Chronic Kidney Diseases

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Objectives

To be able to:

- Define and classify chronic kidney disease into stages
- To realize the impact of such classification
- To list the different causes (risk factors) of CKD
- To know the common complications of uremia
- To outline the main management plan in CKD

Definition of CKD

- Persistent damage (structural or functional) ≥ 3 months with or without reduced GFR

Or

- GFR < 60 mL/min/1.73 m^2 for ≥ 3 months with or without kidney damage

AS Levey et al, KDIGO, KI 2005

Classification of CKD

GFR categories in CKD

GFR category	GFR (ml/min per 1.73 m^2)	Terms
G1	⩾90	Normal or high
G2	60–89	Mildly decreased*
G3a	45–59	Mildly to moderately decreased
G3b	30–44	Moderately to severely decreased
G4	15–29	Severely decreased
G5	<15	Kidney failure

Abbreviations: CKD, chronic kidney disease; GFR, glomerular filtration rate.
*Relative to young adult level.
In the absence of evidence of kidney damage, neither GFR category G1 nor G2 fulfill the criteria for CKD.

AS Levey et al, KDIGO, KI 2005

Classification of CKD

Albuminuria categories in CKD

Category	AER (mg/24 h)	ACR (approximate equivalent) (mg/mmol)	ACR (approximate equivalent) (mg/g)	Terms
A1	<30	<3	<30	Normal to mildly increased
A2	30–300	3–30	30–300	Moderately increased*
A3	>300	>30	>300	Severely increased**

Abbreviations: ACR, albumin-to-creatinine ratio; AER, albumin excretion rate; CKD, chronic kidney disease.

*Relative to young adult level.

**Including nephrotic syndrome (albumin excretion usually >2200 mg/24 h (ACR >2220 mg/g; >220 mg/mmol)).

AS Levey et al, KDIGO, KI 2005

Classification of CKD

Green: low risk
Yellow: moderate risk
Orange: high risk
Red: very high risk

Classification of chronic kidney disease using GFR and ACR categories

GFR and ACR categories and risk of adverse outcomes			ACR categories (mg/mmol), description and range		
			<3 Normal to mildly increased	3–30 Moderately increased	>30 Severely increased
			A1	A2	A3
GFR categories (ml/min/1.73 m²), description and range	≥90 Normal and high	G1	No CKD in the absence of markers of kidney damage		
	60–89 Mild reduction related to normal range for a young adult	G2			
	45–59 Mild–moderate reduction	G3a[1]			
	30–44 Moderate–severe reduction	G3b			
	15–29 Severe reduction	G4			
	<15 Kidney failure	G5			

Increasing risk

Increasing risk

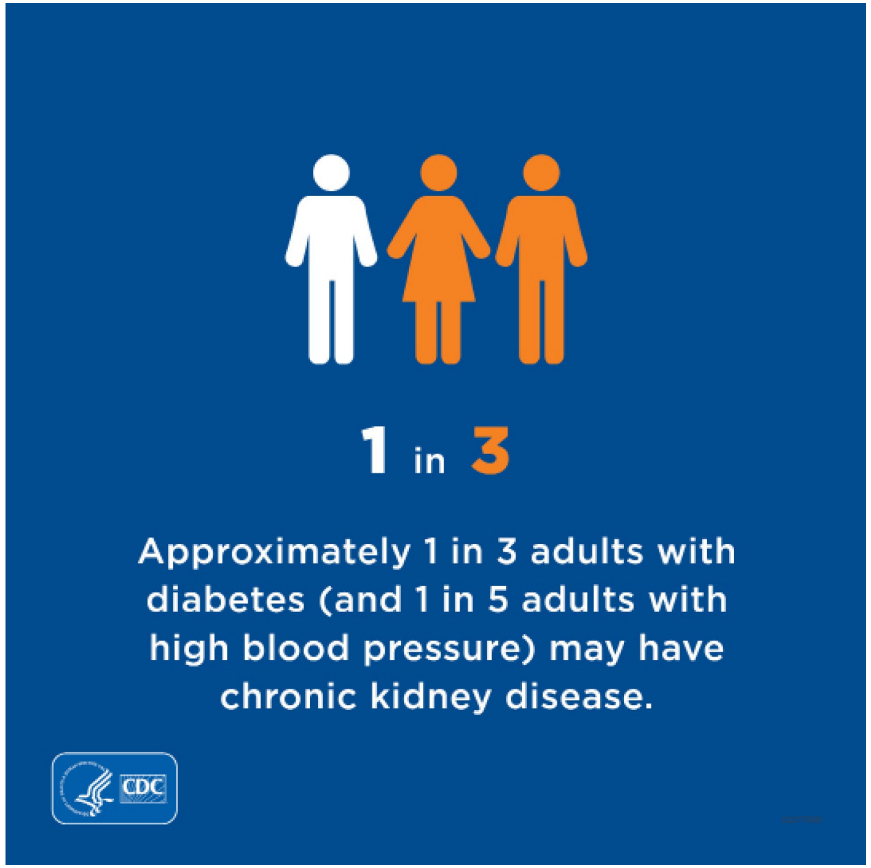
AS Levey et al, KDIGO, KI 2005

Importance of classification

- Determine the risk of progression and that would have an impact on the clinical care:
  - No. visits
  - Frequency of blood work
  - Workup for cardiac diseases
  - Avoiding contrast

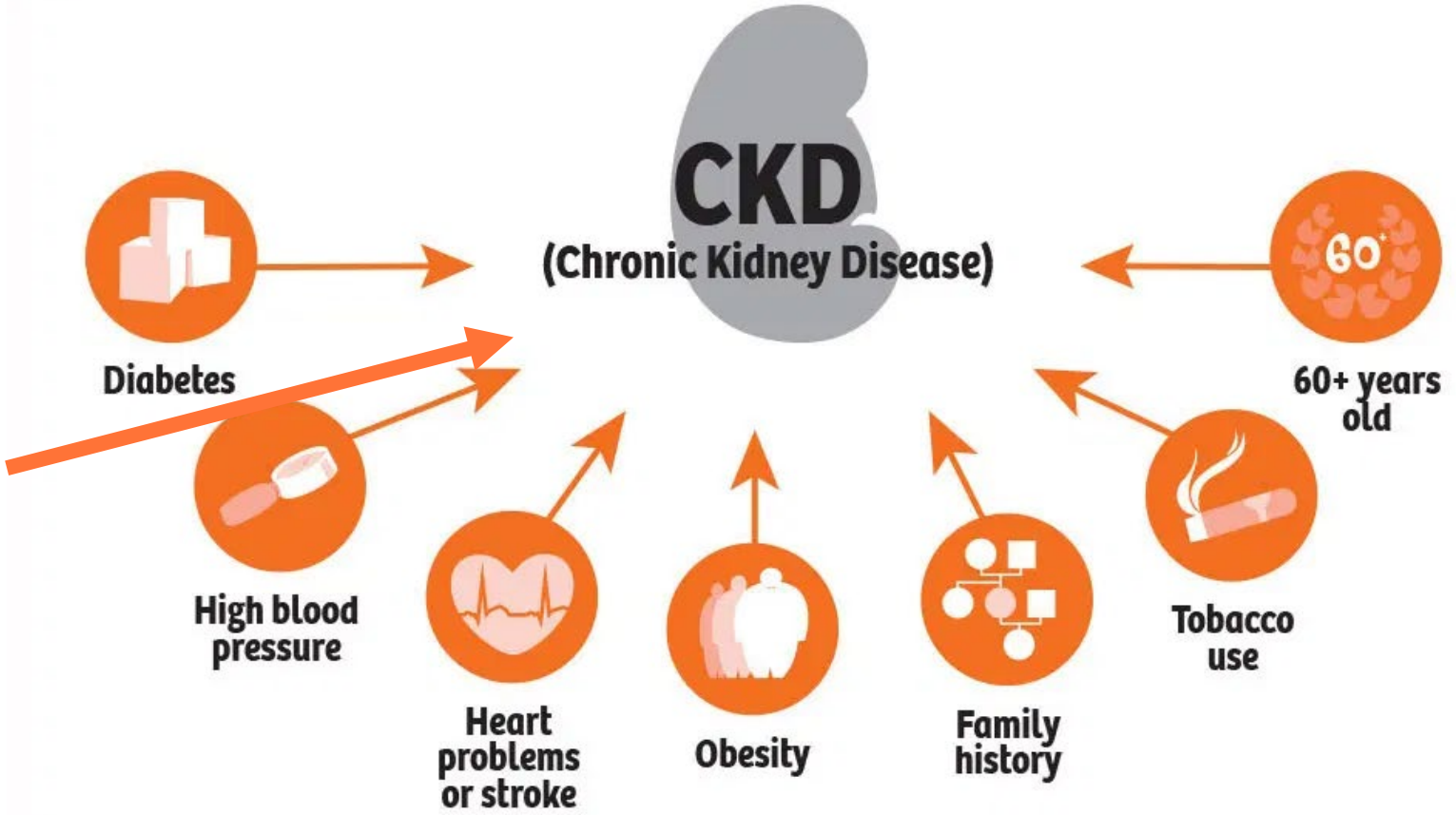
Risk factors for CKD

- DM
- HTN



Risk factors for CKD

Hx of AKI



https://www.siemens-healthineers.com/en-uk/news/chronic-kidney-disease.html

• The leading causes of ESRD in our society

Saudi Center for Organ Transplantation

SCOT

Annual report 2019

Table 3.1.3.1 Causes of Renal Failure among HD patients

Cause of Renal Failure	N	%
Diabetic Nephropathy	8420	43%
Hypertensive Nephropathy	6679	34%
Unknown Etiology	1715	9%
Glumerulonephritis	724	4%
Others	502	3%
Obstructive Uropathy	406	2%
Congenital Malformation	380	2%
Heredofamilial Disease	378	2%
Vasculitis	199	1%
Pregnancy Related	119	1%
Total	**19522**	**100%**

Complications of CKD

Uremia:

- Pruritis
- Decreased oral intake
- Nausea and vomiting
- Wt loss
- Pericarditis
- Cardiomyopathy
- CNS

Complications of CKD

- Volume overload
- Electrolytes imbalance (hyperkalemia)
- Metabolic acidosis

Complications of CKD

Anemia:

- ***Causes:***
  - Deficiency of erythropoietin
  - Uremic-induced inhibitors of erythropoiesis
  - Shortened red blood cell survival
  - High Hepcidin

JL. Babitt and HY. Lin, JASN 2012

Anemia

- Hepcidin:

Is the main hormone responsible for maintaining systemic iron homeostasis

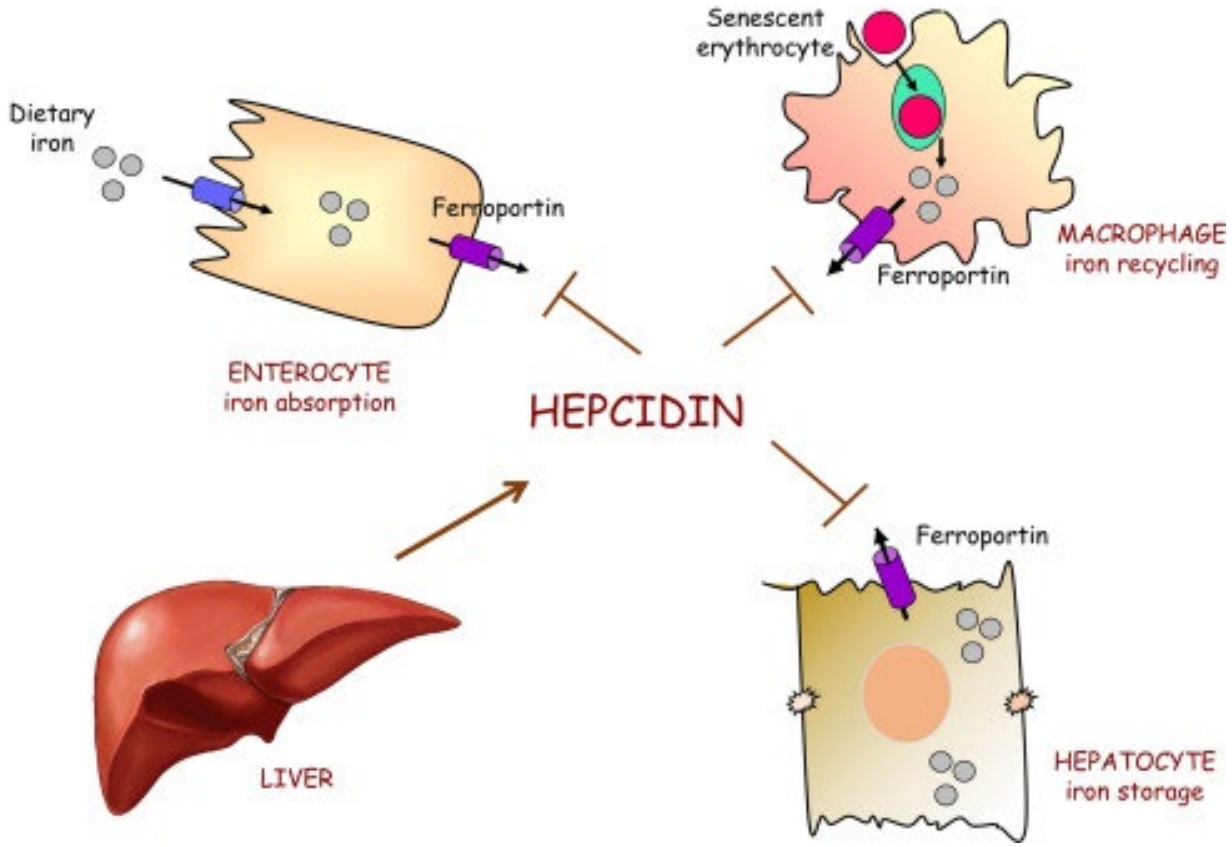
- It is high in CKD

Reduced clearance

Induced by inflammatory cytokines

JL. Babitt and HY. Lin, JASN 2012

Role of Hepcidin



Marie-Paule Roth et al, Vitamins and Hormones, Volume 110, 2019, Pages 101-129

- Hepcidin result in disordered iron homeostasis
- Anemia of CKD is typically normocytic normochromic

Complications of CKD

- Bone disease (Mineral Bone disorders)

Why?

Secondary hyperparathyroidism

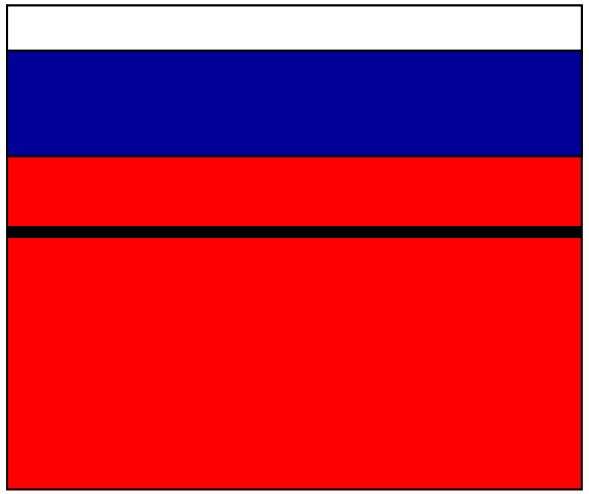
Why Secondary hyperparathyroidism?

- Hyperphosphatemia and hypocalcemia
- Reduced production of 1 alpha-hydroxlase enzyme

Why Hyperphosphatemia and hypocalcemia

- 65% of Phosphate is excreted through the kidneys
- 20% of Ca is exerted through the kidneys

phosphorus

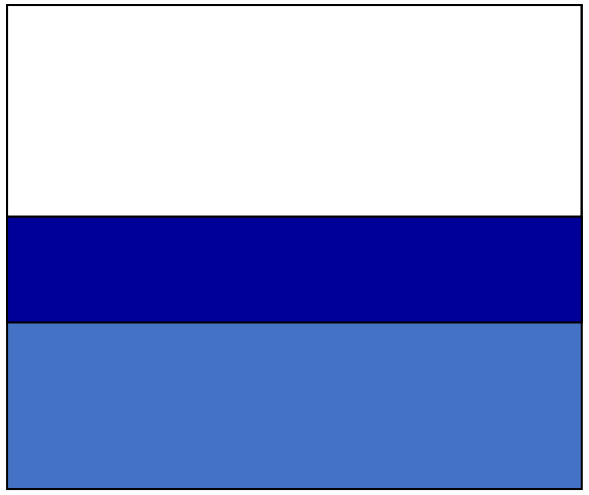


N

phosphorus

N

Ca++



N

Ca++

N

PTH :

1- Bone resorption

2- increase tubular reabsorption of Ca++

3- inhibit tubular reabsorption of phosphorus

4- enhance the formation of calciterol

Renal osteodystrophy

Rugger Jersy spine

Complications of CKD

- Anemia
- Bone mineral disease
- Coronary Heart Disease
- Other complication when CKD is very advance (GFR<15):
  - Neuropathy
  - Malnutrition
  - Decreased quality of life

Management strategy

- Control the underlying cause:
  - e.g. Work on preventing the stone recurrence
- Halt or slow the progression
- Prepare the patient for renal replacement therapy enough time before uremia symptoms occur

Management of CKD

- **Good BP control**
  - BP <130/80
- **RAAS blockade in proteinuric patients independent of BP**
- **Lipid lowering agents especially for diabetic and cardiac patients**
  - LDL-C <2.0 mmol/L
- **Diet (protein, sodium)**
- **Avoid nephrotoxic agents**

Management of diabetic kidney disease

- **Good BP control**
  - BP <130/80

- **RAAS blockade in proteinuric patients independent of BP**

- **Good glycemic control**
  $HgbA_1C$ <7 %

- **Lipid lowering agents including Statins**
- - LDL-C <2.0 mmol/L

- **Diet (protein, sodium)**

Management of diabetic kidney disease

- **For diabetic kidney disease in type 2**
  - **Same as the previous slide plus:**
  - **SGLT2 inhibitors;** such as Dapagliflozin, Empagliflozin
  - To consider Finerenone (Non-steroidal mineralocorticoid receptor antagonists) and GLP1 RA e.g Semaglutide (Ozempic)

Management

- Renal Replacement Therapy:
  - Renal transplant
  - Hemodialysis (Fistula creation)
  - Peritoneal dialysis

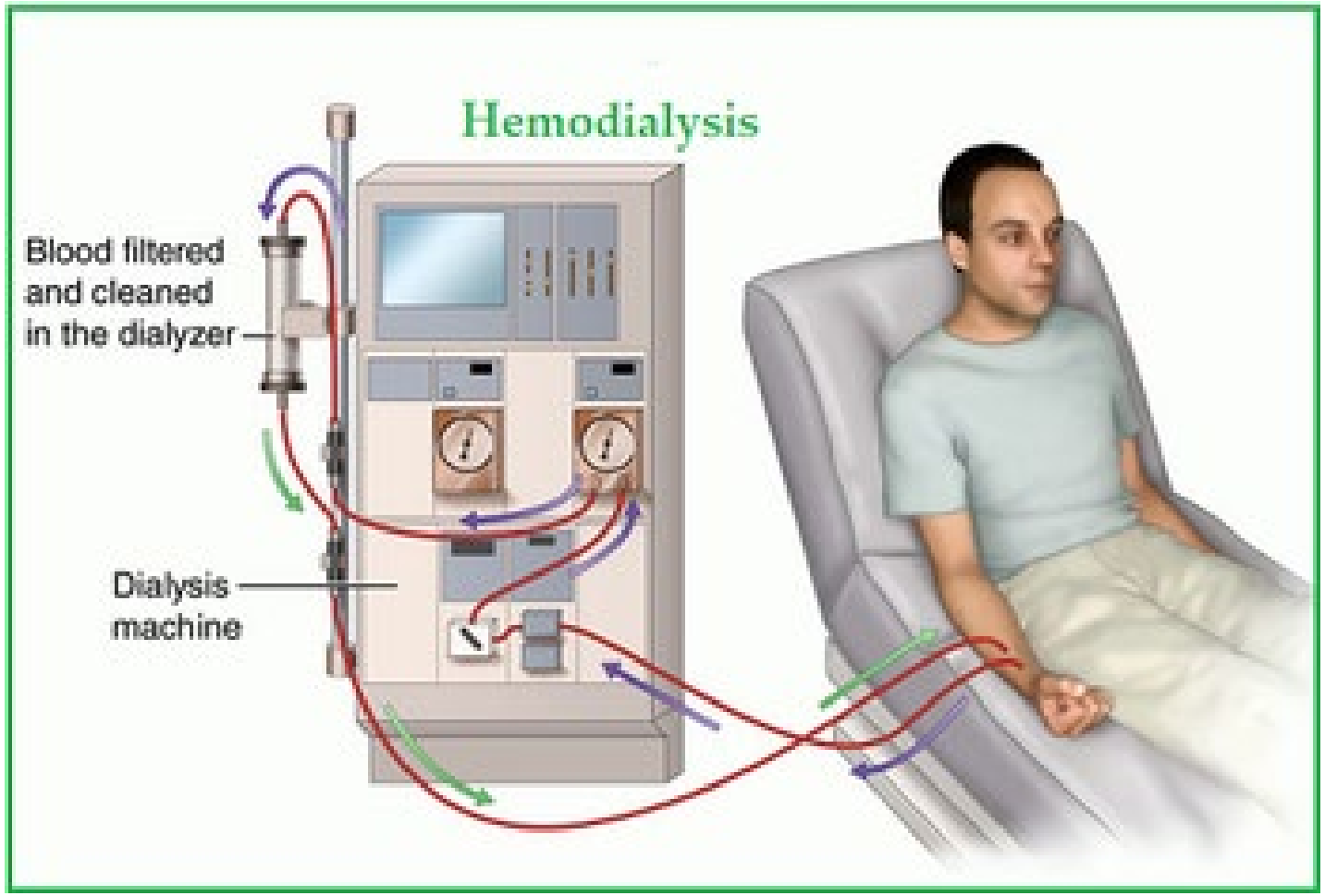
Renal Replacement Therapy

Renal Transplantation

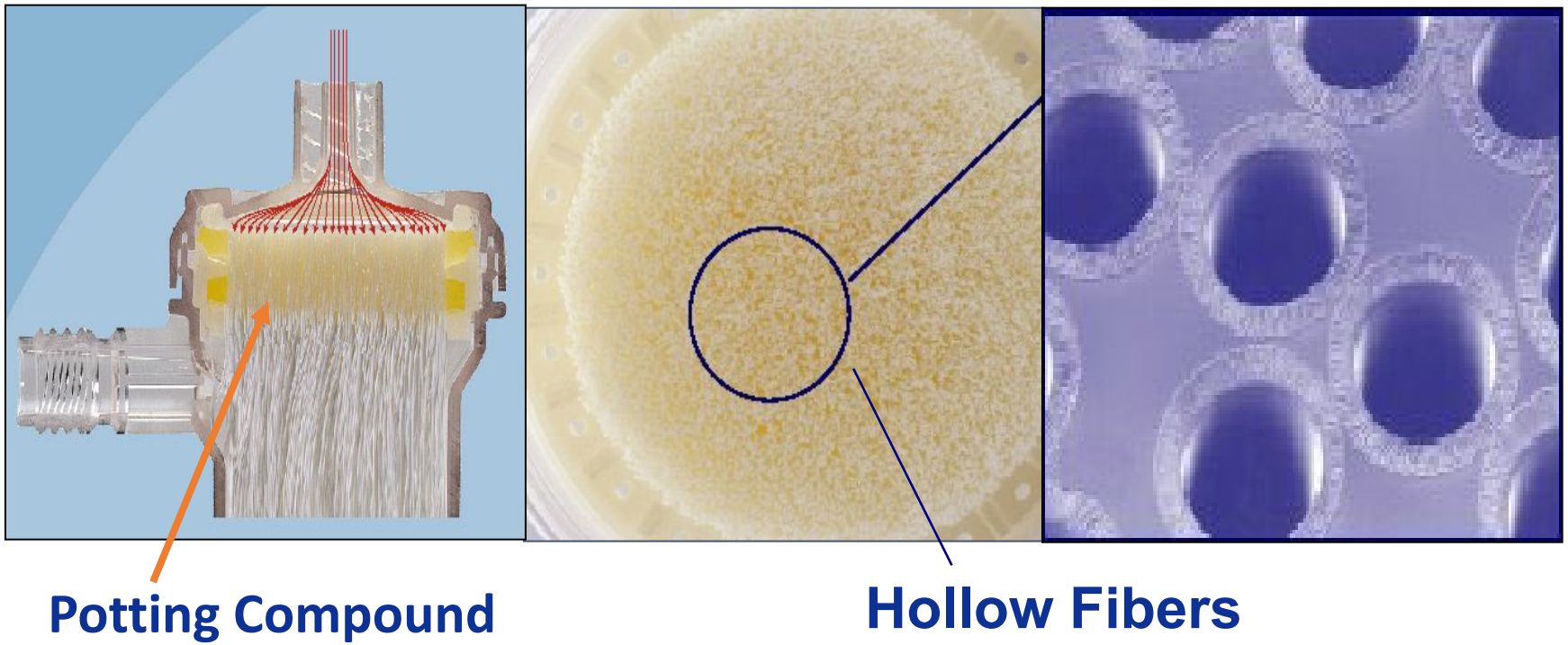
- The modality of choice if no contraidication

- Advantages:
  - Better survival rate
  - Better quality of life
  - Free of dialysis
  - Less medications

Hemodialysis

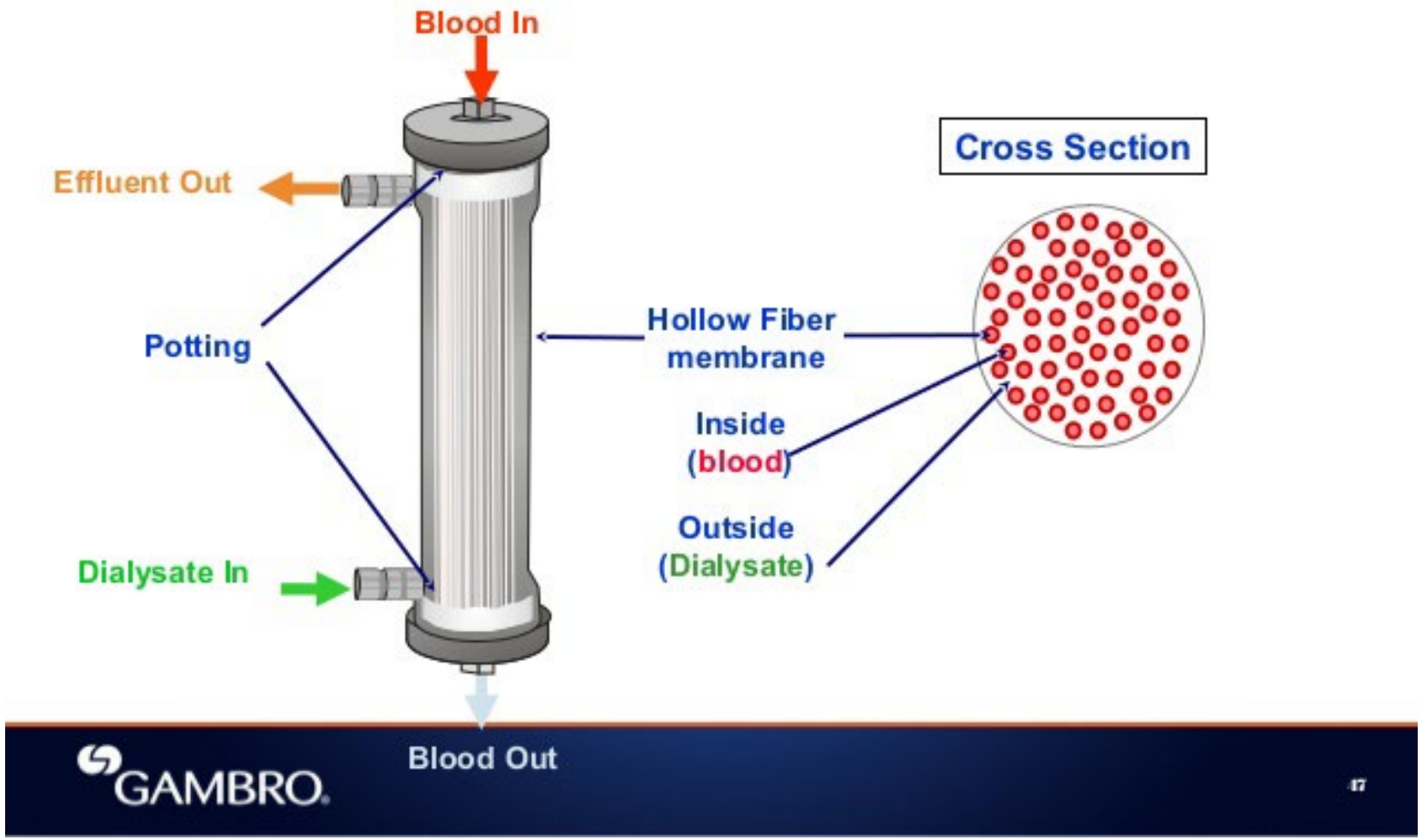


The Basic Filter Membrane

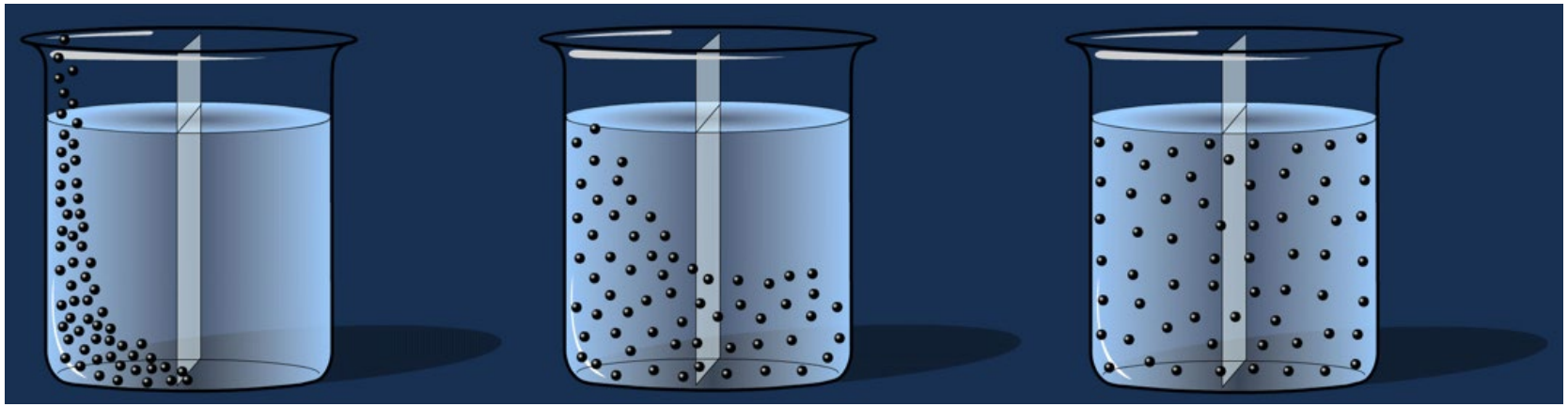


- 2 compartment unit (blood and fluid) separated by a semi- permeable membrane
- Fiber wall is the semi-permeable membrane

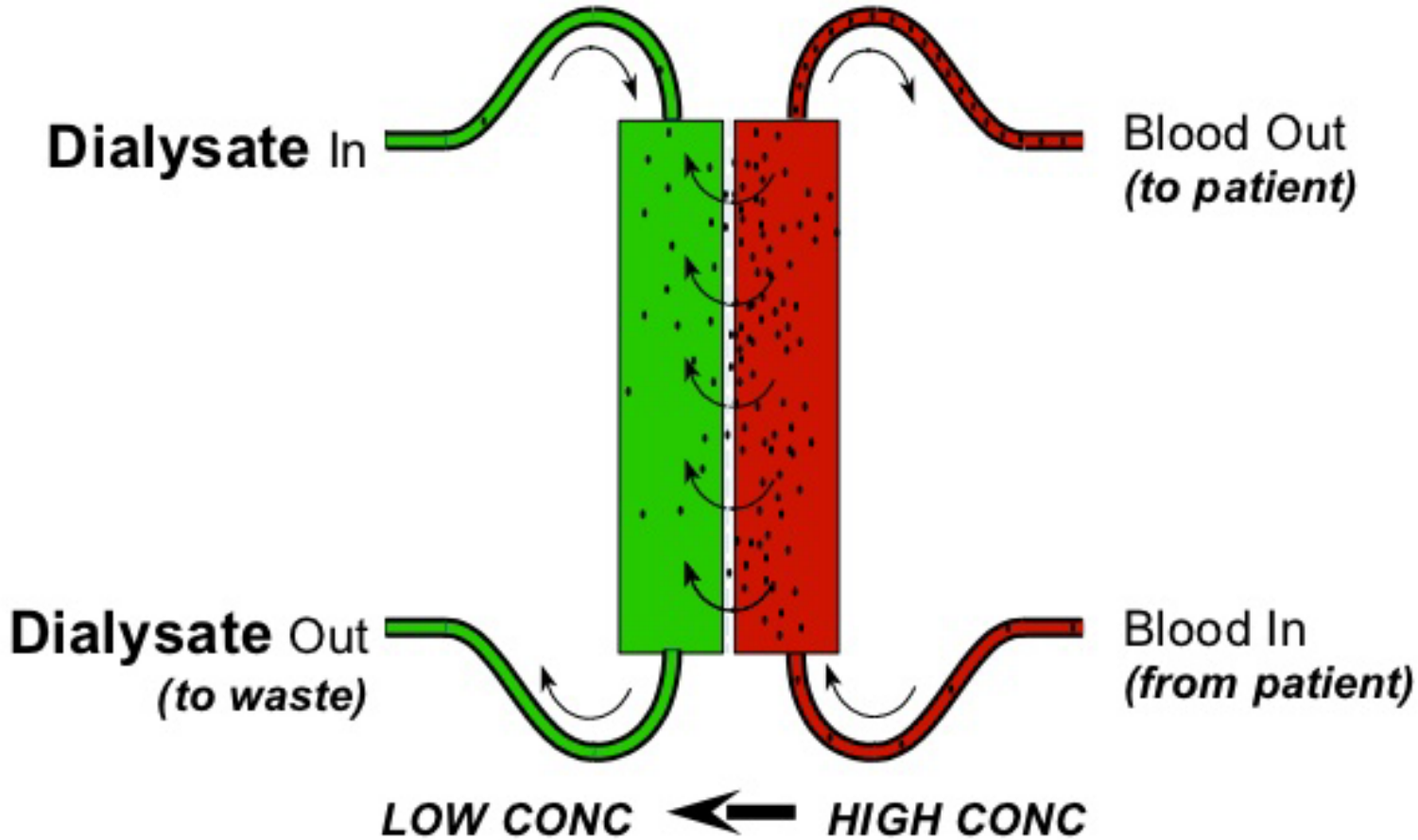
The Basic Hemofilter



Diffusion



Hemodialysis: Diffusion



GAMBRO

Dialyzer

National Kidney Foundation®

What Hemodialysis CAN Do

- Fluid removal
- Solute removal, Removal of metabolic end products
- Removal/replacement of electrolytes
- Acid/Base balance

What Hemodialysis CAN’T Do

- Correct endocrine functions of kidney
  - erythropoeitin
  - Renin
  - Vitamin D

- Hemodialysis at best, gives:

  ~ 15 - 20% kidney replacement

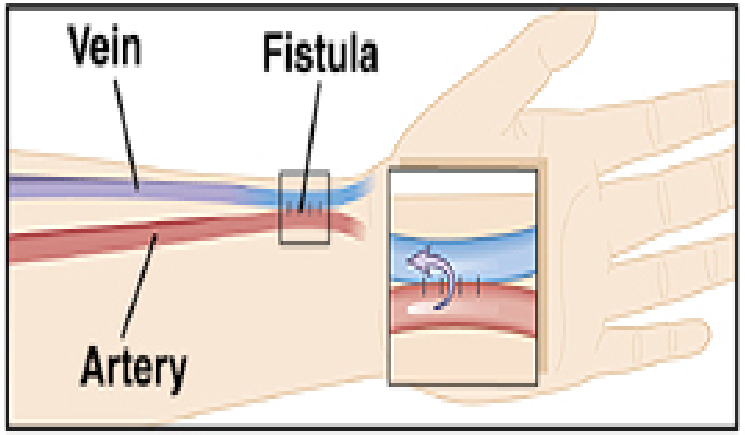
- Conventional Intermittent HD:

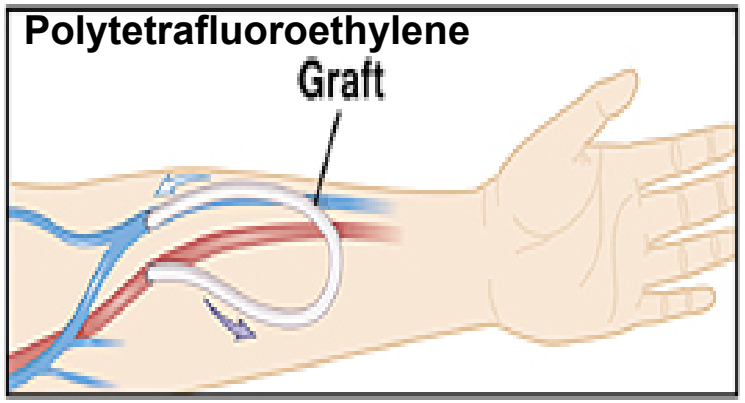
  4hr-duration , 3 times a week

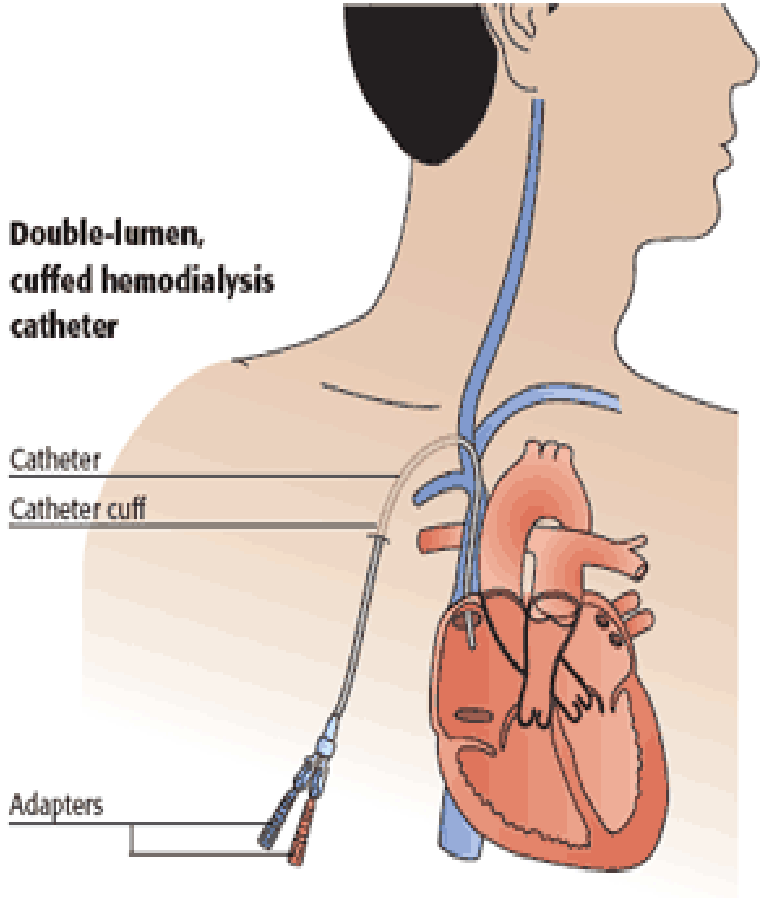
Hemodialysis Vascular Access

- Arteriovenous Fistula (AVF)
- Arteriovenous Graft (AVG)
- Permanent catheter

Hemodialysis Vascular Access







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Arteriovenous (AV) Fistula

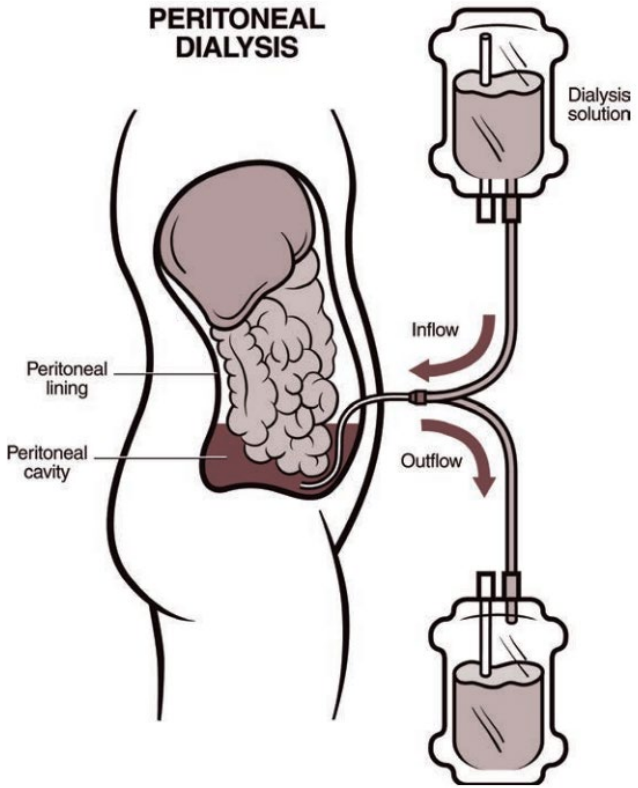
National Kidney Foundation®

Hemodialysis

- Side Effects
  - dizziness
  - fatigue
  - cramping
  - bleeding from sites
  - unsteadiness

Peritoneal Dialysis

The peritoneal membrane works as a filter here



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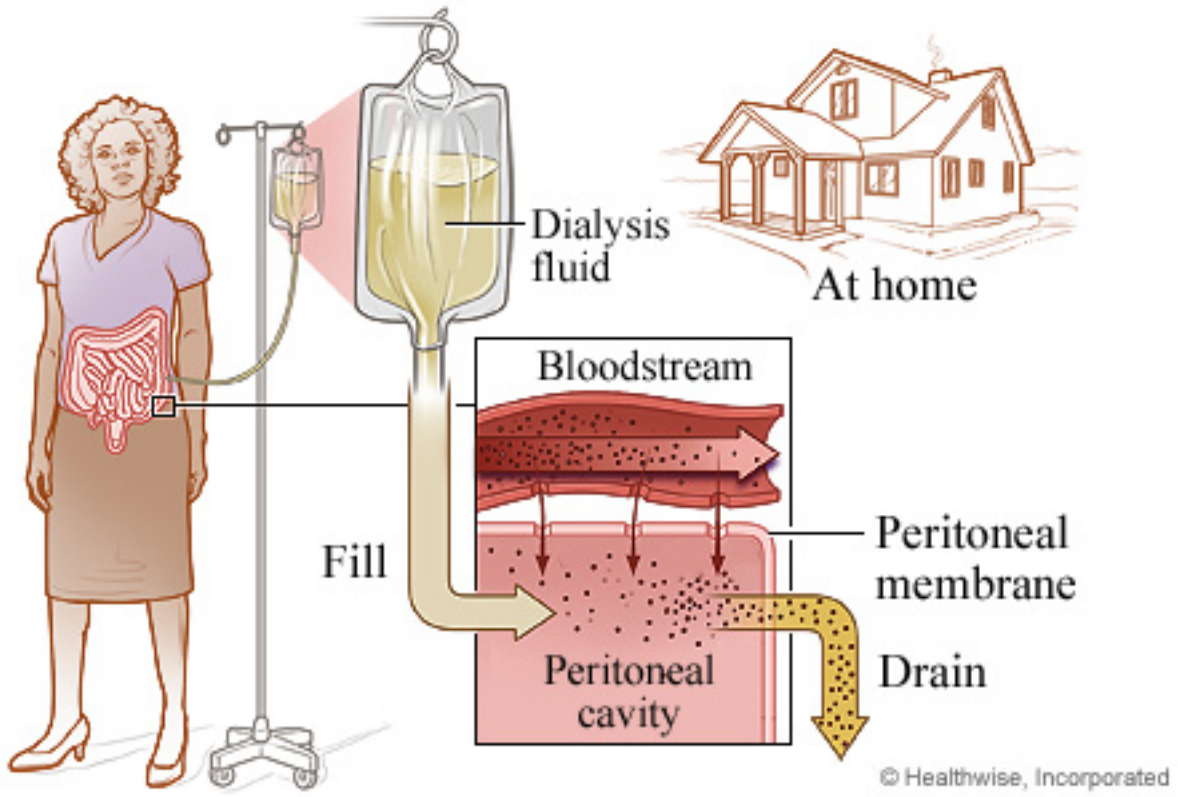
Peritoneal Dialysis



https://www.cigna.com

What PD can do

- Fluid removal
- Solute removal, Removal of metabolic end products
- Removal/replacement of electrolytes
- Acid/Base balance

What PD can’t do?

- Correct endocrine functions of kidney
  - erythropoeitin
  - Renin
  - Vitamin D

Thank you

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