Anemia: Disease Basics, Treatment and Appropriate Use of ESAs

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Dr. Mona T. Thompson has no relevant financial relationships to disclose.

Goal. The goal of this lesson is to provide a basic background on anemia to include pathophysiology, epidemiology, and associated laboratory studies in the diagnosis of anemia; common types of anemia and their causes; and treatment options in adults.

Objectives. At the completion of this activity, the participant will be able to:
1. demonstrate an understanding of the epidemiology, pathophysiology, and associated laboratory studies in the diagnosis of anemia;
2. recognize the general characteristics and causes for select types of anemia;
3. identify the general adult treatment options for anemia types, as well as key prescribing and counseling points for the entities discussed; and
4. demonstrate an understanding of the current recommendations for the use of erythropoietin stimulating agents (ESAs).

Background
Anemia is one of the most common hematologic problems in both adults and children. In a prevalence study conducted using data from 1993 to 2005, the World Health Organization (WHO) reported that globally, anemia affected 1.62 billion people, correlating to almost 25 percent of the population. Therefore, it is considered a public health concern that affects both developed and developing countries. Estimates in the Americas and Europe were lower than in other regions such as Africa and Eastern Mediterranean.

Anemia is the result of one or more of the three independent mechanisms that occur secondary to various deficiencies and disorders: (1) decreased red blood cell (RBC) production, (2) increased RBC destruction, and (3) blood loss. Decreased RBC production is the result of nutrient deficiencies such as iron, vitamin B12, and folate; bone marrow suppression (drugs, chemotherapy, radiation); bone marrow disorders (aplastic anemia, myelodysplasia, tumor infiltration); low levels of erythropoietin (EPO); chronic kidney disease; and other chronic diseases. Iron deficiency is the cause in approximately 30 to 50 percent of anemia cases. Hemolytic anemias are caused by RBC destruction. Examples include sickle cell disease and thalassemias. In some cases, the cause of anemia is unexplained.

The WHO defines anemia as a hemoglobin (Hb) level less than 13 grams per dL in men, and less than 12 grams per dL in women. Other authors have proposed different ranges and lower limits of normal that vary based on age, sex, and race. Patients living at high altitude and athletes may also have different normal values.

Anemia occurs at all stages of life but most often in pregnant women and preschool-aged children, which are populations that have an increased demand for iron. In the United States, the prevalence of iron-deficiency anemia among children declined during the 1970s in association with increased iron intake during infancy. It is estimated that 4 percent of women in the United States between the ages of 20 to 49 years have iron deficiency anemia. According to the WHO definition, more than 10 percent of persons older than 65 years are anemic. The prevalence increases with age, and one study found that it approaches 50 percent in chronically ill patients living in nursing homes.

Table 1 lists the normal red blood cell parameters in adults. Several studies have demonstrated that anemia is an independent risk factor for increased morbidity and mortality, and decreases quality of life in older persons living independently. Functional deterioration increases with decreased hemoglobin concentration in an inverse and linear fashion.

Red Blood Cells Life Cycle and Function of Erythropoietin
RBCs, also known as erythrocytes, are produced through the process of erythropoiesis which occurs in the bone marrow. While the process is dependent on various factors, erythropoietin (EPO) plays an integral role. EPO is an endocrine hormone produced in the kidney by cells that sense inadequate tissue oxygenation. Once hypoxia is sensed, EPO is produced and travels to the bone marrow where
Adults.

To EPO approximately fivefold in increase erythropoiesis in response. In fact, normal bone marrow can the influence of high levels of EPO. Production greatly increases under anemia. The rate of red blood cell reduced rates of production lead to maintain stable RBC mass. Persistent blood each day in order to main-

50,000 reticulocytes/µL of whole row must produce approximately patient. Fatigue, pallor, shortness of breath, dizziness, coldness in hands and feet, and chest pain are common, yet nonspecific, symptoms that are often experienced. These symptoms occur due to the lack of oxygen delivery to tissue and/or acute, marked bleeding causing hypovolemia. Clinicians are encouraged to complete a thorough and systematic approach so as not to overlook underlying causes. Angular cheilitis (cracking at the edges of the lips) and koilonychias (spooning of the nails) may accompany iron deficiency anemia. Neurological manifestations can accompany or predate anemia associated with vitamin B12 deficiency. The patient’s past medical history can be helpful, as can a review of pharmacologic agents since certain medications, especially chemotherapy, may be associated with bone marrow suppression. In addition, some medications such as NSAIDs and anticoagulants can increase the risk of bleeding resulting in anemia secondary to blood loss.

### Laboratory Studies for Diagnosing Anemia

This section will briefly review the laboratory studies that a clinician may utilize to not only confirm a diagnosis of anemia, but classify the type and determine the treatment approach. Upon confirmation of anemia (Hb <13g/dL in men; <12g/dL in women according to WHO), a complete blood count is generally obtained. The mean corpuscular volume (MCV) or red blood cell size is used to distinguish microcytic (MCV <80fL), normocytic (MCV 80 to 100fL), and macrocytic (>100fL) anemias. The most commonly seen

### Treatment of Select Anemias

The remainder of this lesson will review iron deficiency anemia (IDA), anemia of chronic disease (ACD), and anemia associated with chronic kidney disease (CKD) as these types of anemia are often encountered in the community setting. Various oral and intravenous iron agents as well as erythropoietin stimulating agents (ESAs) are prescribed for their treatment.

### Iron Deficiency Anemia

Iron deficiency is the most common nutritional deficiency worldwide. Iron metabolism is controlled by absorption rather than excretion, and iron is only lost through blood loss or in RBCs as they slough. Men and non-menstruating women lose approximately 1mg of iron each day, while menstruating women lose 0.6 to 2.5 percent more. Pregnancy requires about 700mg of iron; a complete blood donation of 500mL contains 250mg of iron. Iron absorption occurs mostly in...
Dietary Reference Intake (DRI) for iron is 8mg per day for healthy, non-menstruating adults, 18mg per day for menstruating women, and 16mg per day for vegetarians (due to the difference in absorption of non-heme iron).

IDA is usually a microcytic anemia. The most accurate initial diagnostic test for IDA is a serum ferritin measurement less than 40mcg/L. When iron deficiency is diagnosed and the underlying cause addressed, restoration of iron supply is necessary. While transfusion can be considered for patients experiencing fatigue, dyspnea on exertion, or for cardiac patients with Hb less than 10g/dL, oral iron therapy is the first line of therapy.

### Anemia of Chronic Disease

Anemia of chronic disease (ACD) is an anemia of underproduction of red blood cells. The cause of ACD is multi-factoral and includes a mildly decreased life span of erythrocytes, deregulated iron absorption and transport, inhibition of hematopoiesis, and relative deficiency of erythropoietin. In simplified terms, researchers suggest that the underlying inflammatory medical condition causes the release of cytokines such as interleukins (IL-1 and IL-6), and tumor necrosis factor leading to a cascade of events that alters the RBC life cycle and hematopoiesis process as stated above. Interestingly, it has been observed that the treatment of patients with rheumatoid arthritis using an anti-TNF-alpha antibody led to a reduction in IL-6 levels and an improvement in anemia. In addition to IL-6, hepcidin, a protein generated in the liver, interferes with RBC production by decreasing iron availability for incorporation into erythroblasts. Increased hepcidin levels have been documented in patients with ACD, multiple myeloma, inflammatory bowel disease, and Hodgkin lymphoma. Precipitating illnesses to ACD include active infection, inflammatory condition, alcoholic liver disease, congestive heart failure, thrombosis, chronic pulmonary disease, diabetes, trauma, etc.

ACD is generally mild, normocytic and normochromic (concentration of Hb in RBC is normal). However, it can become microcytic and hypochromic in long-standing cases, and can be severe. Laboratory findings usually reveal a low reticulocyte count (<25,000/µL) reflecting reduced RBC production. The differential diagnosis for ACD among other anemias can be challenging, and is most likely when the following are present: low serum iron, normal to low serum transferrin (glycoprotein that binds to iron and controls the level of free iron), normal to increased ferritin, and elevated erythrocyte sedimentation rate and/or C-reactive protein. The last two findings indicate systemic inflammation. Recognizing iron deficiency along with ACD may require additional testing, but is suggested by the finding of low serum ferritin levels.

Optimal treatment of ACD involves correction of the underlying disease process, if one can be clearly documented. Managing chronic diseases will minimize inflammation and lessen bone marrow suppression. Most patients with mild anemia will have no symptoms; therefore, treatment should be limited to those with severe, symptomatic anemia (Hb <10g/dL). Treatment options for these patients include blood transfusions and ESAs. Transfusions provide immediate relief of symptoms, yet are associated with the following risks: volume overload, iron overload, infections, and acute reactions. ESAs may be used for the treatment of ACD in limited situations, but their use remains controversial.

### Anemia in Chronic Kidney Disease

Chronic kidney disease (CKD) affects approximately 26 million adults in the U.S. and is associated with significant morbidity and mortality. Among the medical problems facing this population is anemia with incidence increasing with declining glomerular filtration.

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**Table 2**

<table>
<thead>
<tr>
<th>Causes and Examples of Iron Deficiency in Adults</th>
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<tbody>
<tr>
<td><strong>Increased iron loss</strong></td>
</tr>
<tr>
<td>Acute hemorrhage</td>
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<tr>
<td>Chronic or occult hemorrhage</td>
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<tr>
<td>Menstruation</td>
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<td>Inflammation</td>
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<tr>
<td>Cancer</td>
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<tr>
<td>Vascular malformation</td>
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<tr>
<td>Hemolysis</td>
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<tr>
<td>Blood donation</td>
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<tr>
<td><strong>Decreased iron in diet</strong></td>
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<tr>
<td>Vegetarian diet</td>
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<tr>
<td>Malnutrition</td>
</tr>
<tr>
<td>Dementia</td>
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<tr>
<td>Psychiatric illness</td>
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<tr>
<td><strong>Decreased iron absorption</strong></td>
</tr>
<tr>
<td>Antacid therapy or high gastric pH</td>
</tr>
<tr>
<td>Celiac disease</td>
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<tr>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>Partial gastrectomy</td>
</tr>
<tr>
<td><strong>Increased iron requirements</strong></td>
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<tr>
<td>Pregnancy</td>
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<tr>
<td>Lactation</td>
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</table>

the jejunum, the middle section of the small intestine, and is only about 5 to 10 percent of the dietary intake. The absorption is also somewhat regulated by the body as it decreases in states of overload and increases in states of depletion.

There are two forms of dietary iron: heme iron, which is found in meat; and non-heme iron, which is found in plant and dairy foods. The bioavailability and absorption of non-heme iron requires acid digestion. It is enhanced by ascorbic acid and meat, while it is inhibited by calcium, fiber, tea, coffee, and wine. A large amount of iron is recycled daily for heme synthesis; therefore, only 1 to 2mg of (absorbed) iron is required to replace the iron losses. It is important to note that iron stores become depleted before iron deficiency anemia occurs. Table 2 lists common causes of iron deficiency in adults.

The U.S. Preventive Services Task Force recommends routine screening for iron deficiency in pregnant women. The task force found insufficient evidence to recommend for or against screening in other asymptomatic persons. The
The problem can also be compounded by iron deficiency. The mechanism for how EPO production is hindered is not fully understood; however, as renal failure progresses, the contribution of EPO deficiency to anemia increases. Additionally, as previously discussed, acute and chronic inflammation impact CKD patients with anemia by the involvement of cytokines and hepcidin. RBCs have a decreased life span, and uremic toxins are thought to contribute to apoptosis (programmed cell death) in the development of RBCs. Studies have demonstrated an improvement in Hb levels and decreased ESA use with increased adequacy of dialysis (which removes the toxins). It has been hypothesized that one of the molecules in uremia is involved in bone marrow suppression.

The National Kidney Foundation (NKF) Kidney Disease Outcomes Quality Initiative’s (KDOQI) clinical practice guidelines and clinical practice recommendations advocate annual screening for anemia in all patients with CKD. Most of the anemic patients with CKD will have erythropoietin deficiency which is a diagnosis of exclusion. Many of these patients will also have coexisting iron deficiency. Iron deficiency is almost always present in hemodialysis patients due to bleeding when needles are removed from vascular access, blood infiltration of the vascular access, vascular access procedures, frequent blood testing, and clotting or general blood loss in the extracorporeal circuit. Iron deficiency in patients not yet on hemodialysis is likely due to dietary protein restriction or decreased appetite for red meat. According to the NKF/KDOQI guidelines, ESA therapy should be initiated when the patient’s Hb drops below 10g/dL with target Hb level for treatment being 11 to 12g/dL. Treatment levels should not exceed a Hb of 13g/dL. If not already present, iron deficiency often develops with ESA therapy due to the depletion of existing iron stores when stimulating new RBCs.

Iron is usually administered orally in patients on peritoneal dialysis, but not in patients on hemodialysis. Hemodialysis patients, and those unable to respond to oral supplements, will require intravenous iron therapy. Despite adequate dosing of ESAs and iron therapy, patients may still require blood transfusions depending on symptoms.

### Iron Treatment

The three most common salts found in oral iron preparations are ferrous sulfate, ferrous gluconate, and ferrous fumarate. Oral iron is available as non-enteric coated tablets, enteric coated tablets, prolonged release formulations, or elixirs. Table 3 lists the elemental iron content of common iron salt tablet preparations.

<table>
<thead>
<tr>
<th>Preparation</th>
<th>Dose</th>
<th>Elemental Iron Content</th>
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<tbody>
<tr>
<td>Ferrous sulfate tab</td>
<td>325mg</td>
<td>65mg</td>
</tr>
<tr>
<td>Ferrous gluconate tab</td>
<td>300mg</td>
<td>36mg</td>
</tr>
<tr>
<td>Ferrous fumarate tab</td>
<td>100mg</td>
<td>33mg</td>
</tr>
<tr>
<td>Ferrous sulfate elixir</td>
<td>220mg/5mL</td>
<td>44mg</td>
</tr>
</tbody>
</table>

Non-enteric coated iron tablets are the most commonly used agents because of their low cost and effectiveness. Delayed-release and enteric coated preparations are often promoted because they have better gastrointestinal tolerance. However, they are not recommended for initial therapy as they contain less iron and are released further down in the intestinal tract leading to decreased absorption.

Many factors alter the absorption of iron. Iron is best absorbed in a mildly acidic medium. Hence, the co-administration of ascorbic acid 250mg improves the degree of absorption and is recommended. Phytates (bran, cereal), tannates (tea), and phosphate-containing carbonated beverages bind to iron. Therefore, iron salts should not be given with these foods or beverages. Other factors that limit absorption include medications that raise the gastric pH such as antacids, proton pump inhibitors, and histamine blockers. Certain antibiotics (quinolones and tetracyclines) also bind to iron. Ideally, iron should be taken two hours before or four hours after the ingestion of antacids, quinolones and tetracyclines. Multivitamins should never be used as the sole supplement for IDA, since calcium, phosphate, and magnesium found in the tablet can alter absorption.

The recommended oral daily dose for the treatment of IDA in adults ranges from 150 to 200mg of elemental iron. A common starting regimen is ferrous sulfate tablets 325mg, three times a day. This yields an oral dose of 195mg of elemental iron each day. Using the assumption that 10 percent of the iron is absorbed, hemoglobin may correct in four weeks in patients with moderate, uncomplicated anemia. The duration of therapy varies as some experts recommend continuing iron therapy for six months after hemoglobin is restored so that iron stores are replenished. Others stop therapy upon Hb restoration, and assess for repeated anemia alerting the patient and physician to determine the cause of iron deficiency. Patients predicted to have ongoing iron deficits may require individualized maintenance dosing.

Dose dependent gastrointestinal symptoms, such as abdominal discomfort, nausea, vomiting, diarr-
rhea, and constipation, are common and occur in up to 20 percent of patients. Changing the iron salt and formulation are commonly tried; however, these involve dose reductions leading to extended treatment duration. Ferrous sulfate elixir is an option for patients with persistent gastric intolerance. It allows the dose to be titrated up or down until it is tolerated by the patient. While absorption will be affected, taking iron salts with food may alleviate symptoms. Laxatives, stool softeners, and adequate intake of liquids may also reduce constipation.

Indications for intravenous iron include chronic uncorrectable bleeding, intestinal malabsorption, and intolerance to oral iron. As previously discussed, intravenous iron is commonly used in hemodialysis patients. It is important to state that the hematologic response to parenteral iron treatment is not faster than that of oral therapy.

Hypersensitivity reactions have been reported with all of the intravenous iron products. Patients should be closely monitored during administration and for at least 30 minutes following administration of the iron preparation. Deaths have been reported following anaphylactic-type reactions; therefore, these agents should only be used where resuscitation equipment and personnel are available.

At the time of writing this lesson, there were four intravenous preparations available in the U.S. which are described briefly. Refer to product labeling for full prescribing information.

**Iron dextran complex** contains 50mg of elemental iron per mL and can be given IM or IV. It is indicated for IDA in patients in whom oral iron is not feasible or ineffective. INFeD® and Dexferrum® are two brands of iron dextran, but differ in that they are low and high molecular weight preparations, respectively. Anaphylactic reactions occur in about 1 percent of patients with either the low or high molecular weight products, and are thought to be caused by the free iron present in the preparation. High molecular weight products are associated with a considerably higher incidence of adverse events than the low molecular weight product. Local reactions include pain, muscle atrophy, and phlebitis. Systemic reactions include fever, urticaria, and a flare in arthritis in patients with rheumatoid arthritis.

Patients receiving iron dextran for the first time must receive a 0.5mL test dose given by slow IV push over five minutes. The remainder of the dose, which is calculated and individualized for the patient based on Hb, may be administered following a one-hour observation period. Fatal reactions have occurred, even in patients who tolerated the test dose. It may be administered by IV bolus at a rate of ≤50mg/minute or diluted in 250 to 1000mL of normal saline over one to six hours. Subsequent doses do not require a test dose. While it may be given IM, IV is the preferred route. IM administration has not been shown to be safer or less toxic, and may be associated with bruising due to repeated injections and variable absorption. Iron dextran complex use has decreased since the introduction of other intravenous iron preparations associated with fewer adverse events.

**Ferric gluconate complex** (Ferrlecit®) is approved for the treatment of iron deficiency anemia in patients with CKD who are undergoing hemodialysis and receiving ESAs. Off-label use includes cancer-/chemotherapy-associated anemia. It is dosed as 125mg undiluted by slow IV push at a rate of 12.5mg/min or diluted in 100mL of normal saline and infused over 30 to 60 minutes. The dose may be repeated up to a cumulative dose of 1000mg. A 2mL test dose was previously recommended, but is not in current manufacturer labeling. Doses greater than 125mg are associated with increased adverse events. Data indicates that, in comparison to iron dextran, Ferrlecit use results in 3.3 versus 8.7 allergic events per one million doses per year.

**Iron sucrose** (Venofer®) is approved for IV use only and appears to be safe even in patients with a prior history of sensitivity to iron dextran. It is indicated for the treatment of iron-deficiency anemia in CKD, including non-dialysis dependent patients (with or without ESAs) and dialysis-dependent patients receiving ESA therapy. It may be used off-label for cancer- or chemotherapy-associated anemia. Dosing varies by indication, but is generally either 100mg or 200mg per infusion with a cumulative dose of 1000mg. It may be given slow IV push over two to five minutes, or diluted in normal saline for a slower infusion. Adverse reactions include hypotension (up to 39 percent in hemodialysis patients), peripheral edema, headache, diarrhea, nausea, vomiting, and muscle cramps (29 percent in hemodialysis patients). Life-threatening reactions, including anaphylaxis, may occur in fewer than 1 percent of patients. Product labeling does not indicate the need for a test dose in product-naïve patients, but a test dose is strongly recommended in patients who are sensitive to iron dextran or have other drug allergies.

**Ferumoxytol** (Feraheme®) is approved for the treatment of IDA in adult patients with chronic kidney disease. It is administered as a 510mg intravenous dose at a rate of 30mg/second as a single dose, followed by a second 510mg dose three to eight days later. A test dose is not required, however, patients should be monitored during and for 30 minutes, or until clinically stable, following administration. Anaphylactic-type reactions presenting with cardiovascular/respiratory arrest, clinically significant hypotension, syncope, and unresponsiveness have been reported in post-marketing experience. Feraheme may interfere with MRI imaging for up to three months after the last dose.
Erythropoietin Stimulating Agents

ESAs are used to prevent the need for RBC transfusions. They have not been shown to improve quality of life, fatigue or patient well-being. ESAs stimulate erythropoiesis through the same process as endogenous EPO. Increases in Hb levels are generally seen two to six weeks after administration. During treatment with ESAs, iron repletion must be maintained to ensure effectiveness.

Currently there are three ESAs available in the U.S. Epoetin alfa, the first ESA available, was marketed as Epogen® and Procrit® in 1989. Darbepoetin alfa (Aranesp®) was introduced in 2001. Most recently, peginesatide (Omontys®), a synthetic peptide analog of EPO, was approved in 2012, and voluntarily recalled in February 2013. Table 4 summarizes the FDA-approved indications for these products. Refer to product information for approved indications, dosing, monitoring, subsequent dosing adjustments, and information regarding converting patients from one ESA to another.

The use of these agents has reduced the need for RBC transfusions, but their use is not without risk. All three product labels carry similar black box warnings regarding greater risk for death, serious adverse cardiovascular reactions, and stroke when the ESA is administered to target a Hb level greater than 11g/dL. Possible causes include complete and/or too rapid correction of anemia that can increase blood pressure and the risk of thrombosis, by accentuating vasoconstriction and increasing platelet adhesiveness and blood viscosity. All of the agents are contraindicated in uncontrolled hypertension. Additional warnings and prescribing restrictions are included for ESAs that are approved for use in patients in treating anemia due to myelosuppressive chemotherapy. Clinicians are reminded to use the lowest ESA dose sufficient to reduce the need for RBC transfusions. In terms of efficacy, epoetin alfa and darbepoetin are widely considered equal when dosed accordingly. ESA doses should be individualized based on causes of anemia and symptoms.

Summary

Iron deficiency anemia, anemia of chronic disease, and anemia due to chronic kidney disease are among the most common types of anemia. Anemia can have a profound effect on quality of life with symptoms including fatigue, dizziness, shortness of breath, and decreased sense of well being. Complications of anemia include reduced cognitive function and mental acuity, impaired quality of life, and the need for blood transfusions. Untreated anemias can lead to cardiovascular disease with left ventricular hypertrophy and congestive heart failure, or worsen existing heart disease. Anemia may also be responsible for declining renal function in some groups. Oral and parenteral iron supplements, as well as ESAs, are available treatment options. Iron must be administered with ESA therapy to avoid depletion.

Table 4
Guidelines for Use of ESAs in Patients with Anemia

<table>
<thead>
<tr>
<th>Indications approved by FDA</th>
<th>Treatment of anemia due to</th>
</tr>
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<tbody>
<tr>
<td><strong>Epogen/Procrit</strong></td>
<td>- Chronic Kidney Disease (CKD) in patients on dialysis and patients not on dialysis.</td>
</tr>
<tr>
<td><strong>Aranesp</strong></td>
<td>- the effects of concomitant myelosuppressive chemotherapy, and upon initiation, there is a minimum of two additional months of planned chemotherapy.</td>
</tr>
</tbody>
</table>

**Epoetin Alfa**

- Treatment of anemia due to:
  - Chronic Kidney Disease (CKD) in patients on dialysis and patients not on dialysis.
  - the effects of concomitant myelosuppressive chemotherapy, and upon initiation, there is a minimum of two additional months of planned chemotherapy.

**Darbepoetin Alfa**

- Treatment of anemia due to:
  - Chronic Kidney Disease (CKD) in patients on dialysis and patients not on dialysis.
  - the effects of concomitant myelosuppressive chemotherapy, and upon initiation, there is a minimum of two additional months of planned chemotherapy.

The author, the Ohio Pharmacists Foundation and the Ohio Pharmacists Association disclaim any liability to you or your patients resulting from reliance solely upon the information contained herein. Bibliography for additional reading and inquiry is available upon request.

This lesson is a knowledge-based CE activity and is targeted to pharmacists in all practice settings.
Anemia: Disease Basics, Treatment and Appropriate Use of ESAs

1. An example of hemolytic anemia caused by red blood cell destruction is:
   a. iron deficiency.   c. chronic kidney disease.
   b. folate deficiency. d. sickle cell disease.

2. Anemia occurs most often in all of the following EXCEPT:
   a. pregnant women.
   b. preschool aged children.
   c. newborns.

3. Erythropoiesis occurs in the bone marrow.
   a. True   b. False

4. All of the following symptoms are common in anemia EXCEPT:
   a. fatigue.   c. headache.
   b. pallor.   d. shortness of breath.

5. Macrocytic anemias are often due to all of the following EXCEPT:
   a. alcoholism.   c. liver disease.
   b. thalassemia. d. vitamin B12 deficiency.

6. Iron absorption occurs mostly in the:
   a. cecum.   c. ileum.
   b. duodenum. d. jejunum.

7. Iron deficiency anemia is usually a:
   a. microcytic anemia.
   b. macrocytic anemia.
   c. normocytic anemia

Completely fill in the lettered box corresponding to your answer.

1. [a] [b] [c] [d]   6. [a] [b] [c] [d]   11. [a] [b]
2. [a] [b] [c]   7. [a] [b] [c]   12. [a] [b]
3. [a] [b]   8. [a] [b] [c]   13. [a] [b] [c] [d]
4. [a] [b] [c] [d]   9. [a] [b] [c] [d]   14. [a] [b] [c] [d]
5. [a] [b] [c] [d]   10. [a] [b] [c]   15. [a] [b] [c]

I am enclosing $10 (member); $15 (non member) for this month’s quiz made payable to: Ohio Pharmacists Association.

1. Rate this lesson:   (Excellent)  5 4 3 2 1 (Poor)
2. Did it meet each of its objectives?   yes   no
   If no, list any unmet_______________________________
3. Was the content balanced and without commercial bias?   yes   no
4. Did the program meet your educational/practice needs?   yes   no
5. How long did it take you to read this lesson and complete the quiz?__________________
6. Comments/future topics welcome.

8. Recognizing iron deficiency along with ACD is suggested by the finding of low:
   a. sedimentation rate.
   b. serum iron levels.
   c. serum ferritin levels.

9. The National Kidney Foundation Kidney Disease Outcomes Quality Initiative recommends screening for anemia in all patients with CKD:
   a. only at diagnosis.   c. biannually.
   b. annually.   d. every five years.

10. The oral iron salt containing the highest amount of elemental iron is:
    a. ferrous sulfate.
    b. ferrous gluconate.
    c. ferrous fumarate.

11. Iron is best absorbed in a mildly:
    a. basic medium.   b. acidic medium.

12. The preferred route of administration for iron dextran complex is:
    a. intravenous.   b. intramuscular.

13. Which of the following requires a test dose prior to administration?
    a. Ferumoxytol   c. Iron dextran complex
    b. Iron sucrose   d. Ferric gluconate complex

14. All ESA products carry a black box warning regarding greater risk of all of the following EXCEPT:
    a. stroke.   c. serious cardiovascular reactions.
    b. death.   d. serious hypersensitivity reactions.

15. All erythropoietin stimulating agents are contraindicated in:
    a. HIV infection.
    b. rheumatoid arthritis.
    c. uncontrolled hypertension.