



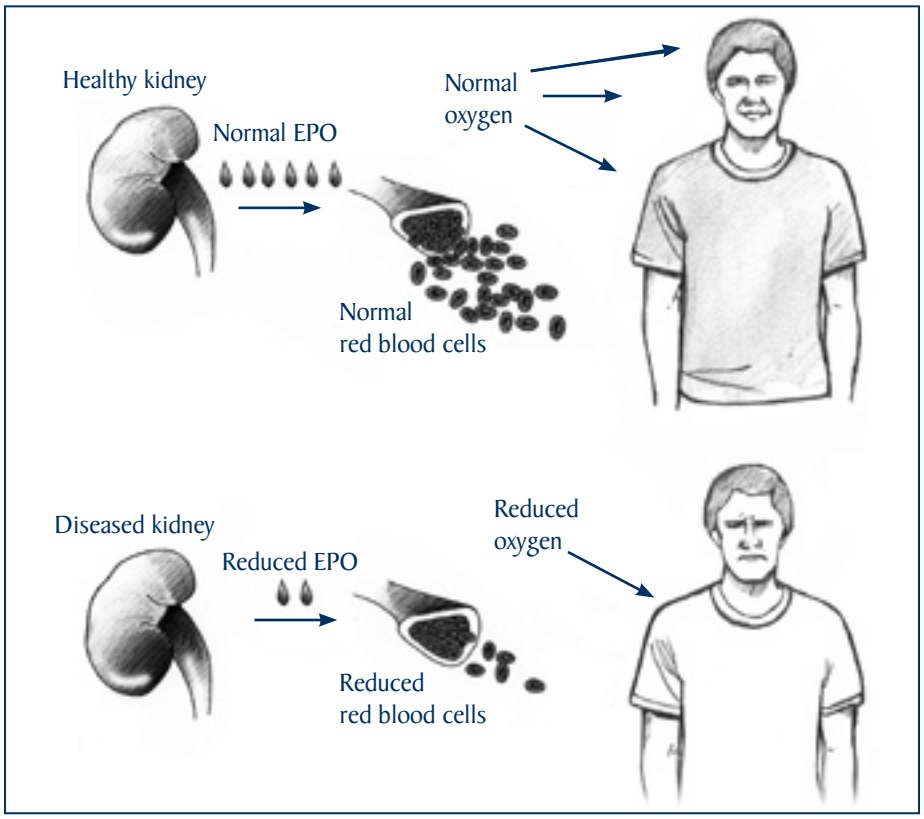



# Anemia in Kidney Disease and Dialysis

## What is anemia?

A person whose blood is low in red blood cells has anemia. Red blood cells carry oxygen ($O_2$) to tissues and organs throughout the body and enable them to use the energy from food. Without oxygen, these tissues and organs—particularly the heart and brain—may not do their jobs as well as they should. For this reason, a person who has anemia may tire easily and look pale. Anemia may also contribute to heart problems.

Anemia is common in people with kidney disease. Healthy kidneys produce a hormone called erythropoietin, or EPO, which stimulates the bone marrow to produce the proper number of red blood cells needed to carry oxygen to vital organs. Diseased kidneys, however, often don't make enough EPO. As a result, the bone marrow makes fewer red blood cells. Other common causes of anemia include blood loss from hemodialysis and low levels of iron and folic acid. These nutrients from food help young red blood cells make hemoglobin, their main oxygen-carrying protein.




Healthy kidneys produce a hormone called erythropoietin, or EPO, which stimulates the bone marrow to make red blood cells needed to carry oxygen throughout the body. Diseased kidneys don't make enough EPO, and bone marrow then makes fewer red blood cells.

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National Kidney and Urologic Diseases Information Clearinghouse

## What are the laboratory tests for anemia?

A complete blood count (CBC), a laboratory test performed on a sample of blood, includes a determination of a person's hematocrit, the percentage of the blood that consists of red blood cells. The CBC also measures the amount of hemoglobin in the blood. The range of normal hematocrit and hemoglobin in women who have a period is slightly lower than for healthy men and healthy women who have stopped having periods (postmenopausal). The hemoglobin is usually about one-third the value of the hematocrit.

## When does anemia begin?

Anemia may begin to develop in the early stages of kidney disease, when a person still has 20 to 50 percent of normal kidney function. This partial loss of kidney function is often called chronic kidney disease (CKD). Anemia tends to worsen as kidney disease progresses. End-stage kidney disease, the point at which dialysis or kidney transplantation becomes necessary, doesn't occur until a person has only about 10 percent of kidney function remaining. Nearly everyone with end-stage kidney disease has anemia.

## How is anemia diagnosed?

If a person has lost at least half of normal kidney function and has a low hematocrit, the most likely cause of anemia is decreased EPO production. The estimate of kidney function, also called the glomerular filtration rate, is based on a blood test that measures creatinine. Experts recommend that doctors begin a detailed evaluation of anemia in men and postmenopausal women on dialysis when the hematocrit falls below 37 percent. For women of childbearing age, evaluation should begin when the hematocrit falls below 33 percent. The evaluation will include tests for iron deficiency and blood loss in the stool to be certain there are no other reasons for the anemia.

## How is anemia treated?

### EPO

If no other cause for anemia is found, it can be treated with a genetically engineered form of EPO. The EPO is usually injected under the skin two or three times a week. Patients on hemodialysis who can't tolerate EPO shots may receive the hormone intravenously during treatment. The intravenous method, however, requires a larger, more expensive dose and may not be as effective.

The U.S. Food and Drug Administration (FDA) recommends that patients treated with EPO therapy should achieve a target hemoglobin between 10 and 12 grams per deciliter (g/dL). Recent studies have shown that raising the hemoglobin above 12 g/dL in people who have kidney disease increases the risk of heart attack, heart failure, and stroke. People who take EPO shots should have regular tests to monitor their hemoglobin. If it climbs above 12 g/dL, their doctor should prescribe a lower dose of EPO. The FDA recommends that patients whose hemoglobin does not rise to the target level with normal doses of EPO ask their doctor to check for other causes of anemia.

### Iron

Many people with kidney disease need both EPO and iron supplements to raise their hematocrit to a satisfactory level. If a person's iron levels are too low, EPO won't help and that person will continue to experience the effects of anemia. Some people are able to take an iron pill, but many studies show that iron pills don't work as well in people with kidney failure as iron given intravenously. Iron can be injected into an arm vein or into the tube that returns blood to the body during hemodialysis.

A nurse or doctor will give each patient a test dose because a small number of people—less than 1 percent—have a bad reaction to iron injections. If a patient begins to wheeze or have trouble breathing, the health care provider can give epinephrine or corticosteroids to counter

the reaction. Even though the risk is small, patients are asked to sign a form stating they understand the possible reaction and they agree to have the treatment. Patients should talk with their health care providers if they have any questions.

In addition to measuring hematocrit and hemoglobin, the CBC test will include two other measurements to show whether a person has enough iron.

- The ferritin level indicates the amount of iron stored in the body. The ferritin score should be no less than 100 micrograms per liter (mcg/L) and no more than 800 mcg/L.
- TSAT stands for transferrin saturation, a score that indicates how much iron is available to make red blood cells. The TSAT score should be between 20 and 50 percent.

## What are some other causes of anemia?

In addition to EPO and iron, a few people may need vitamin B12 and folic acid supplements.

If EPO, iron, vitamin B12, and folic acid supplements do not help, the doctor should look for other causes of anemia such as sickle cell disease or an inflammatory problem. At one time, aluminum poisoning contributed to anemia in people with kidney failure. Many phosphate binders used to treat bone disease caused by kidney failure were antacids that contained aluminum. But aluminum-free alternatives are now widely available. People with CKD and kidney failure should be sure their phosphate binder and other drugs are free of aluminum.

Anemia keeps many people with kidney disease from feeling their best. But EPO treatments help most patients raise their hemoglobin and have more energy.

## Points to Remember

- A person whose blood is low in red blood cells has anemia.
- Anemia is common in people with kidney disease.
- Healthy kidneys produce a hormone called erythropoietin, or EPO, which stimulates the bone marrow to produce the proper number of red blood cells needed to carry oxygen to vital organs. Diseased kidneys, however, often don't make enough EPO.
- A complete blood count (CBC), a laboratory test performed on a sample of blood, includes a determination of a person's hematocrit, the percentage of the blood that consists of red blood cells.
- If no cause for anemia other than reduced EPO production is found, it can be treated with a genetically engineered form of EPO, which is usually injected under the skin two or three times a week.
- The U.S. Food and Drug Administration (FDA) recommends that patients treated with EPO therapy should achieve a target hemoglobin between 10 and 12 grams per deciliter (g/dL).
- People who take EPO shots should have regular tests to monitor their hemoglobin. If it climbs above 12 g/dL, their doctor should prescribe a lower dose of EPO.
- Many people with kidney disease need both EPO and iron supplements to raise their hematocrit to a satisfactory level.

## Hope through Research

The National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), through its Division of Kidney, Urologic, and Hematologic Diseases, supports several programs and studies devoted to improving treatment for patients with progressive kidney disease and end-stage kidney failure, which is sometimes called end-stage renal disease or ESRD, including patients on hemodialysis:

- **The End-Stage Renal Disease Program.** This program promotes research to reduce medical problems from bone, blood, nervous system, metabolic, gastrointestinal, cardiovascular, and endocrine abnormalities in end-stage kidney failure and to improve the effectiveness of dialysis and transplantation. The research focuses on reuse of hemodialysis membranes and on using alternative dialyzer sterilization methods; on devising more efficient, biocompatible membranes; on refining high-flux hemodialysis; and on developing criteria for dialysis adequacy. The program also seeks to increase kidney graft and patient survival and to maximize quality of life.
- **The Frequent Hemodialysis Network.** This multicenter clinical trial will test whether receiving hemodialysis more than the standard three times a week provides better outcomes.
- **The U.S. Renal Data System (USRDS).** This national data system collects, analyzes, and distributes information about the use of dialysis and transplantation to treat kidney failure in the United States. The USRDS is funded directly by the NIDDK in conjunction with the Centers for Medicare & Medicaid Services. The USRDS publishes an *Annual Data Report*, which characterizes the total population of people being treated for kidney failure; reports on incidence, prevalence, mortality rates, and trends over time; and develops data on the effects of various treatment modalities. The report also helps identify barriers to the delivery of quality health care and opportunities for more focused studies of renal research issues.
- **The Hemodialysis Vascular Access Clinical Trials Consortium.** This program is conducting a series of multicenter, randomized, placebo-controlled clinical trials of drug therapies to reduce the failure and complication rate of arteriovenous grafts and fistulas in hemodialysis. Recently developed anti-thrombotic agents and drugs to inhibit cytokines are being evaluated in these large clinical trials.

Participants in clinical trials can play a more active role in their own health care, gain access to new research treatments before they are widely available, and help others by contributing to medical research. For information about current studies, visit *www.ClinicalTrials.gov*.

## For More Information

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## About the Kidney Failure Series

The NIDDK Kidney Failure Series includes booklets and fact sheets that can help you learn more about treatment methods for kidney failure, complications of dialysis, financial help for the treatment of kidney failure, and eating right on hemodialysis. For a free printed copy of this series, please contact the National Kidney and Urologic Diseases Information Clearinghouse.

You may also find additional information about this topic by

- searching the NIDDK Reference Collection at *www.catalog.niddk.nih.gov/resources*
- visiting MedlinePlus at *www.medlineplus.gov*

This publication may contain information about medications. When prepared, this publication included the most current information available. For updates or for questions about any medications, contact the U.S. Food and Drug Administration toll-free at 1–888–INFO–FDA (463–6332) or visit *www.fda.gov*. Consult your doctor for more information.

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The National Kidney and Urologic Diseases Information Clearinghouse (NKUDIC) is a service of the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). The NIDDK is part of the National Institutes of Health of the U.S. Department of Health and Human Services. Established in 1987, the Clearinghouse provides information about diseases of the kidneys and urologic system to people with kidney and urologic disorders and to their families, health care professionals, and the public. The NKUDIC answers inquiries, develops and distributes publications, and works closely with professional and patient organizations and Government agencies to coordinate resources about kidney and urologic diseases.

Publications produced by the Clearinghouse are carefully reviewed by both NIDDK scientists and outside experts. This publication was originally reviewed by John C. Stivelman, M.D., Emory University School of Medicine.



This fact sheet is also available at *www.kidney.niddk.nih.gov*.










U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health

NIH Publication No. 09–4619
October 2008