRT techniques (other than SCUF) require the use of sterile Dialysate and/or Replacement fluids
  - ❑ Dialysate
  - ❑ Replacement
- Used to facilitate the removal of solutes from the patient's blood using the principles of convection (replacement) and/or diffusion (dialysate)

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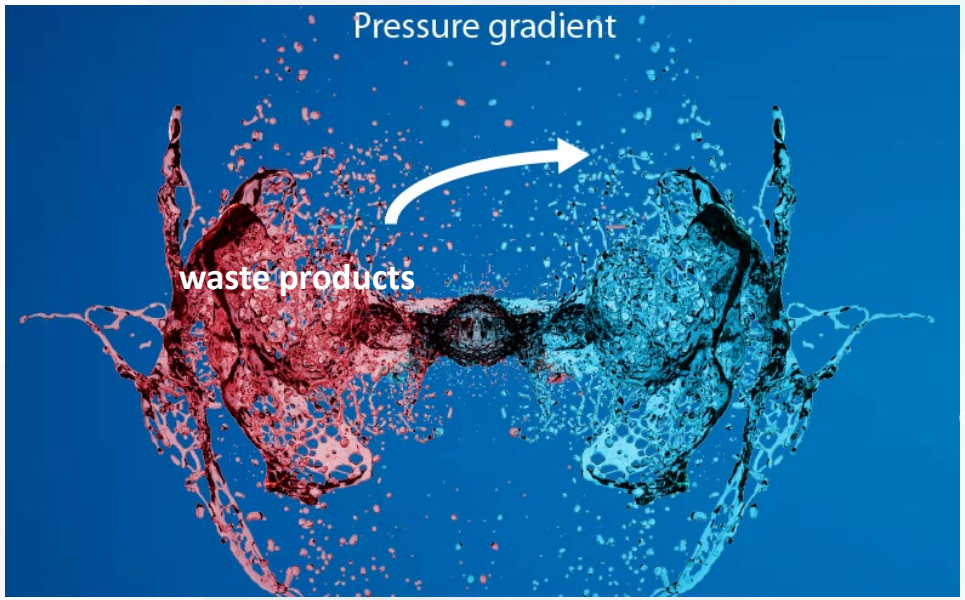
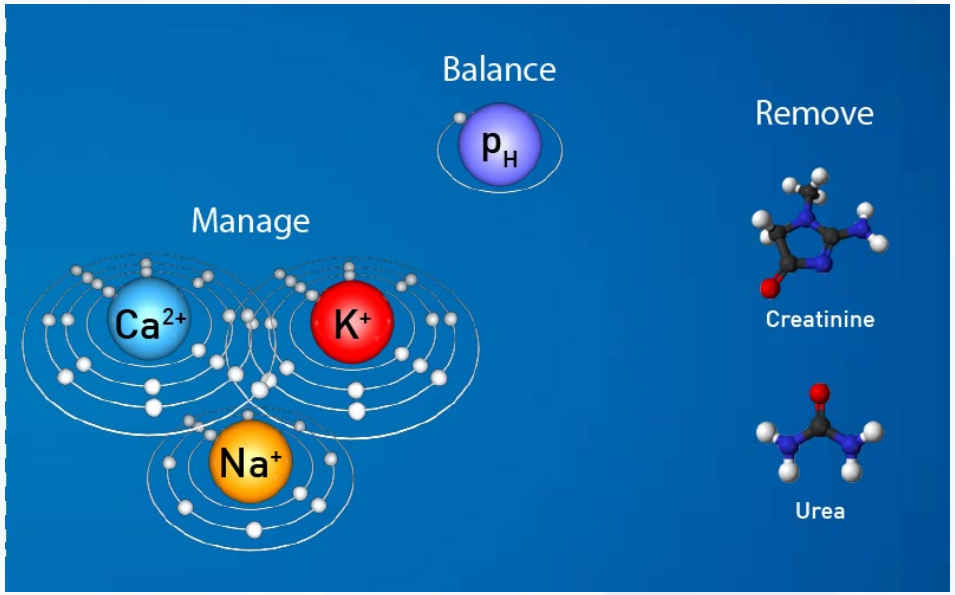
Molecular Transport Mechanisms





Fluid Transport

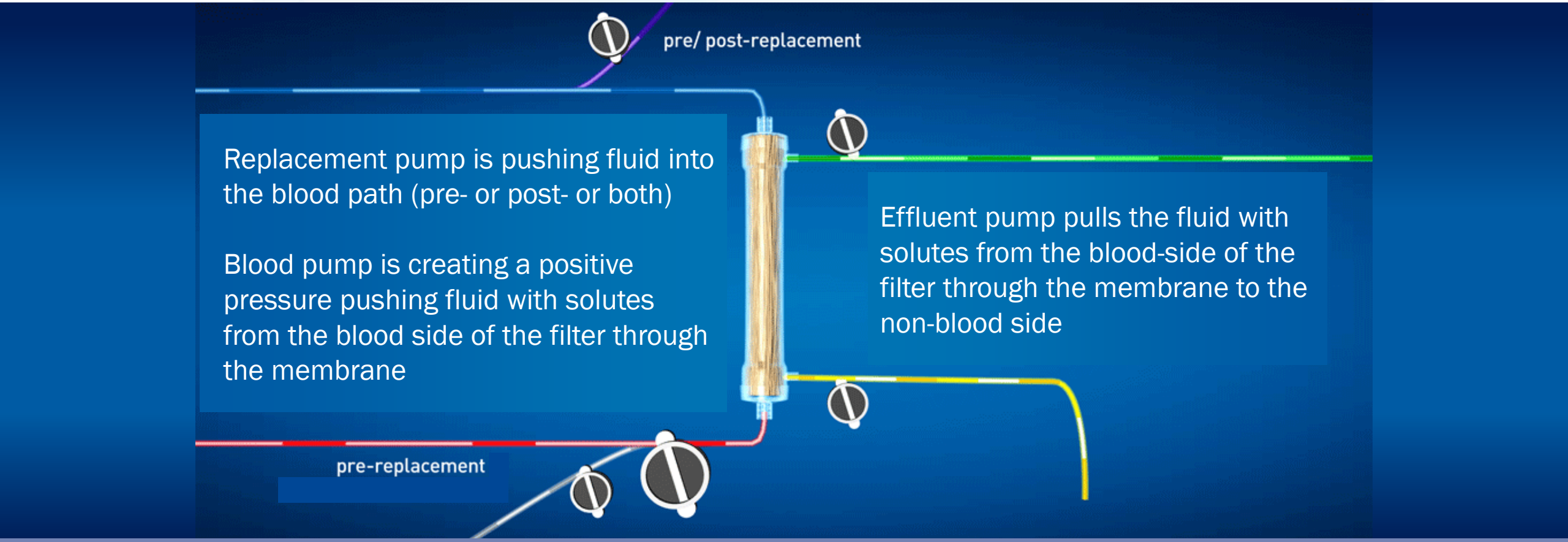
- Ultrafiltration

Solute Transport

- Diffusion
- Convection
- Adsorption

Convection “Solvent Drag” = Hemofiltration

The forced movement of fluid with dissolved solutes (the fluid will drag the solutes)



Convection is the main transport mechanism used in CVVH and CVVHDF.

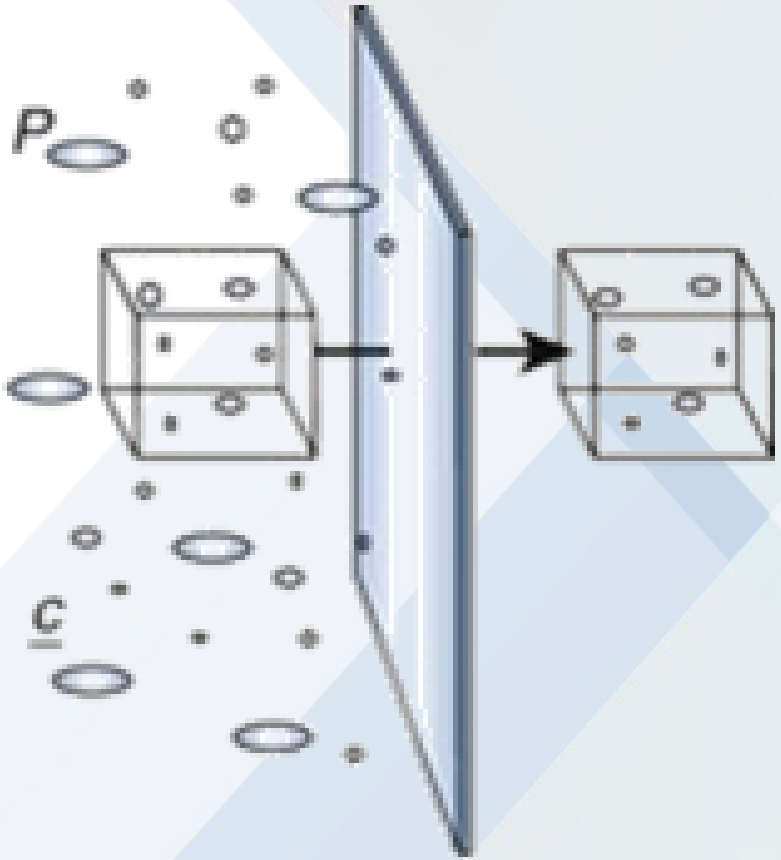
Considerations for electrolyte clearance in CRRT

Convection

Effectiveness less dependent on molecular size

Hemofiltration

All electrolytes are freely removed so, overtime assuming no other intake or losses, plasma concentrations will approach those of the replacement fluid.



Major Factors Affecting Convection

Solute removal by convection depends on:

- High Membrane permeability
- Molecular size
- Degradation of filter membrane (can decrease performance)
- Replacement fluid flow rate (pressure gradient)

Protein caking: protein tends to stick to each other - decreasing filter performance.

Role of Replacement Solutions

- Fluid containing electrolytes and buffers given to replace the losses of plasma water induced by CVVH or CVVHDF
- Small, medium and large molecule management
- Delivered pre- or post-filter which impacts its actions
- Can act as a “diluent” pre filter
- In post-dilution hemofiltration the replacement rate should not be greater than one third of the blood flow rate
- IV drug – mixes with blood

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What's in the Body?

	Normal Plasma Ranges
Calcium (Total)	9-11 mg/dL; 4.5-5.5 mEq/L
Magnesium	1.8-3.6 mg/dL; 1.5-3.0 mEq/L
Sodium	135-147 mEq/L
Potassium	3.5-5.5 mEq/L
Chloride	98-106 mEq/L
Lactate	0.5 - 2.2 mmol/L
Bicarbonate	18-30 mEq/L
Glucose	80-120 mg/dL

The normal ranges in each laboratory depend on the local population, test methodology and conditions of assay, units, and a variety of additional circumstances.

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ADQI Recommendations for CRRT Solutions

- **Sodium:** Generally kept isonatric with consideration of anticoagulant in use
- **Potassium/Magnesium/Chloride/anions:** should be present in replacement and/or dialysate and tailored to patient needs
- **Calcium:** presence determined in replacement and /or dialysate based on patient needs and anticoagulation in use
- **Phosphate:** presence determined in replacement based on patient needs
- **Glucose:** can be present or absent, if present should be physiological

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How Pre and/or Post Replacement Work

Pre Replacement

- Pre-filter replacement solution will deliver into the blood flow at set rate.
- Blood will be diluted ↓Hct.
- The replacement “fluid volume” will be removed by the effluent pump.
- Pre-filter administration has two effects: First it dilutes the concentration of solute entering the filter. This decreases the efficiency of solute removal.

Post Replacement

- The replacement “fluid volume” will be removed by the effluent pump.
- Blood will be concentrated ↑Hct.
- Post-filter replacement solution will deliver replacement solution to “replace” the removed “volume” and replenish lost electrolytes

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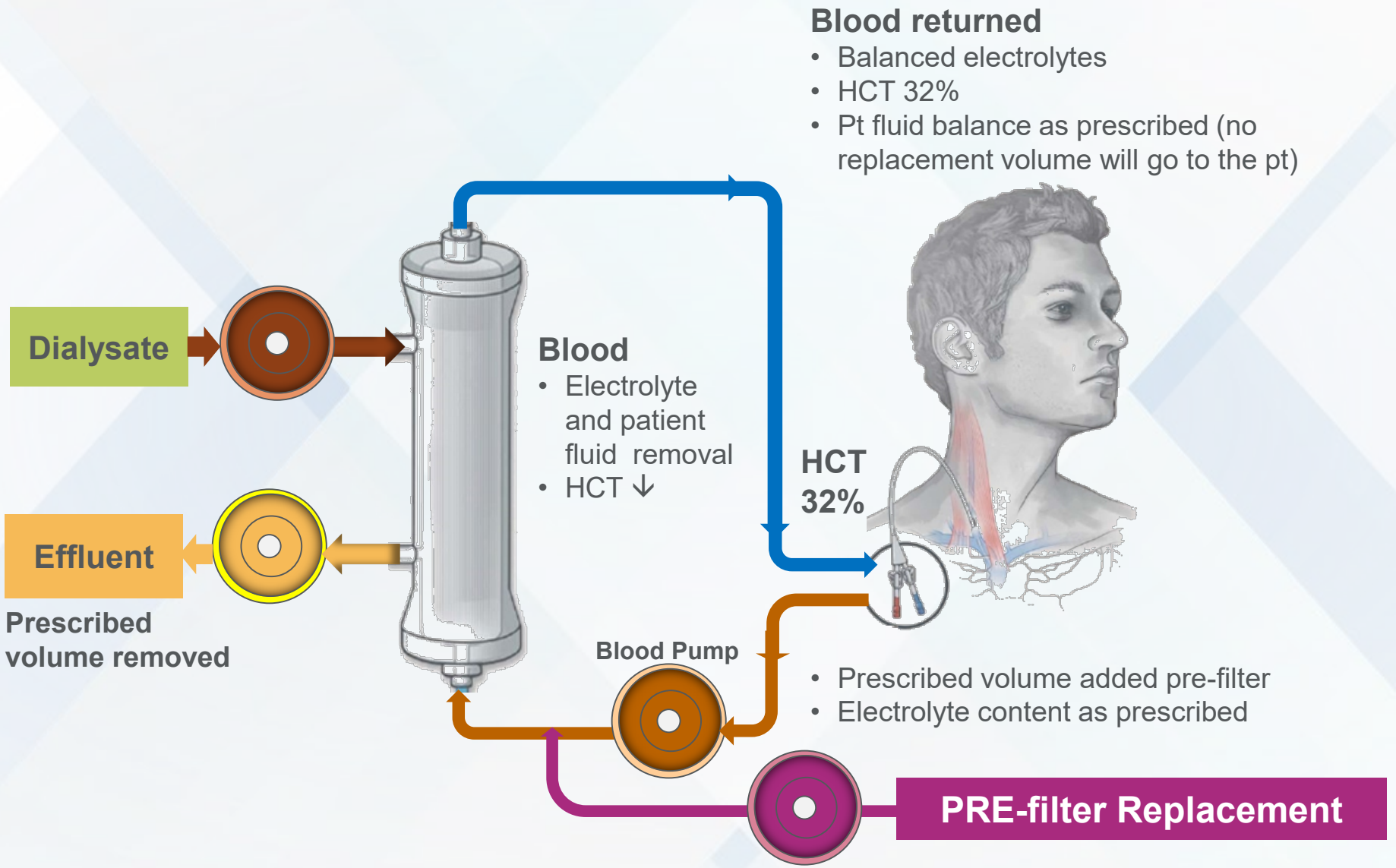
Pre-Filter Replacement Example



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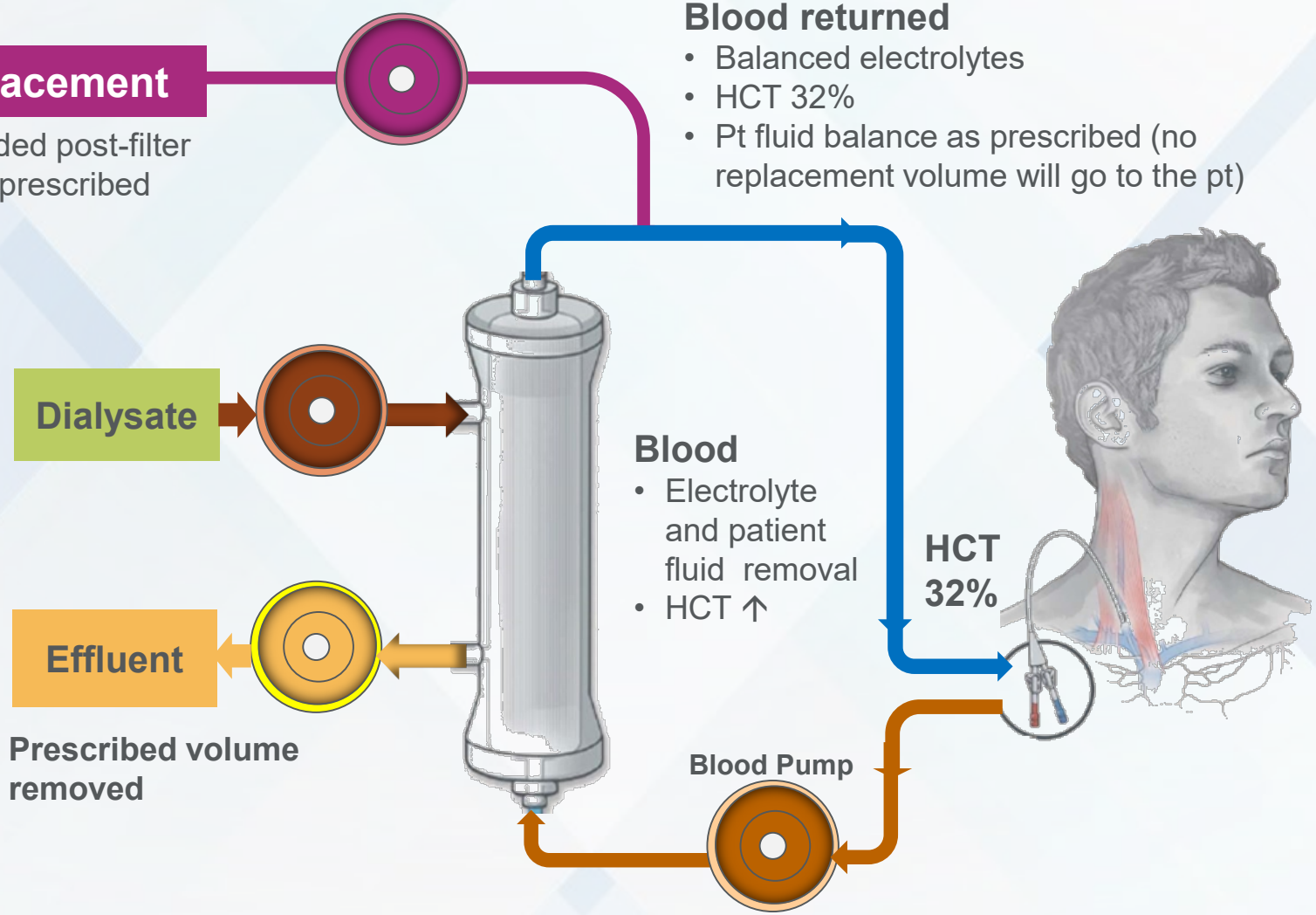
Post-Filter Replacement Example

POST-filter Replacement

- Prescribed volume added post-filter
- Electrolyte content as prescribed

Blood returned

- Balanced electrolytes
- HCT 32%
- Pt fluid balance as prescribed (no replacement volume will go to the pt)



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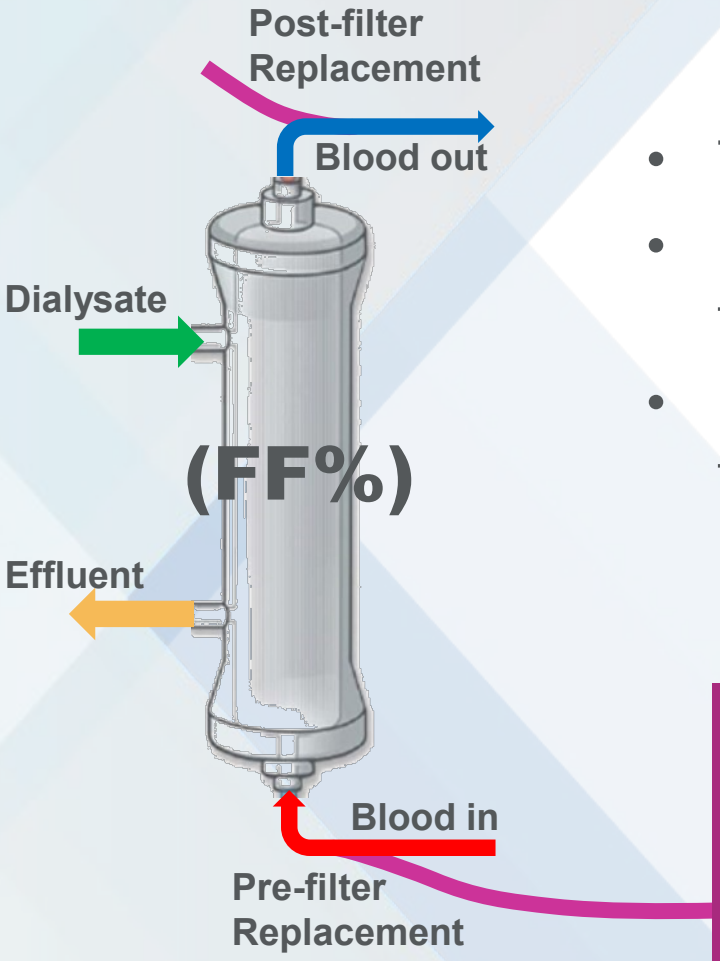
Filtration Fraction (FF%)

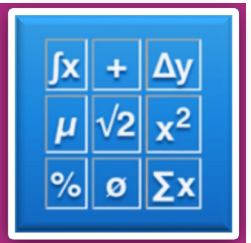


- The Filtration Fraction tells us “how likely is the filter to clot?”
- Reflects the level of blood hemoconcentration present at the filter outlet.
- Estimate the degree of blood dehydration by determining the filtration fraction (FF), which is the fraction of plasma water removed by ultrafiltration.

QUFR = (1- (HCT / 100)) x Qb

Qplasma = (1- (HCT / 100)) x Qb

FF: 100 × (QUFR) / (Qplasma × 0.95 + Qpre)



CRRT Related Options for Replacing Electrolytes

Guiding principle in the management of electrolytes in CRRT is that

“YOU GET WHAT YOU REPLACE”

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To Re-Cap about Replacement Solutions

- The primary purpose of any Replacement solution is the convective clearance of solutes if the flow rates are fast enough.
- Pre-filter dilutes the blood, which can decrease solute clearance but can help prolong filter live.
- Post-filter leads to more efficient fluid utilization and treatment, but can increase HCT and lead to shorter filter life.
- ALL replacement solution volume used is removed 100% by the effluent pump.
- Contain physiologic concentrations of electrolytes and buffer.
- Are infused directly into the blood.
- Are considered and approved as a drug.

“YOU GET WHAT YOU REPLACE”

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Thank You

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