

# Pediatric Hemodialysis Fact Sheet

## Renal Failure (End-Stage Kidney Disease)

Our kidneys are remarkable organs that maintain a constant balance of acid-base, electrolytes and minerals, blood pressure, fluids, red blood cell (RBC) production, and bone growth. Chronic kidney disease (CKD) is an abnormality of kidney structure or function for more than 3 months. CKD is further classified into five stages based on estimated glomerular filtration rate (eGFR), with Stage 1 indicating normal GFR and Stage 5 progressing to renal failure requiring dialysis (end-stage kidney disease [ESKD]). ESKD may occur in children because of many systemic disorders or congenital malformations. The cause of ESKD varies by age and race. Symptoms of kidney failure include:

- Anemia
- Nutritional Imbalances
- Mineral bone disorder
- Cardiovascular mortality
- Reduced neurocognitive function

## Treatment Options

Treatment of children with ESKD can be complicated and involves close monitoring by the nephrology team, medication administration, renal-specific diet, family support, and those in renal failure may require dialysis/transplantation teams. Kidney transplantation should be the goal in managing these children.

Currently, there are four treatment options for patients with ESKD: in-center hemodialysis, home hemodialysis, peritoneal dialysis, and transplantation. The decision not to treat is a fifth option in patients with terminal, complex medical conditions.

## Hemodialysis

Vascular access is necessary for hemodialysis. The hemodialysis machine removes the child's blood using a vascular access and passes it through a dialyzer, where excess water and waste products are removed. This can be done in-center or at home. In-center hemodialysis is performed 2 to 6 days a week in the dialysis facility. Home hemodialysis is performed by a trained caregiver in the child's home per the nephrologist's order.

## Vascular Access

There are three types of vascular accesses used for hemodialysis. A central venous catheter (CVC), a surgically created arteriovenous fistula (AVF), and an arteriovenous graft (AVG).

## Central Venous Catheter

A CVC is a double-lumen catheter tunneled under the skin and connected directly to the heart. On occasion, a temporary catheter may be placed if a patient starts dialysis emergently in an acute setting. A permanent catheter is tunneled under the skin and has a cuff that allows it to be used for a longer period. Cuffed catheters are typically used when an AVF or AVG is maturing or healing, cannot be placed, or a kidney transplant is imminent. The preferred location for a catheter is in the internal jugular vein.

### Care for the CVC:

- Keep the dressing clean and dry.
- This dressing will be changed at least weekly or as needed if soiled, non-occlusive, etc.
- Immediately report signs and symptoms of infection to their dialysis facility. This includes fever, redness, drainage, or pain at the catheter exit site.
- If the catheter becomes dislodged, apply pressure to the insertion site and transport the patient to the emergency room.

## Arteriovenous Fistula (AVF)

An AVF is created when an artery is surgically connected to a vein, most commonly in the arm. The strong flow of the arterial blood through the vein increases the size of the vein and thickens the vein wall. Large needles can be placed into the AVF with every treatment. AVFs are the preferred hemodialysis access when feasible. It should be noted that fistulas in children take significantly longer to mature than in adults, with some patients taking up to 4 months.



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## Arteriovenous Graft (AVG)

If a child does not have large enough blood vessels to create a successful AVF, an AVG may be placed. A graft is a synthetic tubular material used to attach the artery to the vein, which then provides an area of increased blood flow. Large needles are placed into the graft every treatment. AVG can be used sooner, typically within 2 to 4 weeks of placement.

### Care for the AVF or AVG:

- Protect access extremity from trauma.
- No blood pressure, blood draws, or intravenous (IV) lines should be done in the access extremity.
- No tight clothing, backpacks, large purses, or constrictive jewelry on the access extremity.
- Patency is assessed by auscultation with a stethoscope for the presence of a bruit and palpation for the presence of a thrill.
- Assess for signs and symptoms of infection, including pain, swelling, erythema, and fever.
- Immediately notify the dialysis facility if there is no bruit or thrill, or if the child presents with symptoms of infection.

## Medications

Dialysis patients must comply with fluid and dietary restrictions, and a medication regimen, in addition to their dialysis treatments, to maintain optimal patient outcomes. These can be exceptionally challenging for the pediatric patient. Fluid restrictions are based on the size of the child and the amount of residual urine the child still produces. The diet restricts sodium, potassium, and phosphorus, found in most foods children often like to eat. Some medications must be taken at certain times of the day, and others are given at dialysis. Some of the common ones are:

- Calcium carbonate (Phoslo®), sevelamer (Renvela®, Renagel®), lanthanum (Fosrenol®): These are phosphate binders, when taken with meals, may decrease the rate of bone loss common in dialysis patients.
- Calcitriol (Rocaltrol®): The vitamin D analog for the management of hypocalcemia.
- Erythropoiesis-stimulating agent (Epogen®, Retacrit®, Aranesp®, Mircera®, Procrit®): These medications promote red blood cell production, decreasing or eliminating the need for blood transfusions. These medications may be given subcutaneously or intravenously. They are often given IV via the hemodialysis circuit at time of treatment.

- Venofer® (Iron Sucrose), INFed® (Iron Dextran), Ferrlecit®/Nulecit® (sodium ferric gluconate complex). Ferrous sulfate: Iron supplementation for the treatment of iron deficiency anemia, and is often given IV during dialysis.
- Renal vitamin.
- Human growth hormone: Long-term treatment for failure to grow.
- Paracalcitriol (Zemplar®): Used for the prevention and treatment of secondary hyperparathyroidism associated with renal failure.

Children must depend on their parents or guardians to help them maintain compliance with diet, medication regimens, and fluid restrictions.

## Challenges for Children on Hemodialysis

Because children should gain weight with normal growth, blood pressure, weight data, and the physical exam should be utilized to evaluate estimated dry weight (EDW) frequently. Difficulty tolerating fluid removal during treatment, weights greater than EDW after dialysis with normal or low blood pressures, and no appreciable edema indicate actual weight gain associated with growth.

Fluid removal during dialysis can be difficult in children. To prevent low blood pressure during dialysis, ideally, no more than 13 mL/kg/hr should be removed in a session. Therefore, children on hemodialysis must dialyze anywhere from 3 to 6 days per week.

One of the major challenges for children on hemodialysis is dietary and fluid restrictions. For infants, it is a challenge for the parents as most, if not all, of their nutrition is in liquid form. For the school age child, social issues become a factor. Other children do not understand why the child cannot have French fries and a soda with them. Peer pressure may make compliance much more difficult.

School age children tend to miss several hours of school in a week. Dialysis centers try to supplement their learning with tutors and hospital-based schoolteachers.

Children with catheters cannot swim or get the CVC wet during bathing. Special waterproof dressings are provided to the family for use during bathing. Children with grafts or fistulas, as well as catheters, are encouraged to participate in sports if they can protect their vascular access from harm. These factors can be limiting and, thus, emotionally challenging.

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Children who grow up with renal failure may look physically different than other children their age. They may be small in stature, their skin may have a different hue, and they may have an obvious graft of fistula in one of their extremities.

## What is the Goal?

The goal for children on hemodialysis is optimal patient outcomes and to remain as healthy as possible for an eventual kidney transplant. Patient care is very individualized based on the child's health status, physical and emotional age, parental/guardian support and resources, and many other factors. Not all children will qualify for a kidney transplant; therefore, the goal would be to maintain optimal health until the patient is old enough to transition to adult care.

## Additional Readings

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