

A landscape photograph featuring a row of bare trees on the left side, leading to a green field with visible furrows. The sky is bright and hazy, with a white curved line graphic element. The text 'IN THE NAME OF GOD' is centered at the top in orange, and 'Infectious complications of hemodialysis catheters' is centered below it in green. The name 'Dr. Binesh' is in the bottom right corner in green.

IN THE NAME OF GOD

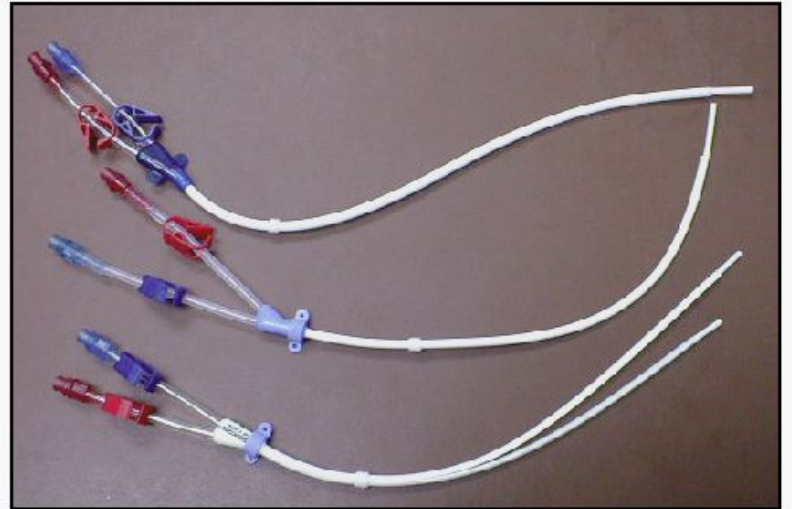
Infectious complications of hemodialysis catheters

Dr. Binesh

Hemodialysis Catheters

Non-tunneled, non-cuffed catheters

Tunneled, cuffed catheters

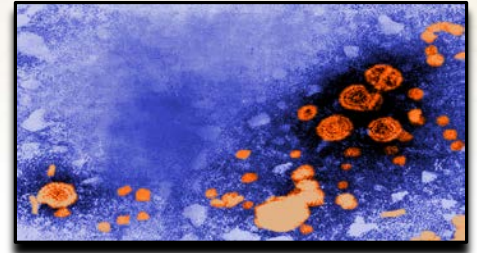


Why are Dialysis Patients at Risk for Infection?

- Patients who undergo hemodialysis have a higher risk of infection, due to the following factors:
 - Frequent use of catheters or insertion of needles to access the bloodstream
 - Weakened immune systems
 - Frequent hospital stays and surgery

Infections in Dialysis Patients

- Dialysis patients are at risk of getting **hepatitis B and C infections** and **bloodstream infections**
 - **Hepatitis B and C** are bloodborne viral infections that can cause chronic (life-long) disease involving inflammation (swelling) of the liver
 - Hepatitis B and C viruses can live on surfaces and be spread without visible blood
 - A **bloodstream infection** is a serious infection that can occur when bacteria or other germs get into the blood
 - One way bacteria can enter the bloodstream is through a vascular access (catheter, fistula, or graft)





- TCCs have been found to be associated with as much as a threefold increased mortality compared with AVFs
- Sepsis-related death is 100 times greater in dialysis patients than in the general population
- Infection-related death and all-cause mortality are highest in those with TCCs



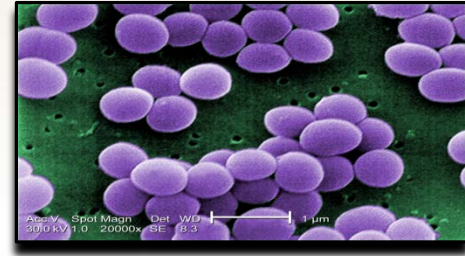
- Bacteremia frequently complicates catheter use in hemodialysis patients
- In a prospective follow-up of 108 patients with tunneled dialysis catheters, the first episode of catheter-related bacteremia developed in 35% within 3 mo and in 48% after 6 mo
- The frequency of catheter-related bacteremia has ranged from 2.0 to 5.5 episodes per 1000 catheter-days at several dialysis centers or 0.9-2.0 episodes per patient-year



- Serious complications, including infective endocarditis, septic arthritis, septic emboli, osteomyelitis, epidural abscess and severe sepsis, have been reported in 20% of cases
- *S. aureus* has been predominantly isolated from those patients as a result of the predilection of *S. aureus* for heart valves and bone

Infections in Dialysis Patients

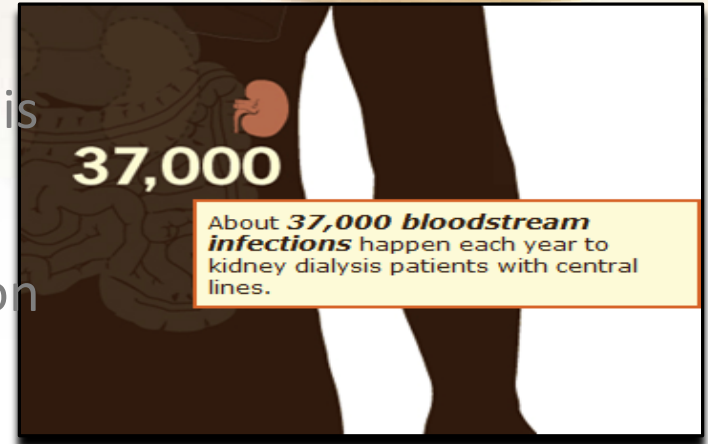
- **Bloodstream infections** are a dangerous complication of dialysis
- 1 in 4 patients who get a bloodstream infection caused by *S. aureus* (staph) bacteria can face complications such as:
 - Endocarditis (infected heart valve)
 - Osteomyelitis (infected bone)
- Total costs for each infection can be more than \$20,000
- Bloodstream infections can cause sepsis (a potentially deadly condition)
- Up to 1 in 5 patients with an infection die within 12 weeks



National Burden of Dialysis Infections

A Cause for Concern

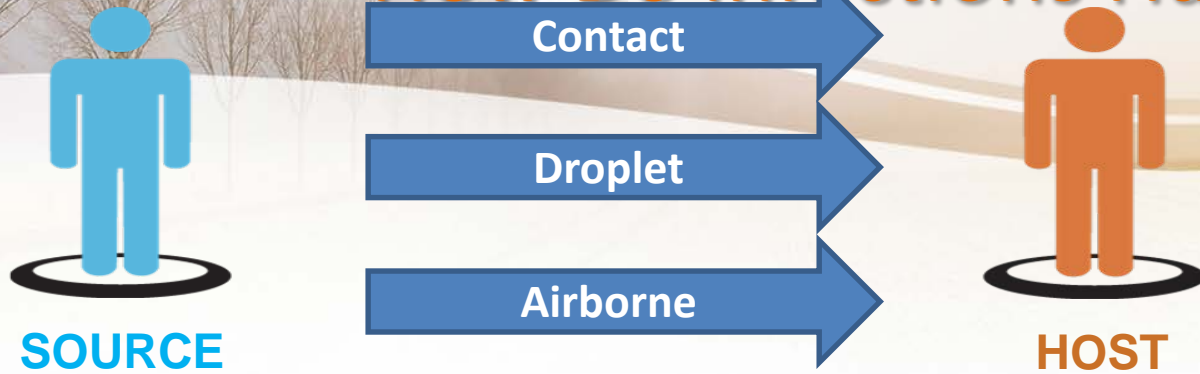
- In the US, there are about 370,000 people relying on hemodialysis
- About 75,000 people receive hemodialysis through a central line
- Central lines have a higher risk of infection than a fistula or graft
- CDC estimates 37,000 central line-associated bloodstream infections may have occurred in U.S. hemodialysis patients in 2008



Risk factors for catheter-related bacteremia

- Duration of catheterization
- Conditions for insertion
- Catheter site and catheter site care
- Repeated catheterization
- Increased catheter manipulation
- Tunneled vs nontunneled catheters
- Immunosuppressive therapy
- Hypoalbuminemia

How Do Infections Happen?



Three elements must be present for an infection to occur:

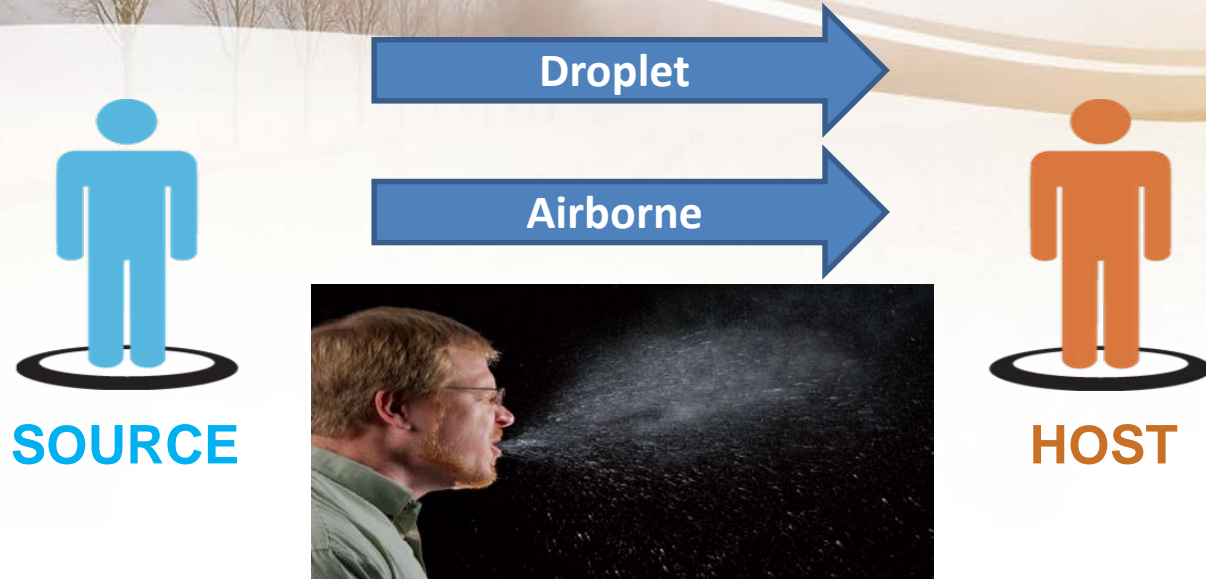
1. A **source** of germs (like bacteria or viruses)
2. A susceptible **host**, meaning a person who is at risk of getting an infection from the germs
3. A **way** for the germs to move from the source to the host
 - There are three ways in which germs move from the source to the host: **Contact, Droplet, and Airborne Transmission**

Your Role in Contact Transmission



- During dialysis, infections can be spread by Contact Transmission
- Most commonly by **healthcare worker hands!**

Spread of Respiratory Infections



- Certain infections are spread by certain routes:
 - Flu may be spread by Droplet Transmission
 - Tuberculosis is spread by Airborne Transmission



Diagnosis



- Often suspected clinically in a hemodialysis patient who presents with fever or chills, unexplained hypotension and no other localizing signs
- Mild symptoms include malaise and nausea, in the setting of a normal catheter exit site or tunnel, on physical exam
- More-severe symptoms include high fever with rigors, hypotension, vomiting and changes in mental status
- Older and more-immunocompromised patients might present with low-grade fever, hypothermia, lethargy, hypoglycemia, or diabetic keto acidosis



- Catheter related bacteremia can be complicated by catheter exit-site or tunnel infection
- Exit-site infection is indicated by the presence of erythema, swelling, tenderness and purulent drainage around the catheter exit and the part of the tunnel external to the cuff
- Symptoms of tunnel infection are swelling, erythema, fluctuance and tenderness over the catheter tunnel central to the cuff



- Requires positive blood cultures obtained from the catheter and from a peripheral vein, with the quantitative colony count being at least four-fold higher in the catheter sample
- A more practical definition is the presence of positive blood cultures in a febrile catheter-dependent patient, in the absence of alternative sources of infection upon clinical evaluation

The definitive diagnosis of CRB requires one of the following

- Concurrent positive blood cultures of the same organism from the catheter and a peripheral vein.
- Culture of the same organism from both the catheter tip and at least one percutaneous blood culture.
- Cultures of the same organism from two peripherally drawn blood cultures and an absence of alternate focus of infection.

Evaluation, diagnosis and differential diagnosis

- CRB suspect threshold should be low.
- Two blood cultures should be drawn;
 - Peripheral vein and catheter
 - Separate peripheral veins
- Differential diagnosis includes pneumonia, foot infection and other infections

TABLE 302-3 Factors Differentiating Device-Associated Bacteremia from Other Septic Syndromes

Local phlebitis, inflammation, or both at catheter insertion site

Lack of other source for bacteremia

Sepsis occurring in a patient not otherwise at high risk for bacteremia

Localized embolic disease distal to cannulated artery¹¹⁹

Hematogenous *Candida* endophthalmitis in patients receiving total parenteral nutrition^{201,202}

Presence of ≥ 15 colonies of bacteria on semiquantitative culture of the catheter tip^{117,118}

Sepsis apparently refractory to "appropriate" antimicrobial therapy

Resolution of febrile syndrome after device removal

Typical (*Staphylococcus aureus*, *Staphylococcus epidermidis*, or other coagulase-negative staphylococci) or unusual (*Burkholderia cepacia* complex, *Enterobacter agglomerans*, *Enterobacter cloacae*) microbiology

Clustered infections caused by infusion-related organisms



Treatment

TABLE 302-2 Microbiology of Device-Associated Bacteremia

Coagulase-negative staphylococci, including *Staphylococcus epidermidis**
Staphylococcus aureus
Enterococcus spp.
Serratia marcescens[†]
Candida albicans[‡]
Candida tropicalis[‡]
Pseudomonas aeruginosa[§]
Klebsiella spp.[†]
Enterobacter spp.[†]
Citrobacter freundii[†]
Corynebacterium (especially *C. jeikeium*)^{||}
Acinetobacter (especially *A. baumannii*)[¶]
Burkholderia cepacia complex[§]

*Most common pathogen for long-term lines; also associated with lipid infusions

Table 4. Microbiologic isolates from 123 episodes of catheter-related bacteremia

Organism	Isolates, <i>n</i> (%)
Gram-positive cocci	104 (84.5%)
<i>Staphylococcus epidermidis</i>	46
<i>Staphylococcus aureus</i>	37
<i>Enterococcus faecalis</i>	15
other group D enterococci	6
Gram-positive rods	2 (1.6%)
Corynebacterium species	4
Gram-negative rods	41 (33.3%)
<i>Enterobacter cloacae</i>	11
other Enterobacter species	2
Pseudomonas species	8
<i>Acinetobacter baumannii</i>	5
Citrobacter species	5
Serratia species	2
<i>Klebsiella pneumoniae</i>	4
<i>Proteus mirabilis</i>	1
<i>Escherichia coli</i>	1
<i>Agrobacterium radiobacter</i>	1
Alcaligenes species	1
Acid-fast organism	2 (1.6%)
<i>Mycobacterium fortuitum</i>	2



- Because of the high prevalence of MRSA and gram negative pathogens, empiric therapy should include Vancomycin and an antibiotic with broad-spectrum gram-negative bacterial coverage
- Antibiotic regimen should be modified as soon as the sensitivity reports are available
- Linezolid should be reserved for treatment of vancomycin-resistant organisms
- With these measures, outpatient management is feasible in greater than 80% of patients with catheter-related bacteremia



- Because of the bacterial biofilm formation, treatment of catheter-related bacteremia without catheter removal is relatively ineffective
- Different options include TCC salvage, TCC exchange over a guidewire with antibiotics or immediate TCC removal with delayed reinsertion and antibiotics

Criteria to attempt catheter salvage

- Difficult to replace catheters
- Blood sterile in 48–72 h
- No sign of tunnel infection
- No signs of metastatic infection
- Microorganisms medically treatable
- A hemodynamically stable patient





- There is a 5-fold higher risk of treatment failure when TCC salvage is attempted, and an 8-fold higher risk in cases associated with *S. aureus* bacteraemia
- Salvage should be used only as a treatment of last resort



- Studies that have evaluated antibiotic lock therapy for treatment have varied in the types of antibiotics and concentrations used, the addition of heparin to the solutions, and dwell times in the catheter lumen
- Reported success in small series ranged between 40% to 87% depending on the pathogen
- Stronger evidence however is available for exchanging catheter over a guidewire

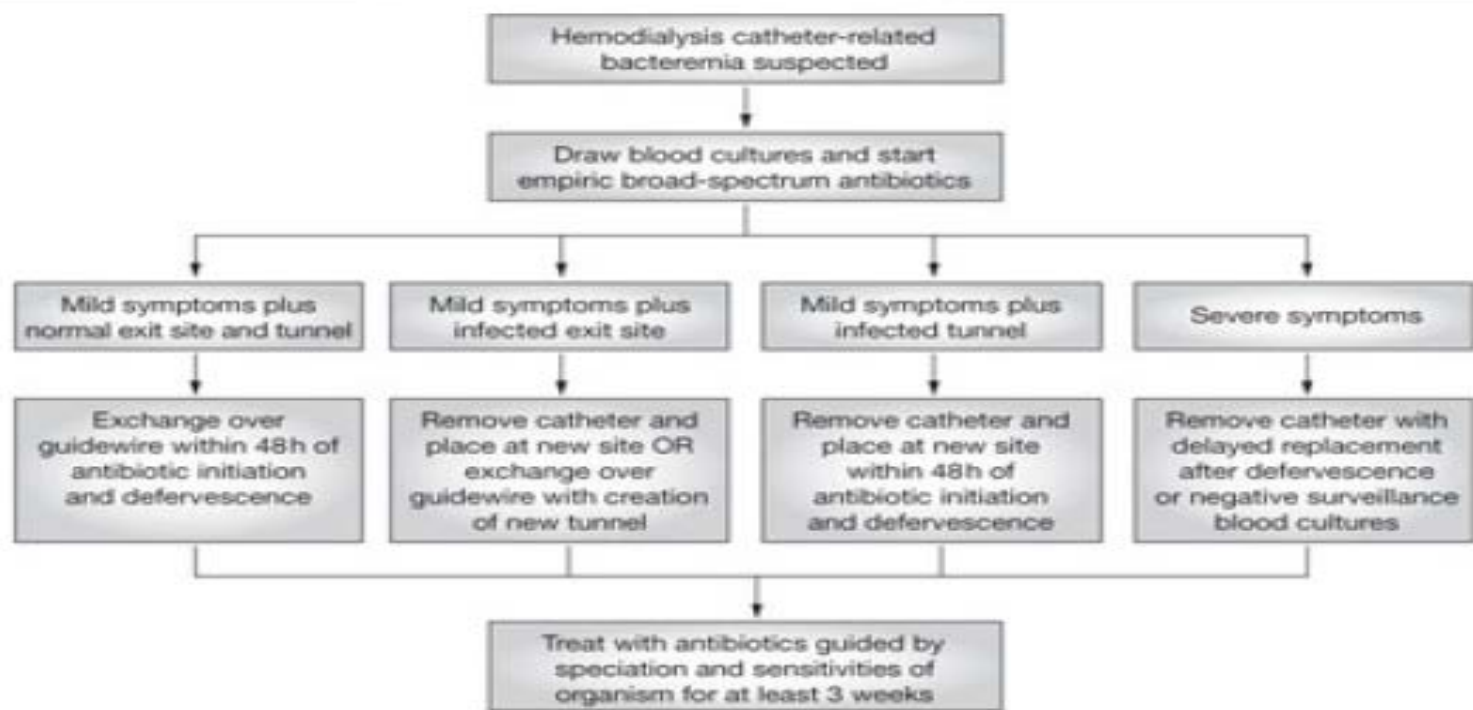


Figure 2 Management of central venous hemodialysis catheter-related bacteremia.

Duration of antimicrobial therapy for CRB

- Uncertain. It depends on clinical, microbiologic features and whether the catheter is removed
- Treat uncomplicated CRB for two or three weeks.
- Treat uncomplicated CRB due to *S. Aureus* for four weeks.
- If there is evidence of metastatic infection, use of antibiotics at least six weeks.
- When blood cultures remain positive after three or more days of appropriate therapy, use antibiotics at least six weeks.
- Among patients with osteomyelitis, experts advise treatment for six to eight weeks.

What Can You do to Prevent the Spread of Infections?

Understand and Follow the Basics of Infection Control

- All healthcare workers are expected to follow **Standard Precautions** for infection control.
 - *Standard Precautions are reviewed in Lesson 2*
- In addition, CDC has developed specific recommendations tailored for hemodialysis healthcare workers, recognizing the increased risks for infection.
 - *These dialysis-specific recommendations are reviewed in Lesson 3*

Standard Precautions for all Healthcare Workers



- Perform hand hygiene
- Use personal protective equipment (PPE)
- Follow safe injection practices

Perform Hand Hygiene

How to perform hand hygiene :



- When hands are visibly soiled with blood or other body fluids, wash hands with **soap and water**



- If hands are not visibly soiled, use an **alcohol-based hand rub**



At least 15 seconds

Remember: hand hygiene is one of the most important ways for you to prevent the spread of infections



Perform Hand Hygiene

When you should perform hand hygiene

- Before you touch a patient
- Before you inject or infuse a medication
- Before you cannulate a fistula/graft or access a catheter
- After you touch a patient
- After you touch blood, body fluids, mucous membranes, wound dressings, or dialysis fluids (e.g., spent dialysate)
- After you touch medical equipment or other items at station
- After you remove gloves



Use Personal Protective Equipment (PPE) Correctly

For your own protection and to protect patients

- Wear **gloves**, a **gown**, and/or **face protection** when you think you may come into contact with blood or other potentially infectious materials
- Change gloves during patient care if the hands will move from a contaminated body-site to a clean body-site
- Remove gloves after contact with a patient and/or the surrounding environment (including medical equipment)
- Do not wear the same pair of gloves for the care of more than one patient





Specific Infection Control Precautions for Hemodialysis Healthcare Workers

- Wear gloves and other personal protective equipment (PPE) for all patient care
- Promote vascular access safety
- Separate clean areas from contaminated areas
- Use medication vials safely
- Clean and disinfect the dialysis station between patients
- Perform safe handling of dialyzers

Basic Steps in Catheter Care

Catheter Connection Procedure:

1. Perform hand hygiene
2. Put on a new, clean pair of gloves
3. Wear proper face protection
4. Apply antiseptic to catheter hub and allow it to dry
5. Connect the catheter to blood lines using aseptic technique
6. Unclamp the catheter
7. Remove gloves and perform hand hygiene

Basic Steps in Catheter Care

Catheter Disconnection Procedure:

1. Perform hand hygiene
2. Put on a new, clean pair of gloves
3. Wear proper face protection
4. Disconnect the catheter from blood lines using aseptic technique
5. Apply antiseptic to catheter hub and allow it to dry
6. Replace caps using aseptic technique
7. Make sure the catheter remains clamped
8. Remove gloves and perform hand hygiene

Catheter Exit Site Care

1. Perform hand hygiene
2. Put on a new, clean pair of gloves
3. Wear a face mask if required
4. Apply antiseptic to catheter exit site and allow it to dry
5. Apply antimicrobial ointment
6. Apply clean dressing to exit site
7. Remove gloves and perform hand hygiene





Infection Control Policies and Practices for Dialysis Facilities

- Vaccination of dialysis staff and patients
- Preventing the spread of hepatitis B
- Preventing the spread of bacterial infections

Vaccine-Preventable Infections

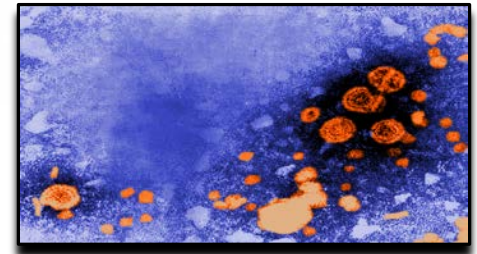
- Influenza

- Influenza or the “flu” is a respiratory infection that infects the nose, throat, and lungs
- The flu is spread mainly by droplets that are made when people with flu cough, sneeze or talk
- The single best way to prevent the flu is to get a flu vaccine each year



- Hepatitis B

- Hepatitis B is a serious infection that affects the liver. It can cause acute (short-term) or chronic (long-term) infection and liver cancer
- Hepatitis B virus is easily spread through contact with the blood or other body fluids of an infected person
- Hepatitis B vaccine can prevent hepatitis B infection



Vaccination and Routine Testing of Hemodialysis Patients

- Vaccinate all susceptible patients against:
 - Hepatitis B
- Recommended vaccines for patients include:
 - Influenza (inactivated)
 - Pneumococcal
- Conduct routine testing for:
 - Hepatitis B virus
 - Hepatitis C virus





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