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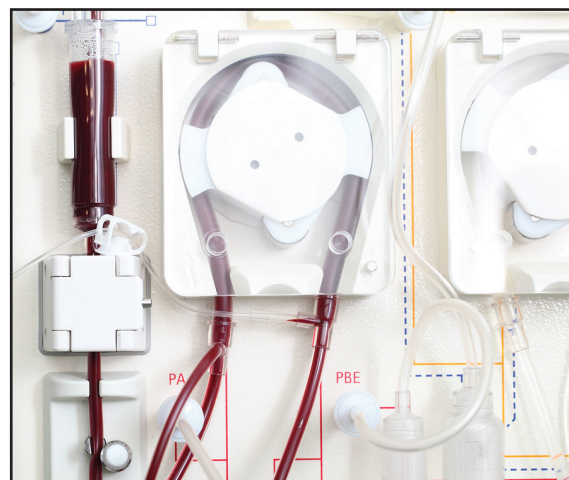
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“HD or PD: Best choice for ESRD?”

October 2015

Chronic kidney disease (CKD) is a serious public health issue in the United States.^{1,2} Over 25 million individuals in the United States have CKD. End-stage renal disease (ESRD), or stage 5 CKD, is defined as requiring chronic dialysis or kidney transplant. In this lesson we discuss the significance of ESRD, and the pharmacist's role in dialysis.



Pharmacists will be able to:

1. Discuss the impact of end-stage renal disease on the US population.
2. Discuss the advantages and disadvantages of hemodialysis (HD) and peritoneal dialysis (PD).
3. Review the complications and adverse effects associated with HD and PD.
4. Describe the role of the pharmacist in managing patients with end-stage renal disease.

Technicians will be able to:

1. Discuss the impact of end-stage renal disease on the US population.
2. Describe the role of the pharmacy professional in managing patients with end-stage renal disease.

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INTRODUCTION

Chronic kidney disease (CKD) is a serious public health issue in the United States.^{1,2} Over 25 million individuals in the United States have CKD. End-stage renal disease (ESRD), or stage 5 CKD, is defined as requiring chronic dialysis or kidney transplant. Currently there are over 600,000 individuals with ESRD. The total cost of managing patients with ESRD was approximately 33 billion dollars in 2010. The cost for treatment of CKD and ESRD accounts for 25% of the Medicare budget and continues to rise.³ With an aging population and the rapid rise in the incidence of diabetes and hypertension, the number of cases of ESRD is expected to increase dramatically over the next 5 years. The majority of these new cases will be associated with diabetes.

There are a number of risk factors for CKD including low socioeconomic status, elderly or minority patients, a family history of CKD, diabetes, hypertension and glomerulonephritis.¹ Other factors that may contribute to the decline of renal function include dyslipidemia, smoking and obesity.² The mortality risk is 6-8 times higher in dialysis patients compared to those with normal kidney function. Death in patients with ESRD is primarily due to cardiovascular complications, although infection is the second leading cause of death. Patients with ESRD have a poor quality of life and are required to balance traveling to a dialysis center 3 times a week and managing other aspects of their life. These individuals frequently suffer from fatigue and depression.

There are 3 treatment modalities available for individuals with ESRD. They include **hemodialysis, peritoneal dialysis and kidney transplant.**² Currently approximately 5% of patients receive peritoneal dialysis, and 175,000 patients are living with a kidney transplant. The remaining individuals are treated with hemodialysis.

Over 60% of patients receiving peritoneal or hemodialysis die within 5 years of starting dialysis treatment.² This mortality rate is even higher than what is reported with most cancers. As a result of this high mortality rate and the projected increase in CKD and ESRD, the World Health Organization has identified CKD as a primary public health goal in Healthy People 2020.³ One objective is to ensure patients with diabetes and CKD receive appropriate care to reduce the progression to ESRD. The pharmacist can have a significant impact on ensuring patients receive appropriate treatment for diabetes and reduce the risk of progression to ESRD.

CKD TO ESRD - PROGRESSION

Although there are 5 stages of chronic kidney disease, many patients are not symptomatic and do not seek medical care until they reach stage 4 (CrCl < 30 mL/min).² When patients become symptomatic it is a result of increased serum phosphorus, accumulation of urea and uric acid and reduced hemoglobin production. Symptoms include nausea, vomiting, weight loss, fatigue and anemia. If a patient reaches CKD stage 4, education and training about dialysis for the patient and family members should occur. Beginning the process early in stage 4 allows the patient adequate time for learning about management of the disease.² Dialysis results in significant disruption in the patient's lifestyle and can be overwhelming to caregivers. It is important to assess the patient's acceptance of dialysis and make appropriate plans to ensure success. In addition, vascular access for hemodialysis or appropriate peritoneal access should occur during stage 4 to allow for complete healing of the surgical site prior to initiation of dialysis. This more permanent vascular access in the form of a fistula is preferred. Tunneled catheters are sometimes used instead of fistulas; however, their use should be discouraged. These tunneled catheters are associated with a higher incidence of hospitalization and death due to the higher risk for bacteremia.⁴

HEMODIALYSIS

Hemodialysis (HD) is based on the principles of diffusion and ultrafiltration.² This is a process that includes a semi-permeable membrane with blood on one side and dialysis solution on the other. Toxins, including urea, creatinine and other waste products are moved through the semi-permeable membrane from the blood into the dialysis solution. The diffusion rate is dependent on a number of factors, including concentration gradient, surface area and porosity of the membrane. Small molecules (urea) can pass efficiently through the membrane, while large molecules like drugs or creatinine do not clear as efficiently. Ultrafiltration or convection uses osmotic pressure gradients to remove excess fluid and larger molecules. By adjusting the dialyzer, diffusion and ultrafiltration can be individualized for maximum efficiency. There are 3 types of dialysis membranes that are used in this process. They include **low-flux, high-flux and high-efficiency membranes**. The low-flux membranes only remove small molecules (≤ 500 Daltons) such as urea. High-efficiency membranes have a large surface area and can also be used to remove small molecules and water. The high-flux membrane can remove both low and high molecular weight substances. Physicians determine the appropriate type of membrane, pressure gradient and dialysate solution and develop a personalized dialysis plan for each patient individually.

An important aspect of hemodialysis is the actual treatment time. The standard treatment time is three times a week for 3 to 5 hours.² This treatment time has not changed for over 40 years. Three times a week seems to balance the patient's need to be at the dialysis center and other aspects of their life. Some providers are using other forms of hemodialysis such as shorter daily dialysis or overnight dialysis in an effort to improve patient outcomes. These alternative dialysis programs are usually administered in the patient's home.

ADVERSE EFFECTS ASSOCIATED WITH HD

Intradialytic Adverse Effects

Patients undergoing hemodialysis are at risk for complications. Intradialytic hypotension (IH) is the most common adverse effect that happens during dialysis procedures and can occur in up to 20% of patients.² IH is defined as a symptomatic drop in systolic blood pressure to < 100 mmHg or a blood pressure drop of >20 mmHg. Symptoms include dizziness, blurred vision, fatigue and muscle cramps. Patients with IH are more likely to temporarily stop their dialysis treatment. IH can also result in more significant effects including mesenteric ischemia, myocardial infarction and stroke. IH is usually associated with the rate of infusion or concentration of dialysis solution. Physicians can change the concentration and ingredients of the dialysis solution or administer hypertonic saline to reduce the risk of hypotension. In addition to modifying the dialysis ingredients, physicians often will reduce the temperature of the dialysis solution to reduce vasodilation. Patients may be placed in the Trendelenburg position to reduce symptoms of IH.

In patients who require pharmacologic intervention, the most common agent prescribed is midodrine, an alpha adrenergic agonist that causes peripheral vasoconstriction.² Midodrine is a prodrug that is converted to the active metabolite, desglymidrodrine.⁵ The drug has a rapid onset with a peak effect at 1 hour and a short half-life of 3 hours. It is a small molecule with low protein binding and is removed during dialysis. The dose of midodrine is 2.5 to 10 mg given 15-30 minutes before HD.⁶ Midodrine carries a black box warning because of its ability to cause a marked elevation in blood pressure. The use of this drug should be reserved for those patients who are significantly impaired by orthostatic hypotension. Midodrine is

contraindicated in patients with heart failure, pheochromocytoma, thyrotoxicosis and acute renal disease. It should be used with caution in patients with significant peripheral vascular disease. Adverse reactions reported with midodrine include hypertension, paresthesia, pruritus, chills, urinary retention and urinary frequency. There are several significant drug interactions with midodrine. When midodrine is combined with cardiac glycosides, it may precipitate arrhythmia or atrioventricular block.

Catheter Thrombosis

It is important to ensure that hemodialysis catheters function properly. These catheters are designed to deliver at least 400 mL/minute.⁷ If the flow rate falls below this rate, the integrity of the catheter should be assessed. Sometimes the flow rate will fall below 400 mL/min due to a partial obstruction, but if the obstruction is not removed, it can become completely blocked.

The most common reason for catheter failure is an intrinsic thrombus.⁷ An intrinsic thrombosis occurs within the lumen of the catheter, the tip of the catheter or on the outer perimeter of the catheter, such as a fibrin sheath. Intraluminal thrombus occurs as a result of an inadequate volume of anticoagulant in the catheter, or if blood is present in the catheter. The catheter tip thrombus can occur because the anticoagulant (e.g. heparin) does not reach the tip of the catheter.

In patients who develop a thrombosis of the catheter lumen, initial treatment should be with a forced saline flush using a syringe no smaller than 5 mL.⁷ If the saline flush is not successful, instillation of a thrombolytic may be required. Thrombolytics include alteplase (2mg/mL) or reteplase (0.4 units/0.4 mL). Instill the thrombolytic into the catheter, after 30 minutes the catheter is aspirated to remove the thrombus. Thrombolytic therapy for occluded catheters can be successful in up to 90% of cases. If these therapies are not successful, the catheter will need to be replaced surgically.

Infection

The majority of blood stream infections in hemodialysis patients are caused by infection of the dialysis catheter.^{2,8} The incidence of bacteremia is higher in patients with indwelling tunneled catheters than in those with fistulas or grafts. Patients with tunneled dialysis catheters have a 10 times greater chance of developing bacteremia compared to a patient with an arteriovenous fistula. In addition, hemodialysis patients with an HD catheter have a two - to threefold higher risk of hospitalization and death from bacteremia when compared to patients with an HD fistula.

Patients suspected of having a catheter or fistula infection receive empiric antibiotic therapy to cover both gram-positive and gram-negative organisms.² This generally consists of parenteral vancomycin and gentamicin OR ceftazidime. In patients with a positive blood culture, parenteral treatment is customized and continued for 2-6 weeks depending on the specific organism and if the HD access device is removed.

PERITONEAL DIALYSIS

As mentioned earlier, peritoneal dialysis (PD) currently accounts for only 5% of all dialysis patients.² Although PD is used frequently in other countries, its use is low in the United States. Although PD could be an appropriate choice clinically for approximately 30% of patients, HD use has been preferred by providers for decades. This may be due to the Medicare payment structure which resulted in higher profits with hemodialysis. New CMS guidelines

have tightened payments to dialysis centers, and physicians are beginning to look at PD as a more cost effective therapy. Practitioners have stated that they perceive PD is less effective than HD and less safe. They also believe that there are higher infection rates and poorer outcomes with PD. Although there is good data to support the use of PD in some patients, it is not commonly used in the United States at this time.

PD is the installation of a dialysis solution into the peritoneal cavity using an abdominal catheter. In peritoneal dialysis, water and toxins are slowly exchanged between the capillary blood of the peritoneum and the intraperitoneal dialysate solution. PD is usually a continuous process (continuous ambulatory peritoneal dialysis). It can also be done by automated peritoneal dialysis (APD), which allows a cyclor to exchange dialysis solutions overnight in select patients.

In CAPD, the patient instills up to 3 L of dialysate solution 3 times a day. The solution remains in the peritoneal cavity for 4 to 6 hours. At night the exchange lasts 8-12 hours. The patient is responsible for infusing and removing the dialysate themselves using aseptic technique. The automated peritoneal dialysis system (APD) uses a cyclor to complete the solution exchanges, relieving the patient of these duties. The APD system incorporates short dwell times (1-2 hours) overnight allowing the patient to have a long daytime instillation (12-14 hours).

The fluids used for PD are aqueous solutions with electrolytes and glucose. Glucose is widely accepted as an osmotic agent for PD due to low cost and safety of the product. **PD has 2 major mechanisms of action: diffusion and ultrafiltration.** Diffusion is the most common and occurs when low molecular weight solutes diffuse through the pores of the peritoneal cells into the dialysate solution. Ultrafiltration occurs via the osmotic gradient that is created with the hypertonic glucose dialysate solution. Higher molecular weight solutes are carried into the dialysate solution via ultrafiltration. Unlike HD, this process does not alter the blood flow to the peritoneal cavity, so PD is a much more passive process and not as efficient as HD. The efficiency of PD is dependent on solution dwell times, glucose concentration and transport characteristics of the peritoneum.

ADVERSE EVENTS ASSOCIATED WITH PD

The use of PD is associated with complications.² Since a large volume of concentrated dextrose is used in PD, this can lead to obesity and the need for insulin in diabetic patients. A common problem reported with PD is infection.^{2,9} Infection is predominantly peritonitis or catheter-related infection. Peritonitis occurs in up to 60% of patients receiving CAPD within the first year. Treatment for peritonitis is primarily with intraperitoneal antibiotics. The appropriate drug used should be based on culture results and sensitivities reported in the specific dialysis center. Patients are generally treated for gram positive and gram negative organisms until cultures determine the causative organism. Resistance patterns in various regions of the US may require some agents to be avoided. The table below provides IP doses for common antibiotics used to treat peritonitis.

Table 1: Intraperitoneal dosing of antibiotics⁹

Drug	Dosing in continuous ambulatory peritoneal dialysis (CAPD)	Maintenance Dose
Gentamicin	Loading dose: 8 mg/L	4 mg/L
Amikacin	Loading dose: 25 mg/L	12 mg/L
Tobramycin	Loading dose: 8 mg/L	4 mg/L

Drug	Dosing in continuous ambulatory peritoneal dialysis (CAPD)	Maintenance Dose
Cefazolin	Loading dose: 500	125 mg/L
Ceftazidime	Loading dose: 500 mg/L	125 mg/L
Cefepime	Loading dose: 500 mg/L	125 mg/L
Ampicillin	No Loading dose	125 mg/L
Nafcillin	No Loading dose	125 mg/L
Ciprofloxacin	Loading dose: 50 mg/L	25 mg/L
Vancomycin	Loading dose: 1000 mg/L	25 mg/L

MANAGING DRUG THERAPY IN THE DIALYSIS PATIENT

Patients with chronic kidney disease requiring dialysis are at risk for various co-morbid conditions including cardiovascular disease, depression and diabetes.¹ It is not uncommon for dialysis patients to take 10-20 pills per day to manage their kidney disease and other medical conditions. Studies have shown that patients with a high daily pill burden generally have a lower rate of medication adherence. Hyperphosphatemia is a silent disease, like hypertension until the patient suffers potentially fatal symptoms. This disconnect between the patient's understanding of their disease and the long term impact on their health must be addressed by the pharmacist through education.

The pharmacist is in a unique position to evaluate and streamline the patient's medication therapy to improve the chances for medication adherence. Completing a comprehensive medication therapy management review of these patients can identify opportunities to streamline therapy. One target for the pharmacist is the daily pill burden from the phosphate binder product.¹

HYPERPHOSPHATEMIA

Hyperphosphatemia is a major complication of end-stage renal disease (ESRD). Studies have shown that hyperphosphatemia (> 6.4 mg/dL) is associated with a higher risk of all-cause mortality.¹⁰ Levels above 4.5 mg/dL are associated with an increased risk of a cardiovascular event. Pharmacists should counsel ESRD patients to avoid foods high in phosphorus (protein rich food) and foods with phosphorus additives (soft drinks and processed meat). Foods that are rich in phosphorus can be boiled to reduce phosphorus content. Dialysis patients should restrict their daily phosphorus intake to about 900 mg of which 40% is absorbed. Phosphate binders can provide additional phosphorus reduction depending on the individual patient needs.

Table 2. Phosphate binders¹¹

Drug	Dose	Daily pill burden	Cost	Adverse effects
Calcium salts	2-6 pills per day	2-10	Inexpensive	Hypercalcemia
Sevelamer (Renvela)	3 tablets 3 times a day	9	Expensive	Bloating, diarrhea and constipation
Lanthum carbonate (Fosrenol)	1 tablet 3 times a day	3	Expensive	Nausea and vomiting

ANEMIA

Anemia is a recognized complication of chronic kidney disease. It can occur early in kidney disease and becomes progressively worse with declining kidney function.¹ Anemia is associated with dizziness, fatigue, and shortness of breath. More severe complications associated with anemia include cardiovascular problems, including heart failure. Treatment of anemia results in improvement of cardiac function, exercise capacity, energy, and physical mobility.

Anemia from ESRD results from a lack of the hormone, erythropoietin.¹ Approximately 90% of erythropoietin is produced by the kidneys. In patients with normal kidney function, hypoxia in the kidney leads to an increase in the production of erythropoietin. Erythropoietin stimulates the release of red blood cells, improving oxygen carrying capacity. As renal function declines and renal tissue is damaged, the body is unable to produce adequate amounts of erythropoietin in response to hypoxia in the kidney.

Anemia associated with ESRD is usually normocytic and normochromic.¹ When evaluating anemia, it is important to conduct laboratory testing. Serum ferritin is used to assess the body's iron stores. The serum transferrin saturation (TSAT) or content of hemoglobin in reticulocytes (CHr) are used to evaluate the amount of iron available for erythropoiesis. The NKF KDOQI recommends the following for patients with hemodialysis-dependent ESRD: serum ferritin >200 ng/mL and TSAT >20% OR CHr >29 pg/cell. It is critical to evaluate both TSAT and serum ferritin. Serum ferritin is a sensitive marker and can be elevated in dialysis patients as a result of general inflammation or infection. The TSAT can assist providers in determining if there is an adequate amount of iron available for erythropoiesis. Inadequate iron stores or decreased availability of iron are the most common reason for poor response to erythropoiesis-stimulating agents (ESAs). There are currently four injectable iron preparations available in the U.S.¹²⁻¹⁵ (See Table 3). These agents are equally effective but have different dosing and side effect profiles. The newer agents have better safety profiles than iron dextran and may be preferred in dialysis patients.

Table 3. Injectable iron preparations¹²⁻¹⁵

	Iron Dextran (INFeD)	Iron Sucrose (Venofer)	Sodium ferric gluconate (Ferrlecit)	Ferumoxytol (Feraheme)
Indication	Iron deficiency anemia in adults and children older than 4 months of age	Iron deficiency anemia in adult patients with CKD	Iron deficiency anemia in adult and pediatric patients aged 6 years and older on chronic hemodialysis receiving epoetin	Iron deficiency anemia in adult patients with CKD
Contraindications	Hypersensitivity to iron dextran	Hypersensitivity to product; evidence of iron overload	Hypersensitivity to product; evidence of iron overload	Hypersensitivity to product; evidence of iron overload

	Iron Dextran (INFeD)	Iron Sucrose (Venofer)	Sodium ferric gluconate (Ferrlecit)	Ferumoxytol (Feraheme)
Side Effects	Black box warning describing the risk for anaphylactic-type reactions or death and the need for administering a test dose of iron dextran prior to the first therapeutic dose	Anaphylaxis, hypotension, dizziness, and headache	Anaphylaxis, hypotension, dizziness, and headache	Anaphylaxis, hypotension, dizziness, and headache
Comments	Discontinue oral iron	May reduce absorption of oral iron products	May reduce absorption of oral iron products	May reduce absorption of oral iron products

The availability of erythropoiesis-stimulating agents (ESAs) has had a significant impact on the treatment of anemia in patients with ESRD.¹⁶ There are 2 products currently on the market in the United States; epoetin alfa (Procrit, Epogen) and darbepoetin alfa (Aranesp).¹¹ Peginesatide (Omontys) is a newer agent that had been approved for use in dialysis patients, but was withdrawn from the market due to serious hypersensitivity reactions. It is no longer available for use. Initiation of ESA treatment is recommended in hemodialysis patients who have a hemoglobin level of <10 g/dL.¹ If the hemoglobin level approaches or exceeds 11 g/dL, the dose of the ESA should be reduced or interrupted. When initiating or adjusting therapy, monitor hemoglobin levels at least weekly until stable, then monitor at least monthly. In 2011, the Food and Drug Administration issued a black box warning for ESA's because of an increased risk of death and cardiovascular events when used in patients with hemoglobin levels > 11.5 g/dL.¹⁷ ESAs should be used with caution since hypersensitivity reactions have been reported. Some of the more commonly experienced adverse events include hypertension, headache, tachycardia, nausea/vomiting, shortness of breath, hyperkalemia, and diarrhea. If a patient develops a rash or itching, the symptom may be treated and therapy can be continued. However, if the patient experiences a severe anaphylactic reaction, therapy must be permanently stopped. The dosing of ESAs in patients with ESRD is shown in Table 4.

Table 4. Dosing of ESAs in dialysis patients¹¹

Drug	Dose
darbepoetin alfa (Aranesp)	0.45 mcg/kg IV or subcutaneously once a week in patients with ESRD
epoetin alfa (Procrit, Epogen)	50 to 100 units/kg subcutaneously or IV three times a week for patients with ESRD

THE ROLE OF THE PHARMACIST IN MANAGING PATIENTS WITH ESRD

The pharmacist can have a significant impact on the quality of care of dialysis patients. Although the pharmacist may not be practicing in the dialysis center, they can work with the patient to ensure medication is taken properly. In addition to general medication therapy management techniques, pharmacists should ensure that the doses of all medications are adjusted for the patient's renal function. Pharmacists should counsel ESRD patients to avoid foods high in phosphorus (protein rich food) and foods with phosphorus additives (soft drinks and processed meat).

Medication adherence is critical in this patient population and many of these patients take up to 20 pills a day. The pharmacist can have a significant impact by developing strategies to streamline therapy and ensure adherence. One specific area to target is the daily pill burden associated with the phosphate binder product. Another area of patient management is to ensure that patients on dialysis receive iron supplementation. The pharmacist can review the patient laboratory values to ensure that not only iron supplements are used properly, but that ESAs are not being used beyond the established Hgb level.

As discussed previously, over 60% of patients receiving peritoneal or hemodialysis die within 5 years of starting dialysis treatment. As a result of this high mortality rate and the projected increase in CKD and ESRD, the World Health Organization has identified CKD as a primary public health goal in Healthy People 2020. One opportunity for the pharmacist is to ensure patients with diabetes and CKD receive appropriate care to reduce the progression to ESRD. The pharmacist can identify these patients in their practice and develop specific monitoring parameters and clinical care for them.

CASE STUDY

JG is a 67 year old female patient who comes to the pharmacy for her prescription refills. She is currently taking the following medications:

- PhosLo 2 tablets TID
- Lipitor 10 mg once a day
- Vasoretic 1 tablet once a day
- Aspirin 325 mg once a day
- Aranesep 28 mcg SQ once a week
- Januvia 50 mg once a day

She complains to you that she gets confused and overwhelmed by all the pills she has to take along with the time she has to spend in dialysis three times each week. She feels like her whole day is spent either taking medication or going to the clinic for dialysis. What can you recommend for her?

Answer: First of all, reinforce with JG that you recognize her concerns and want to help her. You offer to complete a medication therapy management review of her medications and review the results with her and her doctor. You review her medication list and determine that the drug therapy is appropriate with a few changes. You note that the Januvia dose of 50 mg once a day is too high. It should be reduced to 25 mg once a day in patients with end stage renal disease. Also she is taking calcium acetate for management of her phosphate

level. You can recommend to her and her physician switching to Lanthum Carbonate which is only 1 tablet 3 times a day. This will reduce her total pill burden. You also counsel JG on the avoiding food products high in phosphorus (high protein food), and foods with phosphorus additives (soft drinks and processed meats). JG is grateful because she tells you she drinks 2 cans of Pepsi each day. She did not realize that she should avoid these products.

CONCLUSION

Chronic kidney disease is a serious public health issue that affects over 25 million individuals in the United States. The cost for treatment of CKD and ESRD accounts for 25% of the Medicare budget and continues to rise. With an aging population and the rapid rise in the incidence of diabetes and hypertension, the number of cases of ESRD is expected to increase dramatically over the next 5 years increasing the number of patients needing dialysis. The pharmacist can have a significant impact on the quality of care of dialysis patients. Although the pharmacist may not be practicing in the dialysis center, they can work with the patient to ensure medication is taken properly. Medication therapy management is critical in this patient population; many of these patients take up to 20 pills a day. The pharmacist can have a significant impact by developing strategies to streamline therapy and ensure adherence. In addition to general medication therapy management techniques, pharmacists should ensure that the doses of all medications are adjusted for the patient's renal function.

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1. Does the program meet the learning objectives?

Discuss impact of ESRD on the US population	YES	NO
Describe advantages & disadvantages of HD & PD	YES	NO
Review complications & adverse effects associated with HD & PD.	YES	NO
Describe role of the pharmacist in managing patients with ESRD	YES	NO
2. Was the program independent & non-commercial YES NO

3. Relevance of topic Low Relevance Very Relevant

1 2 3 4 5 6 7

4. What did you like most about this lesson? _____

5. What did you like least about this lesson? _____

Please Mark the Correct Answer(s)

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Which of these is (are) high in phosphorus? <ul style="list-style-type: none"> A. Diet coke B. Iced tea C. Spinach D. Peaches 2. Leading cause of death in dialysis patients is: <ul style="list-style-type: none"> A. Infection B. Cardiovascular events C. Sudden death D. None of these 3. The most widely accepted osmotic agent for PD is: <ul style="list-style-type: none"> A. Glucose B. Acetate C. Bicarbonate D. Lactose 4. The dose of gentamicin in peritoneal dialysis is: <ul style="list-style-type: none"> A. Loading dose 25 mg/L; maintenance dose 12 mg/L B. Loading dose 16 mg/L; maintenance dose 8 mg/L C. Loading dose 10 mg/L; maintenance dose 4 mg/L D. Loading dose 8 mg/L; maintenance dose 4 mg/L 5. Currently, ESRD is reported in how many patients? <ul style="list-style-type: none"> A. 400,000 B. 900,000 C. 600,000 D. 350,000 6. Hemodialysis patients have how many times higher risk for death than patients with normal kidney function? <ul style="list-style-type: none"> A. 3 - 4 B. 4 - 5 C. 5 - 7 D. 6 - 8 | <ol style="list-style-type: none"> 7. Tunneled hemodialysis catheters cause how many more bacteremia episodes than arteriovenous fistulas? <ul style="list-style-type: none"> A. 5 times more B. 10 times more C. 15 times more D. 20 times more 8. Midodrine: <ul style="list-style-type: none"> A. Is an alpha adrenergic agonist B. Causes peripheral vasoconstriction C. Is a prodrug that is converted to the active metabolite, desglymidrodrine D. All of these are relevant to midodrine 9. Which iron product should be given as a test dose of 25 mg at the beginning of therapy? <ul style="list-style-type: none"> A. Iron dextran B. Iron sucrose C. Sodium ferric gluconate D. Ferumoxytol 10. If a patient develops a rash when taking Epogen, <ul style="list-style-type: none"> A. Stop the drug & do not restart B. Treat the rash & continue therapy C. Immediately administer epinephrine & transfer to an emergency room D. Reduce the dose by 50% |
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Contributing Author

Mary Lynn Moody, BS Pharm
Clinical Assistant Professor
Director, Business Development
Drug Information Group
University of Illinois, Chicago
College of Pharmacy

Executive Editor

William J. Feinberg, RPh, MBA

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