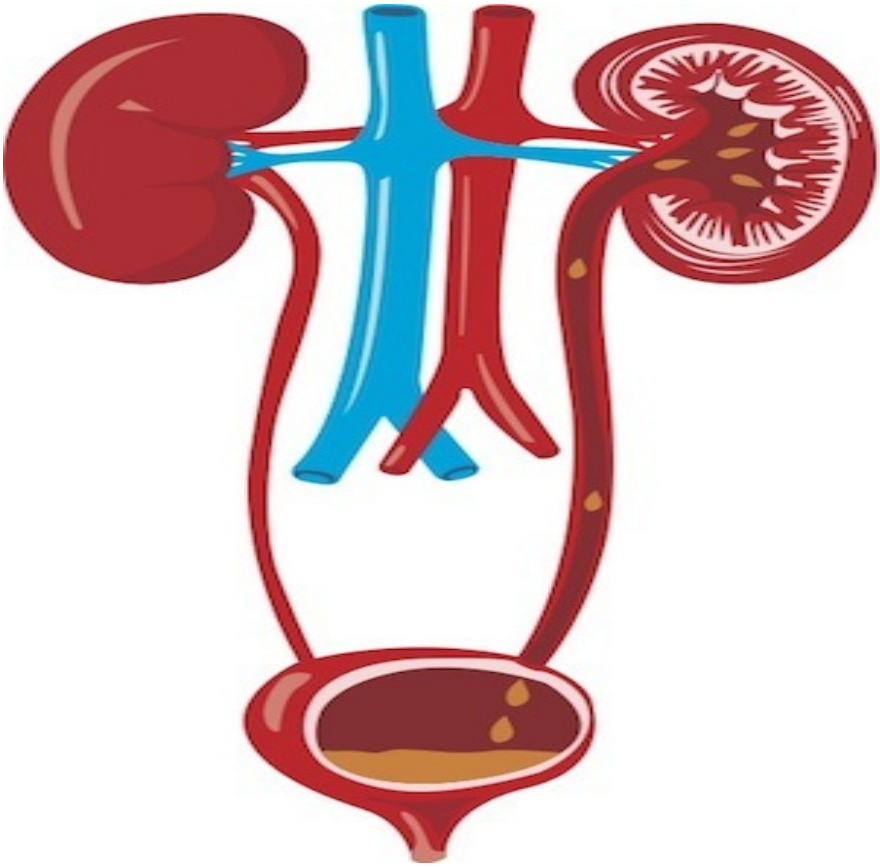
THE SCRUTINIZER JOURNAL

The Kidney and Urinary System edition

Volume 1, Oct. 2017



In the words of Aristotle himself:

"The kidneys are not present for necessity in animals but have the function of perfecting the animal itself"

Foreword:

Welcome to the first edition of **The Scrutinizer Journal**, a monthly online magazine that offers unbiased, reliable science based information on matters related to health, wellness, fitness, diseases, disease management and reviews of latest research. Most months we will be focusing on one topic of interest per volume of journal, however we may also provide issues related to current research or advancements in science.

This first edition is dedicated to learning about the **Kidney and Urinary Systems**, two very important parts of the body that work together to get rid of excess fluids and waste products. Do people really know what they do and what happens when they don't function properly? A recent study was conducted by the National Kidney Foundation with results posted in the May 2015 issue of *Nephrology News*. It showed that one half of Americans do not know how the kidney works or understand what the kidney does. More than 1000 adults were surveyed. 46% were able to identify that the kidneys produce urine, 54% were unable to identify this basic function of the kidneys. 63% have never talked to a healthcare professional about their kidneys or their kidney health. 71% were unable to identify the signs and symptoms of kidney disease. These numbers are a cause for concern because the CDC reports that 1 in 3 Americans is at risk for developing kidney disease. The more you know about your kidneys, the more you will understand why they need to be kept healthy and what can happen if they are not.

Welcome aboard,

Meenakshi and Joanne

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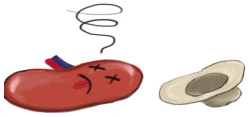
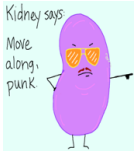
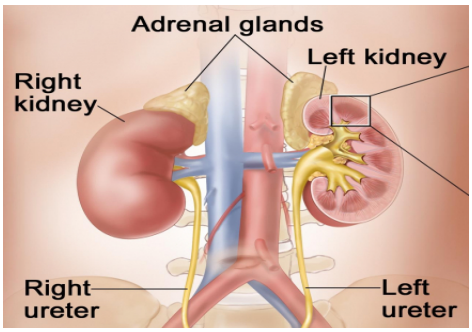




I. WHAT DO THE KIDNEYS LOOK LIKE?

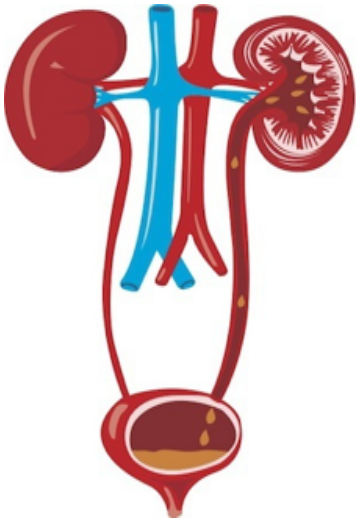
The kidneys are fist sized bean shaped organs that are located, in the lower back just below the diaphragm. They are each attached to a renal artery and vein that supplies the blood for filtering; and are also attached to a ureter that drains the urine into the bladder.



How do Kidneys Work?

The renal artery carries 600 milliliters of blood per minute, (about 2, 12 ounce cans of soda), where it passes through the kidney's filtration system: *glomerulus* and the *nephrons*.
1. The **glomerulus** is the first part of the filtering system through which the blood passes.
2. The blood then passes to the **Nephron, the main part of the filtering system.**

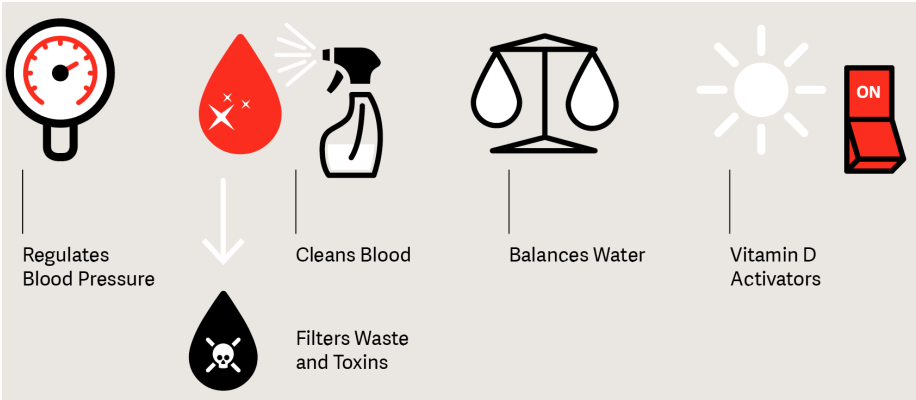
This is where most of the waste products and excess fluid is separated from the blood and passed to the ureter; and eventually out of the body via the bladder. The filtered blood then goes back into circulation through the renal vein.



In a 24hour period, approximately 180 liters of blood is processed and filtered, producing about 1.5L of urine.

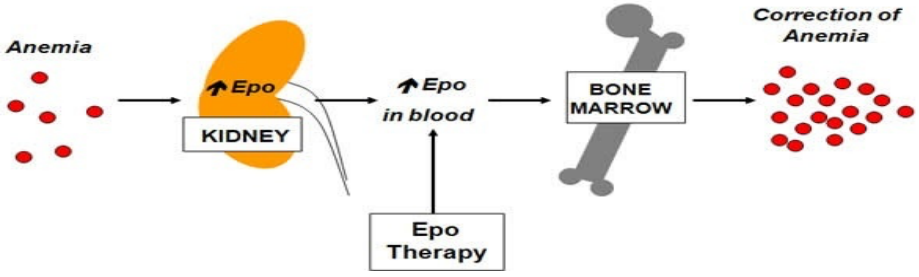
IS FILTERING THE BLOOD THE ONLY JOB THE KIDNEYS DO?

Filtering the blood is only one of many important jobs the kidneys do to keep the body healthy and in balance. Part of the filtering process is also keeping the necessary electrolytes and fluid for use in the body and eliminating what is not needed in the urine.



There are other jobs that the kidneys do:

- ***Stimulate the production of Red Blood Cells***. Red Blood Cells carry oxygen in the blood. When their number becomes lower than needed, kidneys release a hormone called Erythropoietin (EPO). The Erythropoietin travels to the bone marrow via the blood stream and stimulates healthy bone marrow to produce new red blood cells.



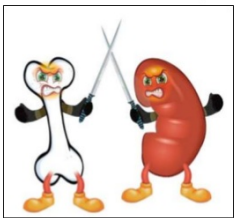
- ***Control the Blood Pressure***. Two **important hormones** are produced to help regulate blood pressure: (i) Renin, and (ii) Angiotensin.

  These two hormones help regulate the amount of salt and water the body retains during the filtering process. They also control how the blood vessel walls expand and contract as the heart beats. If there is too much water in the body, blood pressure goes up, if there is too little water, blood pressure will go down.

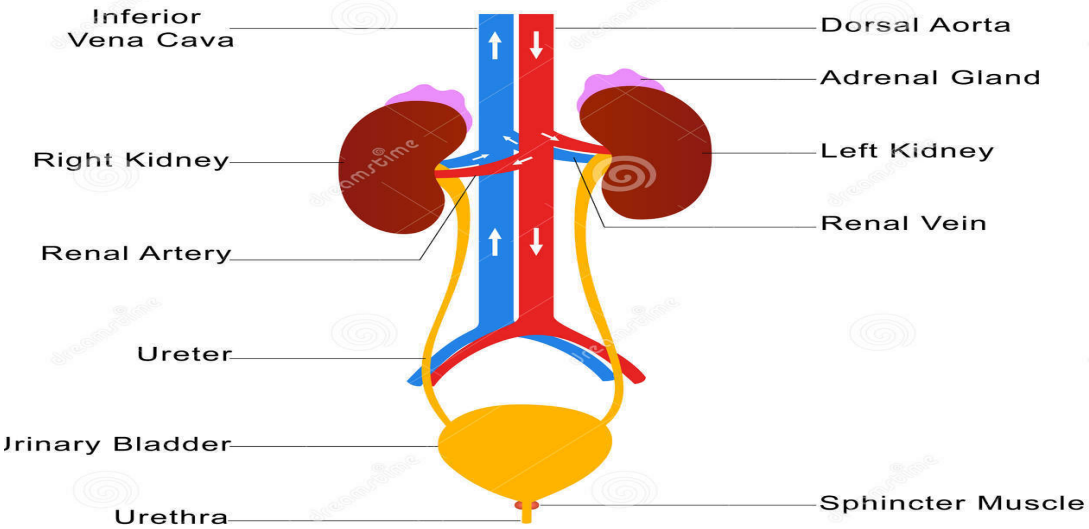
- ***Release the active form of Vitamin D*** to aid the body in absorbing calcium from the blood into the bones. The active form of vitamin D is the hormone **Calcitriol.** This hormone helps the kidney absorb the correct amount of calcium and phosphorus to allow bones to remain healthy and strong. Calcitriol travels through the blood stream to the intestines where it binds with calcium and carries it to the bones.

- ***Control fluid balance in the body***. The ideal percentage of fluid content in the body is 55% for women and 60% for men. It is the kidneys job to maintain a proper balance of what fluid is consumed versus what is lost in the urine.

- Eliminate certain medications and toxins from the body.



II. THE URINARY SYSTEM



In addition to kidneys, this system also contains:

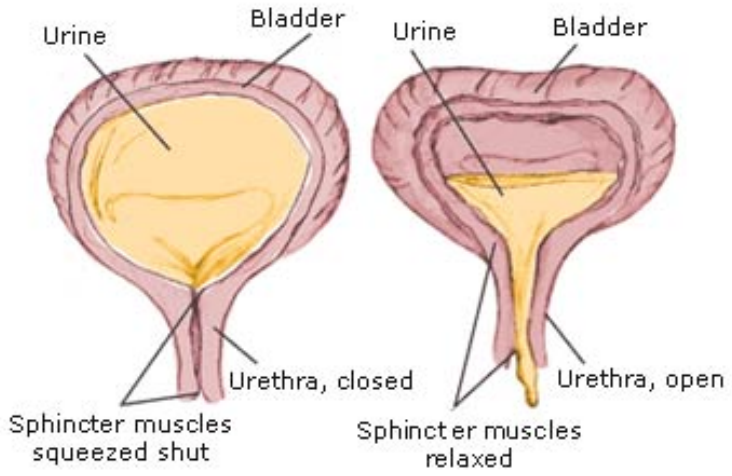
- **Two ureters:** Tubes that transport urine from Kidney to Bladder
- **One bladder:** A sac that collects urine
- **Two sphincter muscles:** control exit of urine
- **One urethra:** a passage that helps pass urine out of the body

Once the blood has filtered all the waste products in the kidneys and has formed urine, the urine then travels through the thin tubes known as **ureters** to the hollow, muscular storage area known as the **bladder**. The balloon-shaped bladder sits in the pelvic region of the lower abdomen and is held in place by ligaments that attach it to other organs and bones in the area. The bladder can be thought of as a storage or holding area for the urine until it is time to go to the bathroom. The bladder is very elastic. It is very small when empty and stretches into a round shape as the urine flows into it. When full it can hold about 2 cups or 16ounces of urine for up to 5 hours before it causes pain and discomfort.

Sphincter muscles: Two **circular muscles** called the sphincter muscles, are located where the bladder and urethra meet and keep the urine from leaking out of the bladder. They work like rubber bands closing around the opening of the bladder until a signal from the nerves in the bladder sends the signal to you that that the bladder

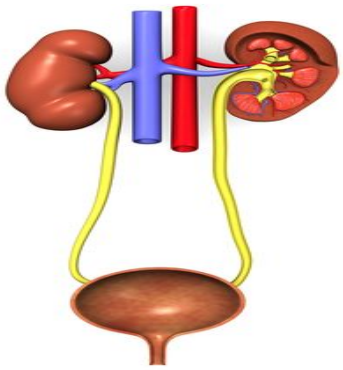
is full and it is time to urinate. At the same time the brain sends a signal to the bladder muscles to contract and tighten cause the sphincter muscles to relax and open causing urine to flow out of the body through the urethra. Most people empty their bladder about 6-8 times per day depending on:

- How much and what type of fluid they drink
- How much sodium or salt they take in each day
- What medications are taken
- Amount of Caffeine taken in during the day



III. CHRONIC KIDNEY DISEASE (CKD)

Sometimes healthy kidneys develop an injury or disease that causes them not to function properly. If it happens for a very short time, it usually does not create a problem. However, if the kidneys are not working properly for an extended period of time, the person will develop **Chronic Kidney Disease** or **CKD**.



Chronic Kidney Disease means that there is a long term decrease in kidney function as the healthy cells of the kidney slowly stop working for a variety of causes. As it progresses and more damage occurs, complications such as **high blood pressure**, **anemia** (low blood count), weakened bones and poor nutritional health can occur. In the early stages of kidney disease, people may not even know they have a problem until one of the above complications appears. Chronic Kidney Disease can actually progress to the point where Kidney Failure occurs, especially if undetected and the cause left untreated.

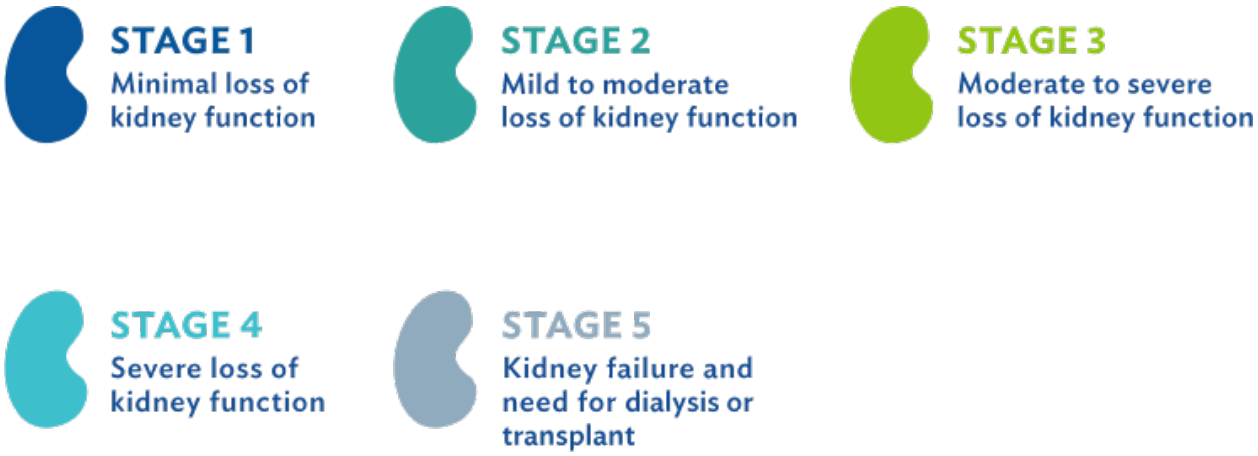
HOW COMMON IS CHRONIC KIDNEY DISEASE?

Chronic Kidney Disease is becoming an increasing worldwide public health problem. In 1990 CKD ranked 27th on the list of causes of death worldwide. In 2012, it had risen to 18th place on the same list. The National Kidney Foundation reports that 26 million Americans have CKD and millions of others are at risk of developing the condition.

HOW DOES CHRONIC KIDNEY DISEASE DEVELOP?

One normal healthy kidney contains approximately 1 million nephrons to filter the blood of the waste products and excess fluid. When Chronic Kidney Disease starts, some of the nephrons stop filtering the blood causing the kidney's filtering function to slowly drop. At first the remaining healthy nephrons will take over the workload from the dead nephrons and people don't notice a change in urination or develop other symptoms until about 50% kidney function remains.

The figure below shows the five stages of CKD

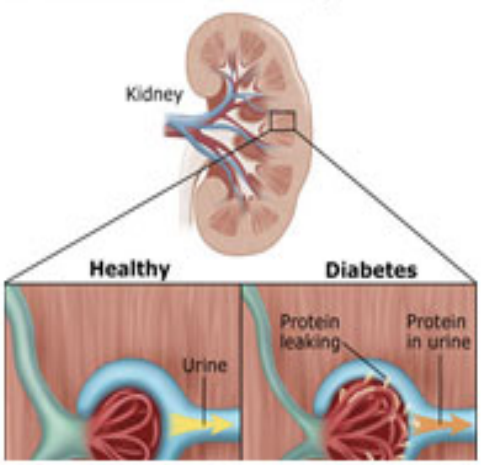


WHAT CAUSES CHRONIC KIDNEY DISEASE?

There are a number of causes of CKD. They include:

1. Diabetic Nephropathy: People with diabetes have an increased risk of developing diabetic nephropathy that leads to CKD. It occurs to 1 in 3 adults with diabetes. Yes, the diabetes affects Kidneys.

In diabetic nephropathy, the tissues of the glomerulus and the nephrons harden and die off.

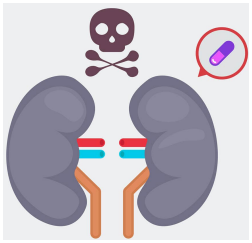


Thus, they can no longer filter the blood properly. This, eventually leads to **Kidney Failure**.

Diabetic nephropathy has been found to be more common in certain ethnic groups such as Blacks, Mexican Americans, Polynesians and certain American Indian tribes.

2. Hypertension or High Blood Pressure: This is the second most common cause of **CKD.** It occurs to 1 in 5 adults with high blood pressure. Long-term, consistently elevated blood pressure can damage the small blood vessels and glomerulus in the kidney. Other tissues in the kidneys can also get damaged. This causes CKD to appear and progress, leading to kidney failure.

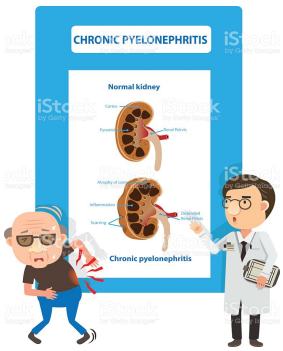
Risk factors for high blood pressure as the cause of CKD include:



- ✓ poorly controlled high blood pressure
- ✓ being of an older age, and
- ✓ the presence of another kidney damaging disease such as **diabetes**.

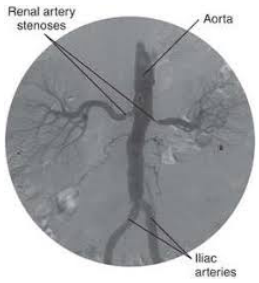
It is interesting to note that Blacks are at an especially increased risk for high blood pressure caused CKD that leads to kidney failure.

3. Chronic Pyelonephritis also known as a chronic kidney infection: People who have an altered anatomy of the urinary system are more prone to frequent bacterial urine infections.



The altered anatomy causes the urine to back up into the kidney and cause damage to the glomerulus and the nephrons. Some common causes of altered anatomy include kidney stones and other obstructions. Left untreated these infections can progress from CKD to kidney failure. Signs of a kidney infection include: fever, feeling of tiredness and fatigue, as well as lower back and flank pain.

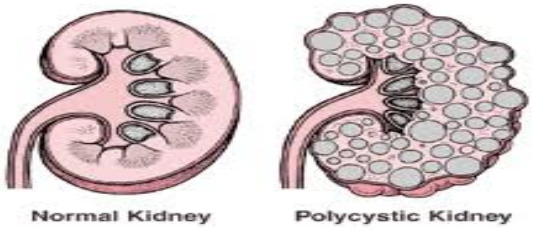
4. Renal Artery Stenosis or occlusion:



Stenosis is a narrowing of the main artery or one if its branches going into the kidney. Blood is still able to pass through, but at a slower than normal rate.
Renal artery occlusion is where the artery or one of its branches is completely blocked allowing no blood flow into the kidney.

This causes the tissues of the kidney to harden and die, no longer able to function properly. Stenosis or Occlusion of the artery can occur because of a blood clot or hardening of the arteries. People with an artery occlusion will typically have steady lower back pain, abdominal pain, nausea, vomiting and blood in the urine.

5. Polycystic Kidney Disease: This is usually an inherited condition that occurs when fluid filled sacs slowly grow and crowd out the healthy kidney tissues and can lead to CKD and eventual kidney failure.



6. Use of Medications that are toxic to the kidneys: These medications include Non-Steroidal Anti-inflammatory Drugs (NSAID's) such as Ibuprofen, certain antibiotics and chemotherapy drugs, and intravenous contrast media.

7. Severe Dehydration and episodes of shock*:* Losing blood from severe bleeding can lead to shock, causing the nephrons to slowly die off from lack of blood supply. Also, not taking in enough water or fluids combined with loss of fluids from sweating and urinating in large amounts can lead to dehydration causing the nephrons to die.

8. Aging: As the body grows older as a part of the aging process, the kidneys also age. The actual mass of each of the kidneys shrink, and nephrons slowly die. Blood flow to the kidneys also decreases as the aging process continues, contributing to the slow death of the nephrons.

SIGNS AND SYMPTOMS OF KIDNEY DIEASE

Symptoms of CKD do not appear as the kidney cells slowly harden or die. Symptoms usually appear as the kidney disease gets worse. These symptoms include:

- More tired and less energy to perform daily tasks
- Having trouble concentrating and completing tasks

- Prolonged loss of appetite or no desire to eat.
- Nausea and vomiting

- Unexplained weight loss
- Difficulty sleeping including waking up not feeling rested
- Night time muscle cramping, especially in the legs.
- Swelling in the feet and ankles. This swelling is also known as **edema**
- Swelling or puffiness around the eyes especially in the mornings
- Skin that is very dry and itchy
- Skin may turn a yellow-brown almost bronze color
- More frequent urination, especially at night
- High Blood Pressure
- Anemia

HOW IS CHRONIC KIDNEY DISEASE DIAGNOSED?

Most often CKD is suspected when the blood levels of **BUN** and **Creatinine** are noticed to be elevated during a routine check-up. **BUN** is the abbreviation for a **Blood Urea Nitrogen level**. Urea nitrogen is a natural waste product produced from the combination of the breakdown of foods that is eaten and the body's build-up and breakdown of tissues.

Creatinine comes from all muscle activity. The body has no use for these waste products so healthy kidneys will remove them from the blood and send them out of the body in urine.

The BUN and Creatinine levels in the blood will start to rise when the glomerulus and nephrons don't filter as efficiently due to cell hardening. If the levels remain elevated for 3 or more months, then a person is considered to have **Chronic Kidney Disease.**

- Doctors will use the BUN and Creatinine levels to determine the **Glomerular Filtration Rate or GFR.** The **GFR is the best test** to determine how the kidneys are really functioning. It lets the doctor know how fast the waste product is being cleared from the blood.

    - ✓ It is calculated using the blood creatinine level, age, weight, race and gender and is reported in milliliters/min. The GFR is used to determine if you have CKD and what stage you are in so that a treatment plan can be developed to slow the progression of the disease.

- A Renal Ultrasound may also be ordered to see the size of the kidneys and check for any structural damage to the kidney or urinary tract.
- An abdominal CT scan may also be ordered.
- Doctors will also take urine samples to check for the presence or absence of protein and micro albumin in the urine. They will also check to see if any infections are present.
- A Urine Creatinine level will be checked to see how much protein is being cleaned out by the kidneys. This test also measures a protein to creatinine ratio

WHAT ARE THE RISK FACTORS FOR CHRONIC KIDNEY DISEASE?

 Hypertension or High Blood Pressure

 Diabetes

 Elevated Cholesterol and Triglycerides

 Smoking and tobacco use

 Heart Problems or Stroke

 Family History of Kidney Disease

 Normal aging process. People over the age of 70 have an increased risk of kidney disease.

People who have more than one risk factor on the above list have an even greater risk for developing CKD and should be talking to their doctors about what can be done to prevent CKD. If CKD is thought to be present, testing should be completed to confirm the diagnosis and a routine follow-up and management plan put in place.

For example, **high blood pressure** should be treated with a goal of maintaining blood pressure at less than 130/80 with the use of medications and diet restrictions of salt. Diabetes should be controlled with an ideal Hgb A1C of less than 7.0. Stopping smoking and starting an exercise program can also help slow the progression.

The goal of minimizing the risk factors is to prevent the Kidney Disease from progressing to the point where the kidneys fail and more aggressive treatment such as dialysis is needed.

In the next article, we will talk about Kidney Failure, End Stage Renal (Kidney) Disease and the treatment options that are available for patients who develop End Stage Renal Disease.

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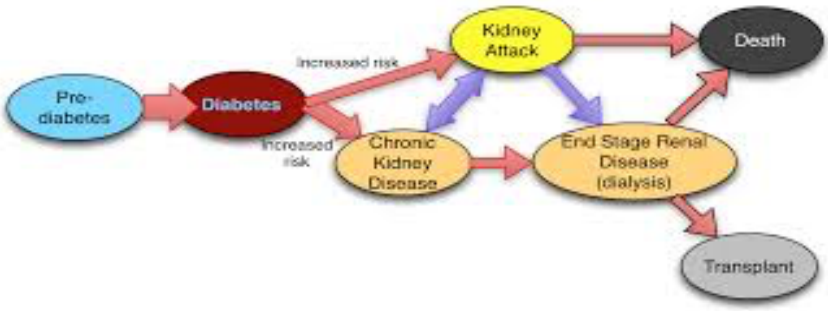
IV. KIDNEY FAILURE AND END STAGE KIDNEY DISEASE

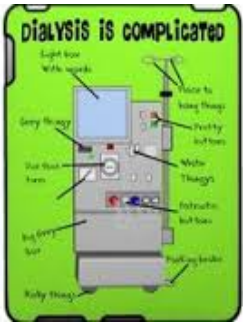
Chronic Kidney Disease may continue to progress to the point where the kidneys are unable to filter enough of the waste products and excess fluid causing a build-up of fluid and toxins in the body. When this happens, a person is said to have **Kidney Failure.** When the kidney function decreases to less than 10% the person is considered to have **End Stage Renal (kidney) Disease (ESRD)** and will need to begin some form of treatment to replace the kidney function or face death. The CDC has reported that in 2011, 2013, 2016 patients started some form of treatment for ESRD.

WHAT HAPPENS WHEN THE KIDNEYS FAIL?



As kidney function continues to decline, patients will be referred to a **nephrologist**, a doctor who specializes in caring for the kidneys. Ideally, before reaching End Stage, the doctor and patient will discuss the treatment options available to replace normal kidney function. This should happen weeks or months before actual treatment begins so the patient and family have time to decide which treatment is preferable to them. Some nephrologists will refer patients and families to a Treatment Option Educator who is either a Renal Social Worker or Registered Nurse.

WHAT IS RENAL REPLACEMENT THERAPY OR DIALYSIS?



Renal Replacement Therapy or Dialysis is used to remove the excess fluid and waste products from the blood. It does not replace other important healthy kidney functions such as producing vitamin D for healthy bones and erythropoietin to make red blood cells.

What Dialysis does is use an artificial process to remove waste products and excess water from the body.

The process involves using a semi-permeable (it allows some items to pass through, while keeping others back) membrane to act as a filter and a specially treated solution known as Dialysate to surround the filter.

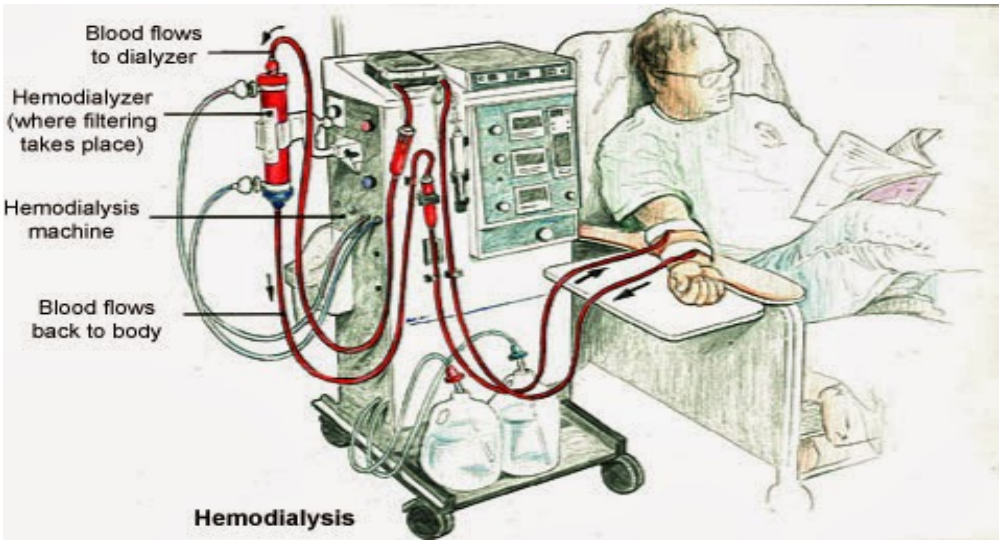
There are two different types of dialysis available:

- Hemodialysis
- Peritoneal

Both use the same principle, but each works differently and offers advantages and disadvantages to patients. We will look at each separately.

HEMODIALYSIS

Hemodialysis is the most common type of dialysis used to treat End Stage Renal Disease. It involves the use of a dialysis machine to pump about 200 ml of blood per minute from the patient's body through an artificial kidney (dialyzer) to clean the waste products and excess water and return it to the patient. It requires a blood pump, a dialyzer or artificial kidney, dialysate or washing fluid, and access to the blood for the procedure to occur.

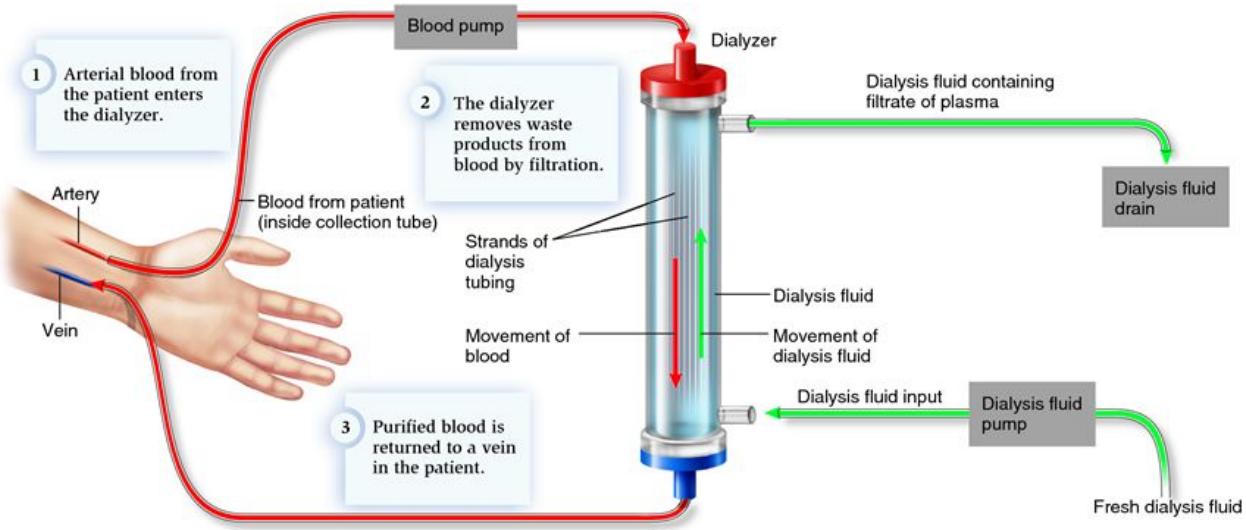


WHAT IS A DIALYZER?

A dialyzer is also known as an **artificial kidney**. It contains thin fibers that act as the filter for the blood. The dialyzer has two compartments, separated by a thin semi-permeable membrane:

- one compartment to carry the blood, and
- the other to carry the dialysate.

The thin membrane fibers not only separate the blood and dialysate, it also acts as the filter and allows waste products such as urea, creatinine and potassium to be removed from the blood and washed out with the dialysate. At the same time keeping important things like blood cells and proteins in the blood.



As shown in the above figure,

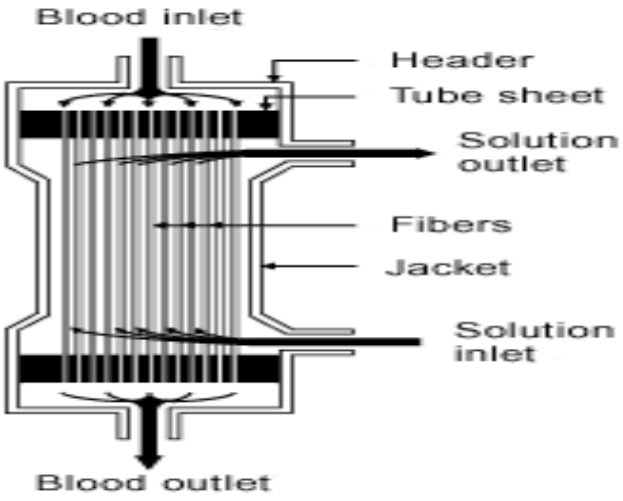
1. Blood from the patient is pumped through the dialyzer in a downward direction.

2. Dialysate is pumped in the opposite direction, surrounding the fibers and pulling the waste products and excess fluid from the blood.

3. The cleaned blood is returned to the body and the dialysate is washed down a drain.

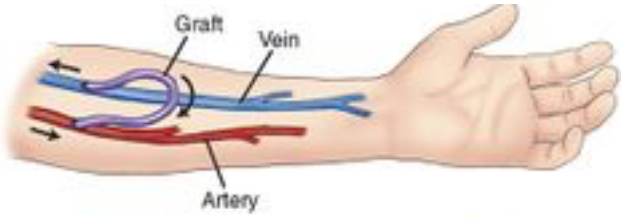
This process is repeated over several hours to assure that the blood is cleaned many times over. The dialysate used as a washing fluid contains no urea nitrogen or creatinine so that these items can be removed in large quantities. It does contain

small amounts of Sodium, Potassium and other electrolytes, mixed with sterile water that the body needs to keep at specific level in order, to survive.



HOW DOES THE BLOOD GET FROM THE BODY INTO THE DIALYZER?

Hemodialysis needs a continuous supply of blood moving to and from the patient. Therefore, an access is created into one of the veins that can remove the blood safely and return it as the body's own natural veins are too small to take the repeated needle sticks.



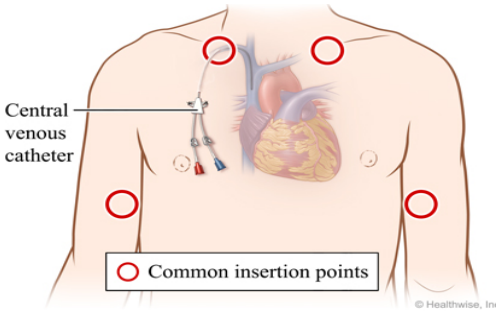
Creation of dialysis access:

Several weeks to months, before the start of dialysis treatment, an outpatient procedure is scheduled.

For the majority of patients, the procedure involves joining an artery and a vein together (Graft) as shown above. This helps divert some of the arteries blood supply into an adjoining vein through what is called an **anastomosis.**

The blood from the artery is under very high pressure and serves to strengthen the weaker walled vein. This creates a much larger vein that can tolerate having two large needles inserted for each dialysis treatment.

However, some patients have **very poor veins** and cannot have this access created. In that case, a **central dialysis catheter** may be placed, usually in the neck as shown below:



HOW LONG DOES IT TAKE TO DO A HEMODIALYSIS TREATMENT?

It depends. There are three types of hemodialysis currently available depending on where the treatment is done.

- **In-center Hemodialysis.** In-center Hemodialysis is the most common type. This is where a patient goes to an outpatient Dialysis Center 3 times a week for a 3 to 4 hour treatment each time. Specially trained nurses and dialysis technicians are there to insert the needles, set up the machines and monitor patients.

Advantages: In-center hemodialysis offers the opportunity for patients to talk to and offer support to each other. **Disadvantage:** The big disadvantage is that patients are scheduled Monday, Wednesday and Friday or Tuesday, Thursday, Saturday causing some patients to feel that they no longer have control over their schedules.

- **Home Hemodialysis.** To do home hemodialysis, the patient and a caregiver partner receive training to perform the dialysis treatments at home. They learn how to set-up the machine, insert the needles, monitor the treatment, troubleshoot any problems and discontinue treatments. After approximately 6

weeks of training at the clinic, they go home to perform the treatment for 3-4 hours 3 times a week as if they were in a center. Once a month they see the doctor and training nurse at the clinic to evaluate their treatments and obtain bloodwork. In the event of a machine problem at home the patient can always return to the dialysis center for ongoing treatment.

Advantages: Major advantage of this method is that the patient decides what times the dialysis will be completed.

- **Short Daily Home Hemodialysis.** Newer types of dialysis machines now allow patients and their caregiver/partner to do their own dialysis at home on a daily basis. After several weeks of training, the patient can then do treatments 5 to 7 days a week for about 2 hours per treatment.

Advantages: With this method, since the water and waste product is removed on a daily-basis, this helps to minimize cramping, nausea and vomiting, some of the common side effects of dialysis.

- **Nocturnal Home Hemodialysis.** After the training period is complete, patients can do their hemodialysis overnight while they sleep. These treatments last for 6 to 8 hours and may be done every other night or six nights a week, depending on the needs of the patient.

The more frequent forms of hemodialysis offer many advantages to patients, including better waste product and fluid removal as well as minimizing the side effects of dialysis such as cramping, nausea and tiredness.

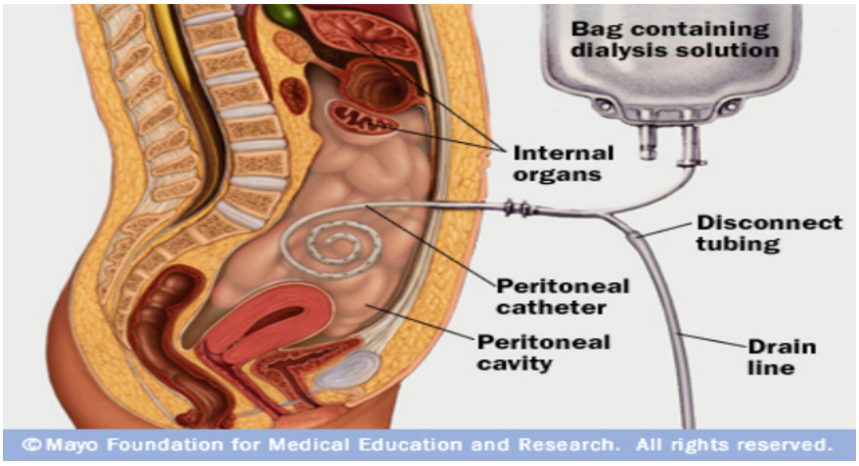
Unfortunately, not all dialysis centers offer home hemodialysis as a treatment option because it requires a specially trained nurse to teach the patient and partner, as well as a readily available dialysis machine and station in the event the home dialysis machine is not working.

ARE THERE OTHER FORMS OF DIALYSIS AVAILABLE BESIDES HEMODIALYSIS?

Yes, there is another dialysis treatment option for patients known as **Peritoneal Dialysis**. Peritoneal Dialysis works along the same principles of Hemodialysis. Blood passes through a semi-permeable membrane that is bathed in dialysate for the blood to be filtered.

The **major difference** is that in Peritoneal Dialysis, the blood does not pass outside the body. Instead it is pumped, by the heart, on its normal course through the

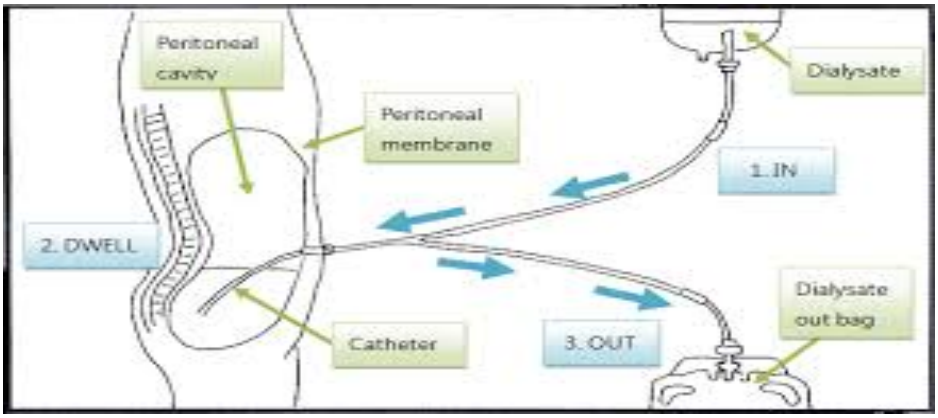
abdomen and the organs contained there-in including the semi-permeable peritoneal membrane which covers the organs. If Dialysate or dialysis washing fluid is present in the abdomen, filtering of the blood can occur.



If a patient chooses peritoneal dialysis as their treatment option, they need to have a way for the dialysate to get into the abdomen and come in contact with the blood. These patients will have a peritoneal dialysis catheter inserted into their abdomen, either to the right or left of the belly button. This catheter is about the diameter of a small pencil and is approximately 16 inches long. About one half of the catheter is inside the abdomen while the remaining portion is outside. The catheter is held in place by a Velcro cuff that is just under the skin. Once the catheter is healed the training for peritoneal dialysis can begin.

HOW DOES PERITONEAL DIALYSIS WORK?

Peritoneal Dialysis works by exchanging the waste-laden dialysate for fresh dialysate.



Following the numbers in the above image: 1. The process begins by connecting to a sterile tubing set that has an empty drain bag and new dialysate bag.

2. **Dwell Phase:** The patient first drains the dialysate that has been sitting in the abdomen, known as **dwelling phase**, into the empty bag. This process lasts about 20-30 minutes as the bag drains by gravity.

3. Once the drain bag is full it is clamped closed and the new Dialysate solution bag is opened to allow the abdomen to refill with fluid. This takes about 5 to 10 minutes.

4. Once the new bag is completely empty, the patient then closes off the tubing and places a sterile cap on the end of the catheter. The new solution then dwells in the abdomen, while the patient continues with normal daily activities. This process of drain, fill and dwell is repeat several times during the day every day of the week.

There are **two different types of Peritoneal Dialysis** currently available as options.

- **CAPD: Continuous Ambulatory Peritoneal Dialysis** is done 4 times per day 7 days per week. This is the manual form of dialysis and does not require a machine. Typically, the dialysate is left to dwell in the abdomen for 4 to 6 hours during the day and 8 to 10 hours overnight. This allows the patient to have flexibility to schedule the drain and fill portion of the cycle around their own schedule.
- **APD: Automated Peritoneal Dialysis**. This type of dialysis uses a small machine called a cycler to do the drain and fill cycles over night while the patient sleeps. The patient sets the machine up and connects before going to bed. The machine does the drain, fill and dwell cycles automatically at preset intervals so the patient can have an uninterrupted night sleep. Some patients may combine this type of dialysis with a manual procedure one time midday. The typical dwell time for patients on APD is between 1 to 3 hours depending on patient need.

WHY DON'T MORE PATIENTS DO PERITONEAL DIALYSIS AT HOME?

Peritoneal Dialysis uses the body's own peritoneal membrane as the filter for the fluid and waste product removal. If the peritoneal membrane has been damaged by multiple surgeries, infections or scar tissue, there may not be enough of the membrane to adequately remove the fluid and waste products putting the patient at risk for a build- up in the blood. People who are morbidly obese are also not

recommended for this type of dialysis. Some patients may also not have enough room in their home for the supplies needed to do the dialysis as the supplies are delivered on a monthly basis. Also, some patients may have other medical issues and handicaps that may require a partner to assist in the procedure and the partner is not available.

One of the main reasons there are not more patients on Peritoneal Dialysis is the risk of an infection known as **Peritonitis**. Peritonitis occurs when the peritoneal membrane and abdomen get bacteria in the normally sterile environment, usually as a result of bacteria getting in when the tubing connection is made. Patients who have tried Peritoneal Dialysis and get peritonitis frequently often have to transfer to Hemodialysis.

IS THERE ANY OTHER TYPE OF DIALYSIS TREATMENT AVAILABLE?

Currently hemodialysis and peritoneal dialysis are the only two dialysis treatments available. In order to decide which is best for each patient, doctors will have a potential patient meet with an educator to discuss the advantages and disadvantages of each type. There is also ongoing research into other dialysis options. In **Part 3** of this series we will look at what the future may hold for patients whose kidneys have failed.

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V. KIDNEY STONES; A GROWING AND PAINFUL PROBLEM

Kidney stones, also known as **Renal Calculi**, can not only be very painful but can also disrupt your normal life in many ways. Unfortunately, kidney stones are also a growing problem in the United States.

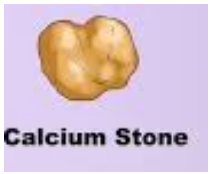
A study was published online in the Clinical Journal of the American Society of Nephrologists in January 2016 and revealed interesting results. This study was conducted in South Carolina and reviewed data from 152,925 obtained from both children and adults. It showed the following:

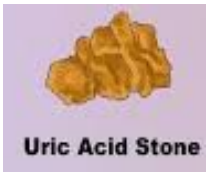
- The yearly occurrence of kidney stones increased by 16% between the years 1997 and 2012 (the years reviewed by the study).
- The greatest increase was noted in teenagers, females and African Americans.
- It was also noted that there was an increased risk of kidney stones developing in children with girls having an 87% risk and boys having a 90% risk.
- There is a 23% risk of males developing kidney stones.
- For females, there is a 15.2% risk of developing a kidney stone.

What is a kidney Stone?

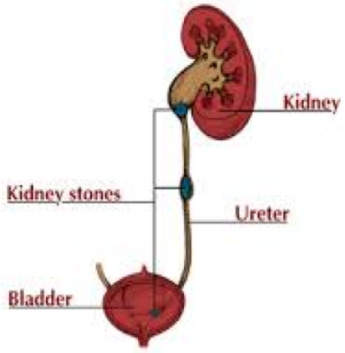
A kidney stone is a hard, solid substance that appears somewhere in the urinary tract. 85% of these stones are made up of calcium, 10% come from uric acid, 2% are made up of cystine and the

remaining come from magnesium ammonium phosphate.



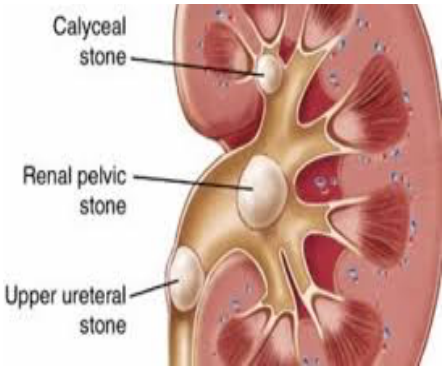


Kidney stones can appear in any part of the urinary tract, anywhere from the kidney itself to the ureter and bladder. As the kidney stone is moving



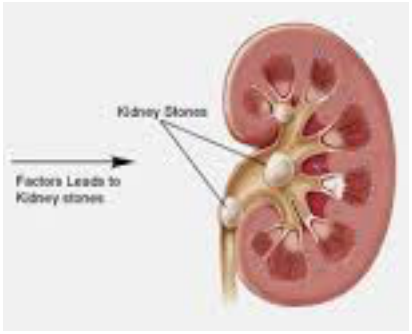
and attempting to exit the body it can become lodged in the lower part of the kidney or the ureter and block the normal flow of urine into the bladder. This blockage can cause both the ureter and the kidney to swell, creating a serious problem for the body.

It is hard to determine when a kidney stone will lodge and block off the urine flow. Typically, the larger the stone, the greater the chance it will lodge in the small ureter and cause a blockage. Stones that are larger than 5 millimeters will typically lodge while stones that are smaller than 5 millimeters will usually pass through on their own.



How do Kidney Stones Form?

Kidney stones typically form when there is an excess of urinary salts such as calcium or uric acid produced from the kidney and in the urine. Stones that form as a result of excess calcium in the urine is known as **hypercalciuria.** The blood levels of calcium remain normal but there is a larger than normal amount of calcium in the urine. The risk for developing **hypercalcuria** can run in families. 50% of male and 75% of females are reported to have inherited the gene for hypercalciuria.



Calcium stones can also form when people drink too much tea or eat too much Rhubarb, spinach, cocoa, nuts, or pepper. It is also reported that people who take in more than 2000 milligrams per day of Vitamin C, eat a low calcium diet, or eat too much meat poultry or fish can also be at a greater risk for getting a calcium kidney stone.

A kidney stone from **uric acid** usually happens as a result of the urine being too acidic. This causes the extra uric acid in the blood to crystalize and form a stone. The stone formed from uric acid can also bind with calcium in the urine and cause a mixed calcium uric acid stone to form.

How do you know if you have a kidney stone?

The symptoms of a kidney stone can be different for everyone and depends upon where the stone is located and whether it is fully lodged or partially lodged.

Some patients report no symptoms at all.

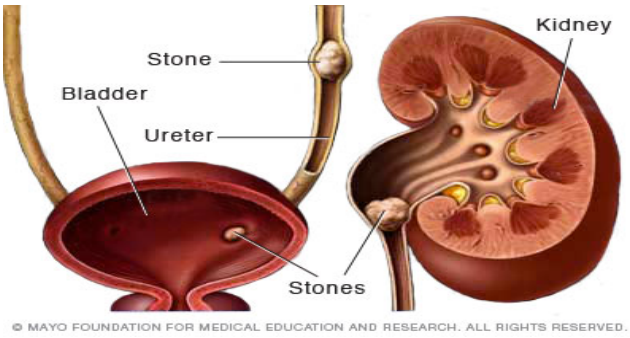
1. **Severe Pain**: The usual symptom most patients notice is severe pain on either the right or left side in the middle to lower back near where the affected kidney and ureter is located.

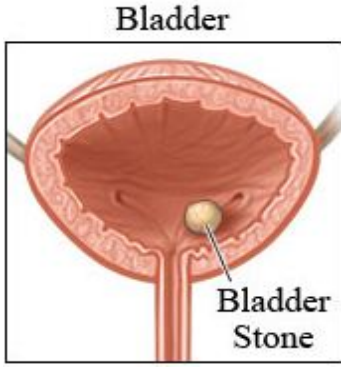
2. **Nausea and Vomiting:** Half of the patients who have this severe pain also complain of nausea and vomiting.

3. Blood in the urine: There could be blood present in the urine (**hematuria)** and/ or there is need to go to the bathroom both frequently and urgently. The exact location of the pain and other symptoms depends on where the stone is.

For example:

- Stones that are located where the kidney and ureter meet will cause mild to severe deep pain in the lower back area. Other symptoms include the need to go to the bathroom frequently and urgently as well as pain when attempting to urinate.
- Stones that are in or get trapped in the ureter can cause a sudden severe pain that seems to come and go with no explanation. Men may complain of pain in the testicles and women in their vulvar area. Patients will usually have intense and severe nausea and vomiting with this pain.
- If the stone is moving down the urinary tract, patients may complain of the pain in changing locations.
- Once the stone reaches the bladder, and come out in the urine, the pain may disappear.
- People with kidney stones may try sitting, laying down, pacing the floor in hopes of relieving the pain without success. This is a good indication that they need to see a healthcare professional as soon as possible.





Healthcare professionals will determine if you have kidney stones based on the symptoms you report as well as a physical examination. They may press on your abdomen and lower back to check for tenderness and if the pain radiates anywhere. They will also do a number of tests to see if it is a kidney stone and where it is located.

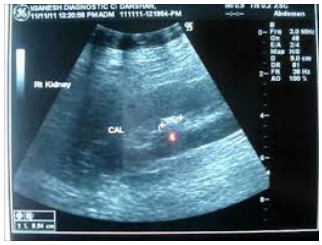
Tests to determine the location of kidney stones

1. **Urine Dipstick:** Getting a urine sample and using a urine dipstick to check for the presence of red blood cells and bacteria.

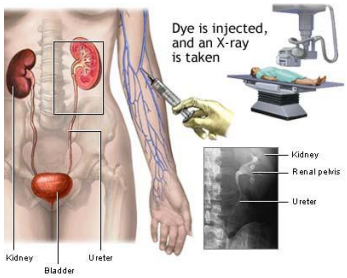
This is a quick test that gives results within a few minutes. If the test comes back positive they will then get a urine culture to see what bacteria is growing and what antibiotic is needed. At this point, pH of urine will also be determined.

2. Blood Draw to check for: Complete Blood Count (CBC), BUN, Creatinine, potassium, sodium, calcium and phosphorus levels to check kidney function.

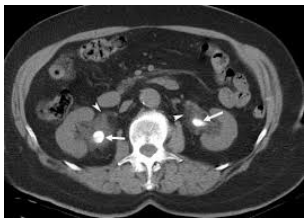
3. 24 hour urine collection



4. An ultrasound of the kidney and pelvis will be done to locate the stone.



5. An abdominal x-ray will be done of the Kidneys, Ureters and Bladder.



6. CT scan will be done of the abdomen and pelvis

How is a kidney stone treated?

Once the healthcare professional has decided that there is a kidney stone and where it is located, they can start treatment to manage the symptoms as well as get rid of the stones.

Treatment can include:

- Intravenous fluids to help keep the patient hydrated and, also to keep the kidney functioning as well as hopefully passing the stone without further intervention
- Medications as needed for pain
- Medications for nausea and vomiting
- Steroids to decrease inflammation
- Antibiotics to treat infections

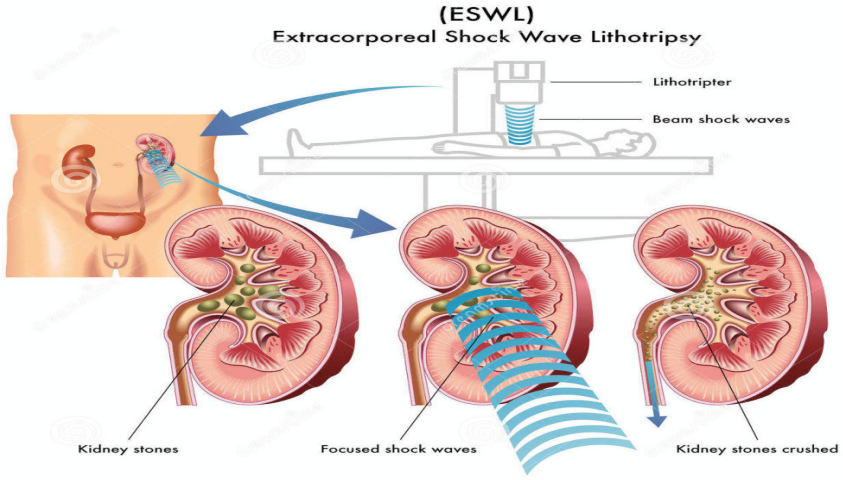
The goal of the above treatments is to keep the patient comfortable and hopefully pass the stone without needing more aggressive treatment. That is not always possible since some stones are larger than others and can get easily stuck in the kidney or ureter.

"Your kidney stone test came back. You didn't pass."

In this case, it would be necessary to have a surgical procedure done to remove the stone. The **different kinds of procedures** include:

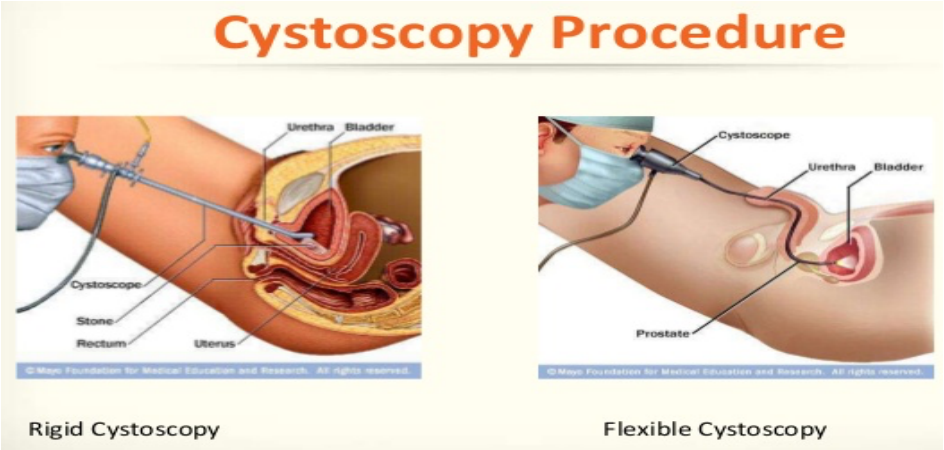
1. Placing a stent in the ureter. The stent used in the ureter is a small, soft, flexible tube, about 10-12 inches long and has a pigtail on each end. One end sits in the kidney with the tube resting in the ureter and the other pigtail end sits in the bladder. It allows urine to flow freely from the kidney to the bladder by keeping the ureter open. It can allow for the kidney stone to pass more quickly from where it is lodged into the bladder and outside the body.

2. Extracorporeal shockwave lithotripsy (ESWL)



If the stones are very large, shock waves can be used to break up the stones and allow them to move into the bladder and exit the body. Patients are given anesthesia to relieve the pain from both the kidney stones and the procedure. Shock waves that are very high energy are used along with sound waves. These waves are guided to the stones by either X-ray of ultrasound and will continue to tap the stones until they are broken up. This treatment is not as commonly used as it used to be.

3. Ureterscopy and Cystoscopy. These procedures are more commonly used currently for the treatment of kidney stones. The procedure involves using a scope inserted into the bladder, ureter and kidneys to look for abnormalities such as kidney stones. It can be used to flush the kidney stone out or to place a **Ureteral Stent**. The scope is long and thin with a light and camera on one end and a lens on the other.



Preventing Kidney Stones

Chances are if you have had one kidney stone in your life, you may develop others. There are some things you can do to lessen your chances of getting one.

Make sure you drink plenty of fluids, especially water during the day. It is recommended you drink 6-8 glasses (8oz.) every day, unless you have another medical condition that means you need to drink less than that.

Avoid certain foods such as nuts, legumes, rhubarb, spinach and wheat bran. These foods are high in Oxalate: a substance that binds with calcium and helps to form kidney stones.

Cut back on the amount of sodium and salt in your daily diet. Foods that are high in sodium include canned, packaged and fast foods. Some seasonings and processed meats are very high in salt.

Supplements like Calcium, Vitamin D and Vitamin C should be consumed with care

Eating too much animal protein can put you at an increased risk for kidney stones so try and limit how much you eat. Animal proteins, high in Oxalate include beef, chicken, pork, organ meats, eggs, fish, shellfish, milk cheese and dairy products.

Good proteins to eat include beans, dried peas and lentils as they are high in protein and have very little oxalate.

It is important to remember to seek treatment immediately if a kidney stone is suspected. Besides being painful, an untreated kidney stone can lead to other more serious problems such as infections and even the need for dialysis.

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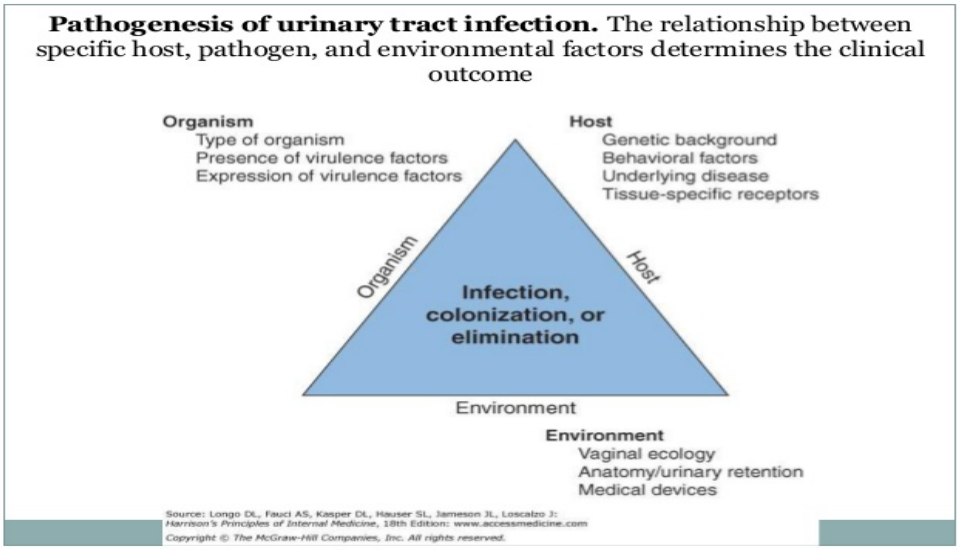
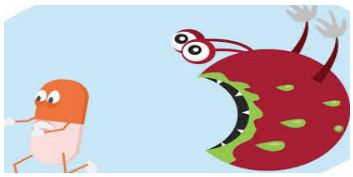
VI. INFECTIONS OF THE KIDNEYS AND THE URINARY TRACT

Kidney and Urinary Tract Infections (UTI) are more than just a nuisance they can also lead to other serious medical problems. How common are these types of infections?

- More than 8 million medical visits per year are a result of Urinary Tract Infections.
- The diagnosis of a UTI accounts for 100,000 hospital admissions in a year.
- 50% of women will have one UTI in their lifetime, with 1 in 3 women having a UTI before the age of 24.
- 20% of young women who have a UTI are at risk for getting recurrent UTI's, and the risk increases with each UTI occurrence
- Men are less likely to get an initial UTI but are more likely to have recurrent UTI's because the bacteria get imbedded in the prostate tissue and is difficult to eliminate.



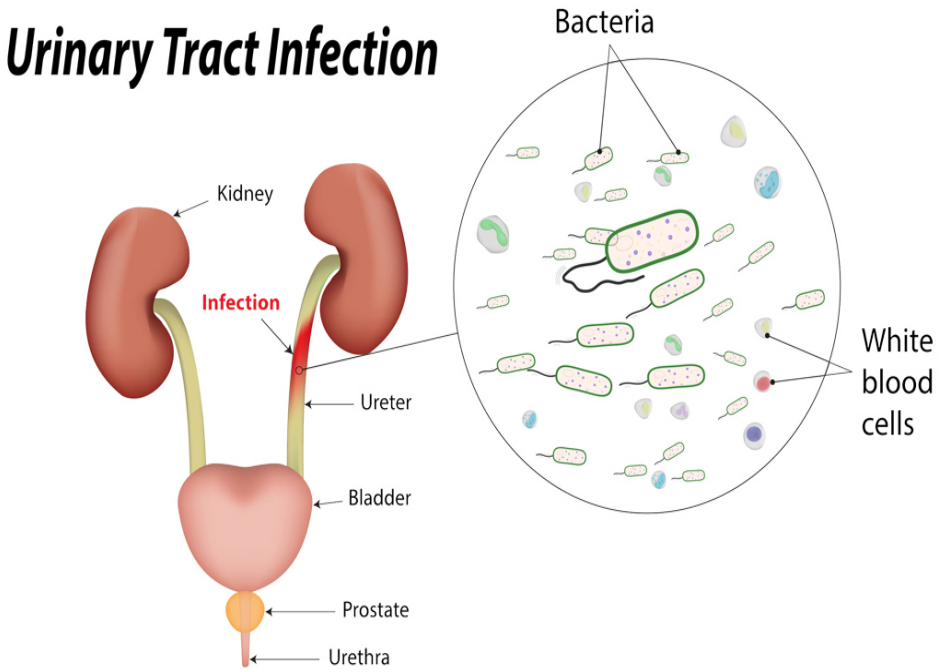
What is a Urinary Tract Infection?



The urinary tract, including the kidneys, ureters, bladder, urethra and in males the prostate are normally sterile or completely free from bacteria. The urethra and prostate does not allow any bacteria, that attempts to invade, an opportunity to lodge in the area and start growing a bacteria colony.

However, it is possible that bacteria can swim up from the opening into the bladder and begin to grow at a very fast rate. As the bacteria begin to grow, white blood cells begin to attack and attempt to destroy them often becoming overwhelmed causing symptoms to occur. The bladder is considered to be good breeding ground for bacteria because it has everything bacteria needs to grow and flourish; it is dark, warm, moist and has a food source (sugar and other items found in urine).

The most common bacteria that causes UTI's is one of the many strains of *Escherichia coli* (*E. coli*) that is able to attach the cells of the bladder. Other Common bacteria include: *Klebsiella, Proteus* and *Pseudomonas*. There are times that the infection can be caused by fungus.

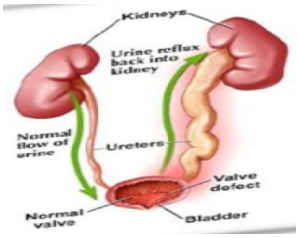


What puts a person at risk for a UTI?

- First UTI at an early age
- History of recurrent UTI's
- Use of antibiotics
- Sexual intercourse
- New Sex partner within a year
- Family history of UTI's
- Not cleaning the urethra and outside surrounding area after a bowel movement

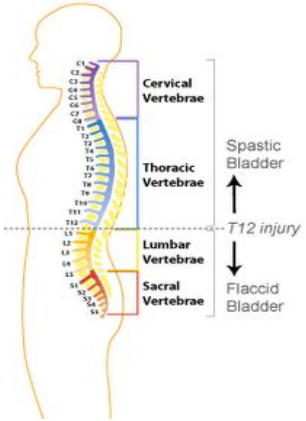
- Females are at more risk for bladder infection than males, because of their short urethral length, bacteria can gain access to the bladder much easier than in males.

There are also certain changes to the anatomy and the functioning of the Urinary tract that can put people at risk for UTI's. These abnormalities may be the result of a birth defect, injury or illness. For instance:



- **Vesicouretal reflux**: where the vesicouretal valve does not function properly and the urine backs up from the bladder into the ureters and even the kidney.

- **Neurogenic Bladder**: When there is disruption of the urinary bladder from within the central nervous system or peripheral nervous system. Interruption could be due to injury to the brain or spinal cord from trauma, Multiple Sclerosis, Parkinson's disease, Stroke or Diabetic Neuropathy.



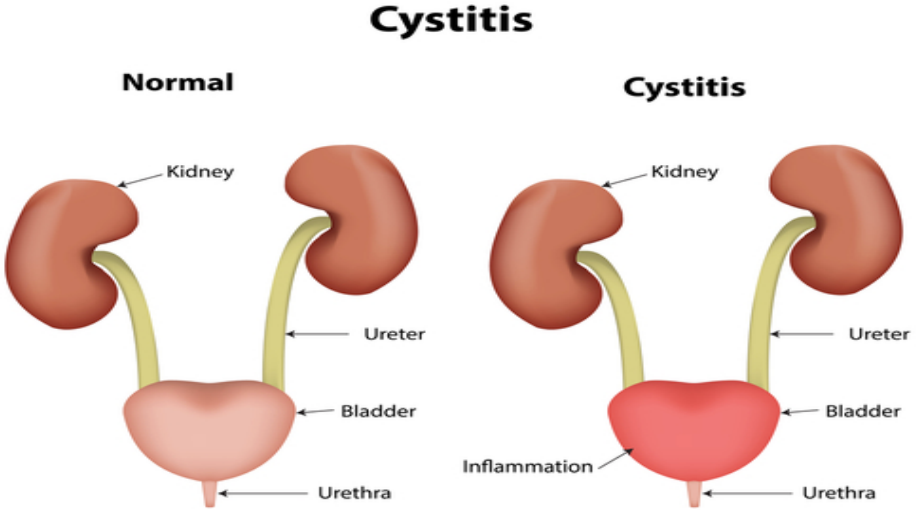
Bladder	Spastic	Flaccid
Injury	above L1	at/below L1
Symptoms	Urgency	Retention
Bladder Pressure	Low	High

Are All Urinary Tract Infections the Same?

There are **different types and classifications for Urinary Tract Infections** depending on where in the urinary tract the bacteria have located themselves.

1. ***Urethritis***: This infection occurs in the **urethra** itself. Bacteria or Fungi get access to the urethra and begin to populate the area. They do not move further up into the bladder but remain in the urethra itself. M**ain symptoms:** severe, non-stop itching and burning in the urethral area. **Gonorrhea** is one type of bacteria that causes this type if infection.

2. Cystitis: is a common infection in the **bladder** itself, especially in women. It usually happens as a result of sexual intercourse when bacteria from the partner's skin comes in contact with the urethra causing the bacteria to move upward into the bladder. Cystitis is not as common in men and usually happens because the infecting bacteria moves up into the bladder from the urethra or prostate. It can be very difficult to treat and eliminate cystitis in men because bacteria can become



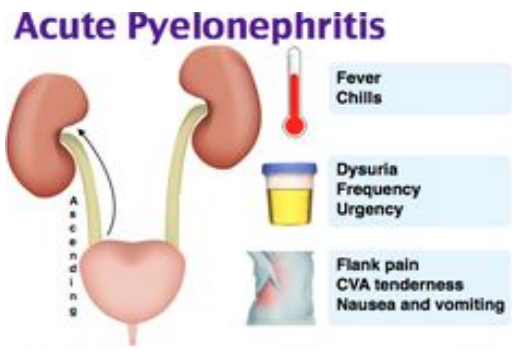
embedded deep in the soft tissues of the prostate and difficult to eliminate completely. Cystitis can also be a complication in both men and women because of placement of **urinary catheters** and **radiation treatments** performed to treat cancers in the abdominal area.

3. Acute Pyelonephritis: is a serious and potentially life threatening infection that can damage and scar the structure of the kidney itself. This type of infection could happen in the following situations:

- when bacteria travel up from the bladder through the ureters and into the lower portion of the kidney itself
- if there is bacteria present in the blood supply going through the kidney and some of the bacteria cross into the kidney and embed in the tissues there
- Kidney stones that are lodged in the ureter can also lead to pyelonephritis due to the back-up of urine into the kidney. As the bacteria grow and begin to form a colony, an abscess can grow on the kidney or the kidney can go into acute kidney failure. Even sepsis and septic shock can occur.

Symptoms of sudden onset pyelonephritis are important to catch early and include:

- Fever >103°F accompanied by chills and a feeling of general weakness.
- Noticeable blood in the urine also known as gross hematuria
- Pain near and over the affecting kidney. The pain can be described as discomfort, pressure or severe
- Nausea and vomiting
- Elderly patients may suddenly become confused, nasty, disoriented, difficulty remembering even simple tasks.



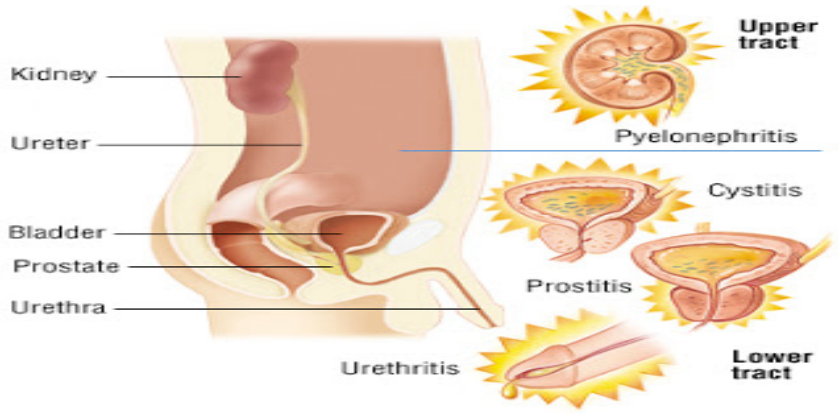
If pyelonephritis is suspected a visit to a healthcare provider, urgent care or emergency room is very important. A physical examination will be done and specific symptoms will be discussed.

Tests may include:

- Collection of Urine for analysis. This can be done by either doing by peeing in a sterile cup, having a sterile catheter inserted directly into the bladder or in cases where there is no urine flow a needle may be inserted into the bladder.
- Culture of both the urine and blood to determine what bacteria is growing and what antibiotic will best treat it. Ideally there would be no bacteria in the blood sample, even though there is bacteria present in the urine.
- CT scan is the preferred imaging study of choice. It can show if an abcess is present on the kidney, its location and size.

Treating acute pyelonephritis quickly is very important in preventing further damage to the urinary tract. **Treatment includes**:

- Seeking immediate medical treatment usually in the emergency room
- Getting intravenous fluids to keep hydrated and preserve as much kidney function as possible
- Medications to relieve the pain and, also to treat a very high fever
- Antibiotics will be given both through the intravenous fluid as well as by mouth.
- If an abscess is present on the kidney, surgical drainage of the abscess along with all of the above treatments may be necessary.
- If the infection is the result of a lodged kidney stone, the stone may need to be removed either surgically or with lithotripsy.
- Antibiotic therapy may need to continue for several weeks



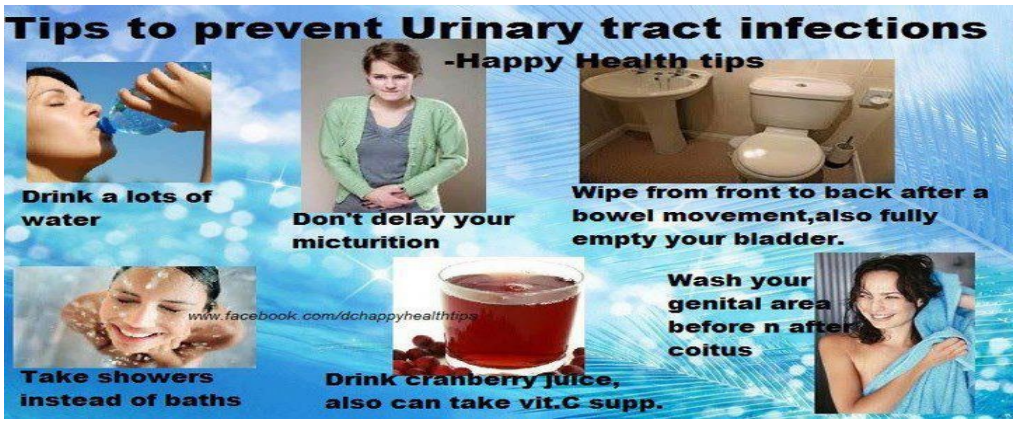
Preventing Urinary Tract Infections

Preventing an initial urinary tract infection from happening or preventing recurrences is very important, especially for women. One of the main risk factors for getting a UTI and possible reoccurrences is sexual intercourse, especially if they are using a Spermicide and or a Diaphragm as contraceptives.

Behavior Modification, or changing behaviors and habits is a usually low cost and simple way to prevent infections or keep infections from coming back. These include:

- After sexual intercourse, attempt to empty your bladder. This will help keep any coitus related bacteria from getting into the bladder and causing an infection.
- Drink 10 ounces of cranberry juice each day. Some studies have shown that the juice contain hippuric acid that helps to fight the bacteria and may also contain tannins that work to keep the *E. coli* from growing. However, these studies are inconclusive and need further review to see how exactly cranberry juice helps, if indeed it does.
- Always wipe from front to back to prevent the bacteria in the rectum can easily be transferred to the urinary tract.
- Showers are preferable to tub baths. Bath water quickly becomes contaminated with the normal bacteria on the skin and can easily enter the urethra and travel into the bladder.
- Use a separate, clean washcloth to wash the urethra, vagina and rectum. Carefully wipe from front to back.
- Urinate at least once every 4 hours while awake and try not to hold urine in your bladder for too long.

- Drink plenty of fluids throughout the day at least 6-8 8 ounce glasses. A good idea is to have one extra glass of water with each meal.
- Urine is normally pale yellow in color. If it appears darker yellow, it's a sign that the body needs more fluid.
- Wear cotton underwear that is not too tight. Cotton is a fabric that breathes well and keeps the moisture away from the skin and urethra. Remember that moisture is one ingredient for helping bacteria grow so you want to keep the urethra as dry as possible.
- Take antibiotics only if prescribed by a healthcare provider. Do not take any leftover antibiotics or antibiotics from someone else.



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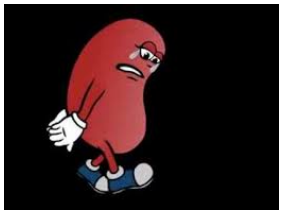
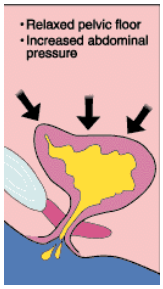


VII.

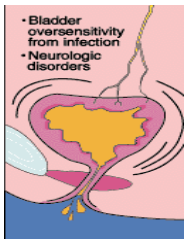
As adults age, they can experience an involuntary and incontrollable loss of urine, known as **Urinary Incontinence**. This health issue is considered to be under reported and two times more common in women than men. It is under reported because many people do not report this problem to their healthcare provider. In addition, most healthcare providers do not ask patients about incontinence during routine visits. It is important to know that urinary incontinence can happen to anyone at any age. Statistics show that about 30% of elderly women and 15% of elderly men have incontinence.

Incontinence can cause serious changes in a person's quality of life due to constant dribbling of urine, intermittent and inconsistent need to urinate. The need to urinate may come on suddenly and the person has no time to reach a bathroom. People with incontinence often feel embarrassment, feel as if everyone knows they have a problem, decide to isolate themselves by not going out and enjoying every day activities. All of this can lead to depression.

The Different Types of Incontinence

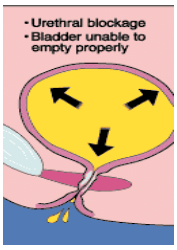


Stress Incontinence: happens when urine leaks out because of laughter, sneezing, coughing, climbing stairs, or other types of physical activities that put increased pressure on the bladder and increase the pressure throughout the abdomen. This is the second most common type of incontinence in women, especially in women who have given birth to children



Urge Incontinence happens when a small amount of leakage occurs and then the person experiences a sudden urgent desire to urinate. This can happen at night, especially for people who take diuretics like Lasix and have a difficult time getting to the bathroom in time.

Mixed Incontinence happens when involuntary leakage occurs and the person has leakage and urgency with stressful situations, sneezing coughing and exercise.

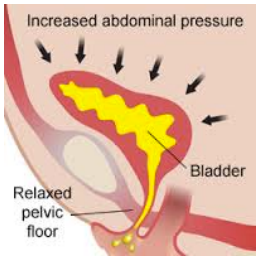


Overflow Incontinence happens when urine dribbles out from an overly full bladder. Usually it comes out in small amounts but may result in the loss of large amounts of urine over time.

Functional Incontinence is usually a result of physical or mental impairments so that the person may not know that they need to urinate or they may not be able to get to the nearest toilet.

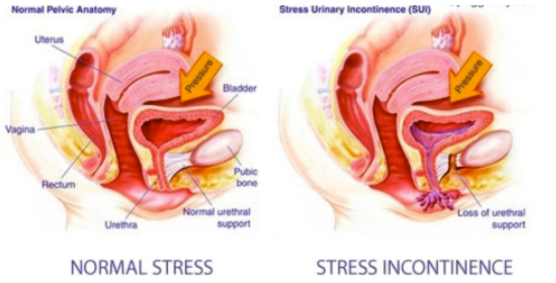
How Does Urinary Incontinence Occur?

Urinary incontinence can happen as a result of nerve signals not properly getting to and from the bladder to signal that it is full. A bladder is considered full when it has between 300 and 500 ml of urine in it. The nerves will begin to send signals to the brain when the bladder reaches between 150-300ml of urine that it needs to be emptied soon. If the signal gets interrupted for some reason, the urethra may open and cause dribbling and incontinence.



When the incontinence is caused by stress, there is an increase in the pressure in the abdomen that becomes greater than the urethra's ability to stop the flow of urine and urine leaks out involuntarily and continues until the pressure in the abdomen becomes less than resistance from the urethra. As a person laughs, coughs, sneezes or does some type of strenuous activity, the pressure in the abdomen increases, the urethra can no longer withstand the pressure increase and the urine flows out until the activity stops.

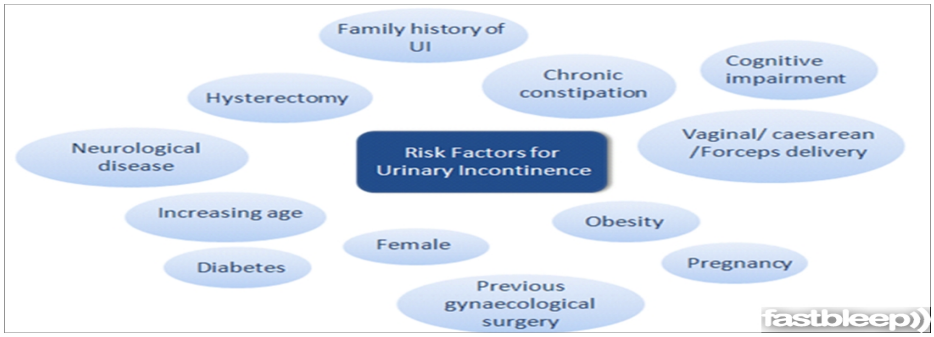
Urine incontinence, especially stress incontinence, can also happens as a result of the Urethra opening too quickly and not closing fast enough. This issue involves both the nerves and the muscles not working properly. The urethra is located along the pelvic floor (the lowest part of the abdomen and pelvis). The pelvic floor acts as a connection and support to both the bladder and the bladder neck. If an injury or



NORMAL STRESS STRESS INCONTINENCE

interruption occurs to the pelvic floor, the urethra and bladder neck rotate back and away from connection when increased pressure is applied to the abdomen. This causes the urethra to open and urine to leak out.

The most common injury to the pelvic floor happens during childbirth.



What can be done to treat Urinary Incontinence?

The first step to treating urinary incontinence is to talk to a healthcare provider about any symptoms and incidences of urinary incontinence. It is important to tell them about how many times the incontinence happen, how often it happens, when does it happen and what other symptoms you notice with it. The healthcare provider will also ask about previous medical issues such as number of children born, any injuries or surgeries to the pelvic floor, medicines taken and any injuries to the neck and back.

The healthcare provider will examine each patient individually based on the symptoms and medical history. A urine sample will be collected to see if there is an infection. The patient may be asked to come to the visit with a full bladder and asked to urinate so the healthcare provider can measure the volume urinated. They may then use an ultrasound device to scan the bladder to see if the urine remains and if

so how much. The abdomen and back will be examined for scars, hernias or any deformities.

One of the important tests the healthcare provider will do is use a cotton swab stick to softly and gently touch the urethra and vagina and see what type of response happens. **This test checks to see how the nerves respond to stimuli.** At the same time the healthcare provider will look for any color and thickness changes to the area. If there are changes noticed further testing can be ordered to find the exact cause.

Another test that can be done is **the paper towel test**. The patient is asked to cough repeatedly for a few minutes while at the same time holding a paper towel a short distance away from the urethra and measuring the size of the area of dribbling captured.

How can Incontinence be treated?

Depending on the type of incontinence, surgery may be needed to correct the problem, especially if it is severely interrupting the person's quality of life. Most patients will be asked to try the following first:

- Changing their way of eating and drinking including cutting back on the amount of caffeine in their diet and losing weight if obese.
- Make sure that Blood sugars are well controlled if diabetic.
- Training the bladder by relearning how to urinate. This includes scheduling times to urinate and consciously delaying urinating to train the bladder and urethra to hold more urine. This can take months to accomplish.
- For women, **exercising the pelvic floor** may help control the incontinence. These pelvic floor exercises are known as **Kegel exercises** or Kegel maneuvers. These exercises help strengthen the pelvic floor connections that hold the bladder in place. It is performed by slowly drawing in the muscles that open and close the bladder, holding them closed for 5 seconds and slowly releasing them. This should be done 5 times in an hour while awake.
- Vaginal cones may also be used to strengthen the muscles. These cones are weighted and inserted into the vagina. The pelvic muscles are then tightly closed around the cone for 15 minutes twice a day.

- **Biofeedback** uses an electronic device to identify which muscles need to be strengthened because of the incontinence. This treatment is very intensive and done weekly at the healthcare provider office. A tampon shaped sensor is placed into the vagina or rectum and a second sensor is placed on the abdomen to pick up the electric signals produced by the pelvic floor muscles during contraction and relaxation of the muscles during exercise. Biofeedback shows 54-87% improvement in incontinence.

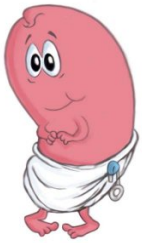
- **Medication** can also be used to treat incontinence and its accompanying symptoms. Medication works best when used along with the pelvic floor (Kegel) exercises. **Ditropan** and **Tofranil** are two examples of medications used to treat incontinence. These medications are often taken together work to cause smooth muscle relaxation in the bladder as well as serve as a mild anesthetic to the area. **Tofranil** can also increase resistance in the bladder outlet in the bladder neck and will help hold the urine in the bladder longer. Other medications can be used in addition to these if the symptoms persist.

Urinary Incontinence can be very embarrassing and costly because it can ruin and underwear and clothing. For some people the use of absorbent products is recommended until a cause is determined, a treatment plan is developed or permanently depending on the person's situation. Absorbent products can include pads that can be placed in standard underwear or adult diapers or pull up briefs.

These products are very helpful for patients who continue to have incontinence in-spite of treatments attempted, have a disability that prevents them from participating in pelvic floor exercises and biofeedback, and people with an incontinence that is not helped with medication or surgery. Use of these products can lead to breakdown in normal healthy skin tissue which can lead to infections.

To prevent this frequent garment or pad changes may be necessary to keep the area dry. The products used over the years have improved and are not as bulky or noticeable today. This photograph of the article author Joanne, shows her dressed for a day out, you would never know she is wearing an adult diaper!

If you are experiencing an issue with urine leakage that is happening more frequently or getting worse, please contact your healthcare provider and discuss treatment options with them. It will help prevent further medical issues and help you maintain a healthy active lifestyle once you get it under control.



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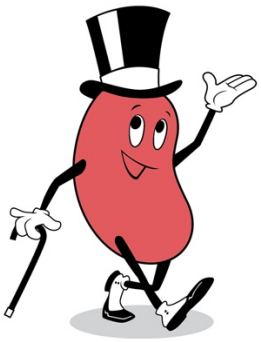

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