Infection Control in the Dialysis Setting: What the Dialysis Techs Need to Know

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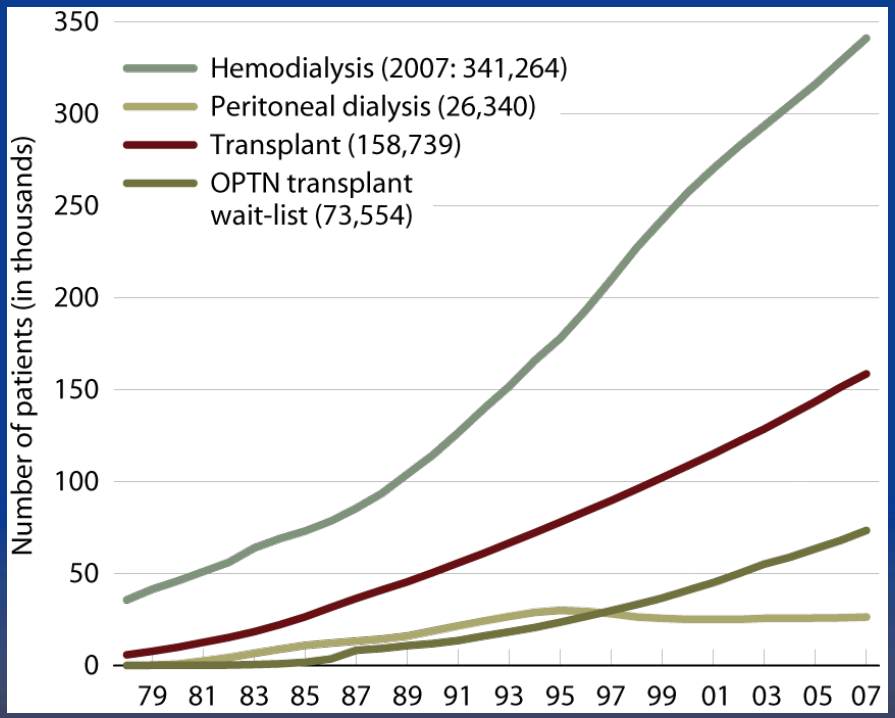
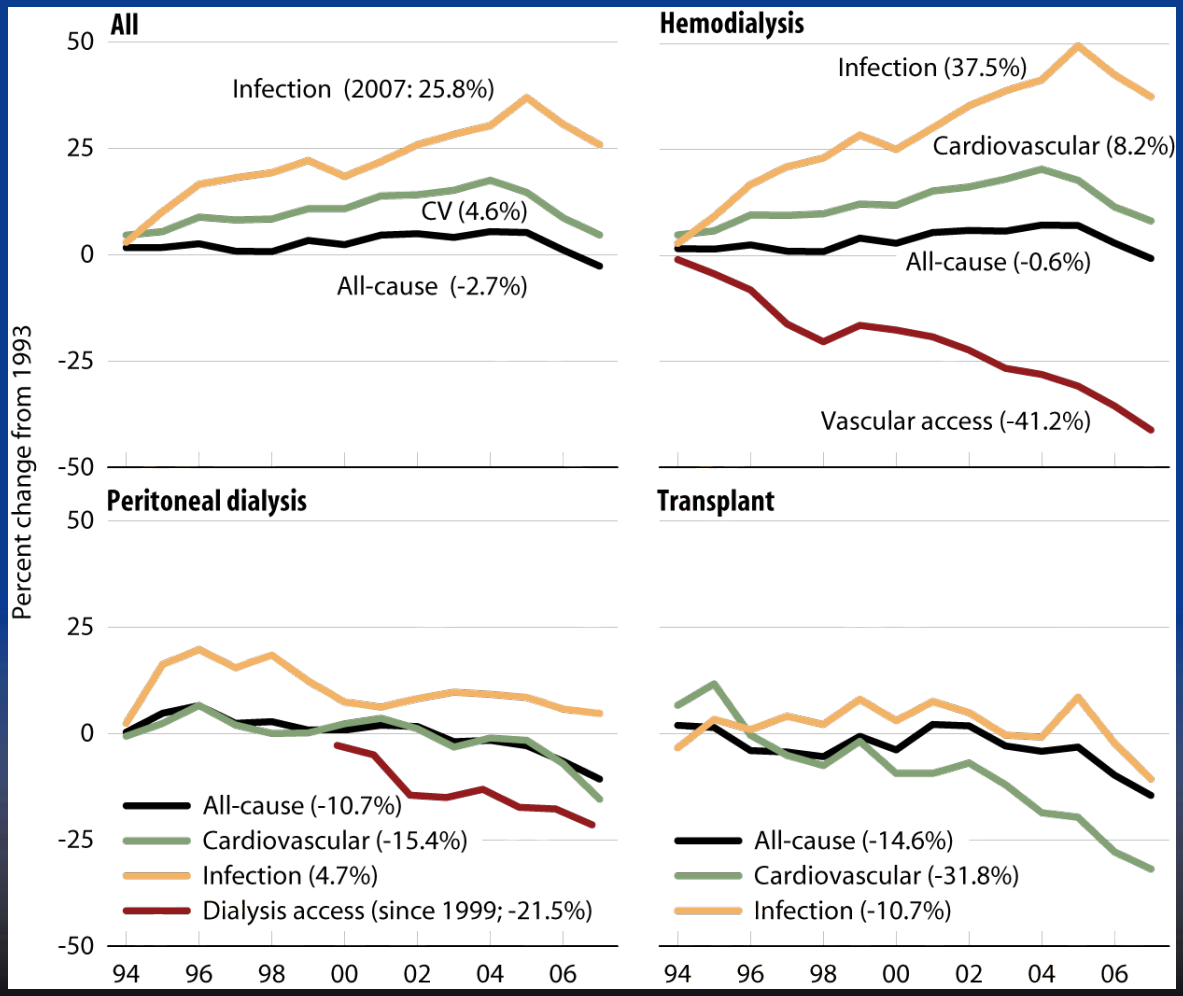
Important Trends (1979-2007)

- Growing dialysis population; 341,264
- Mortality, increasing morbidity from infections
- Antimicrobial resistant infections, other new forms of resistance

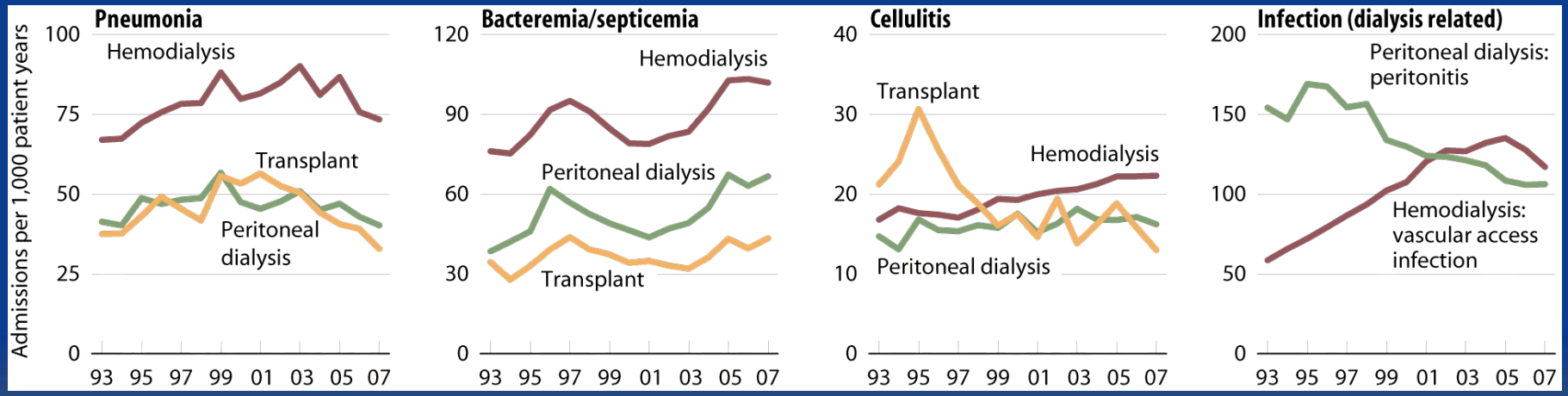


USRDS 2009 Annual Data Report

Cause Specific Hospitalization Rates (USRDS 2009)



Adjusted admissions for principal diagnoses, by modality (USRDS 2009)

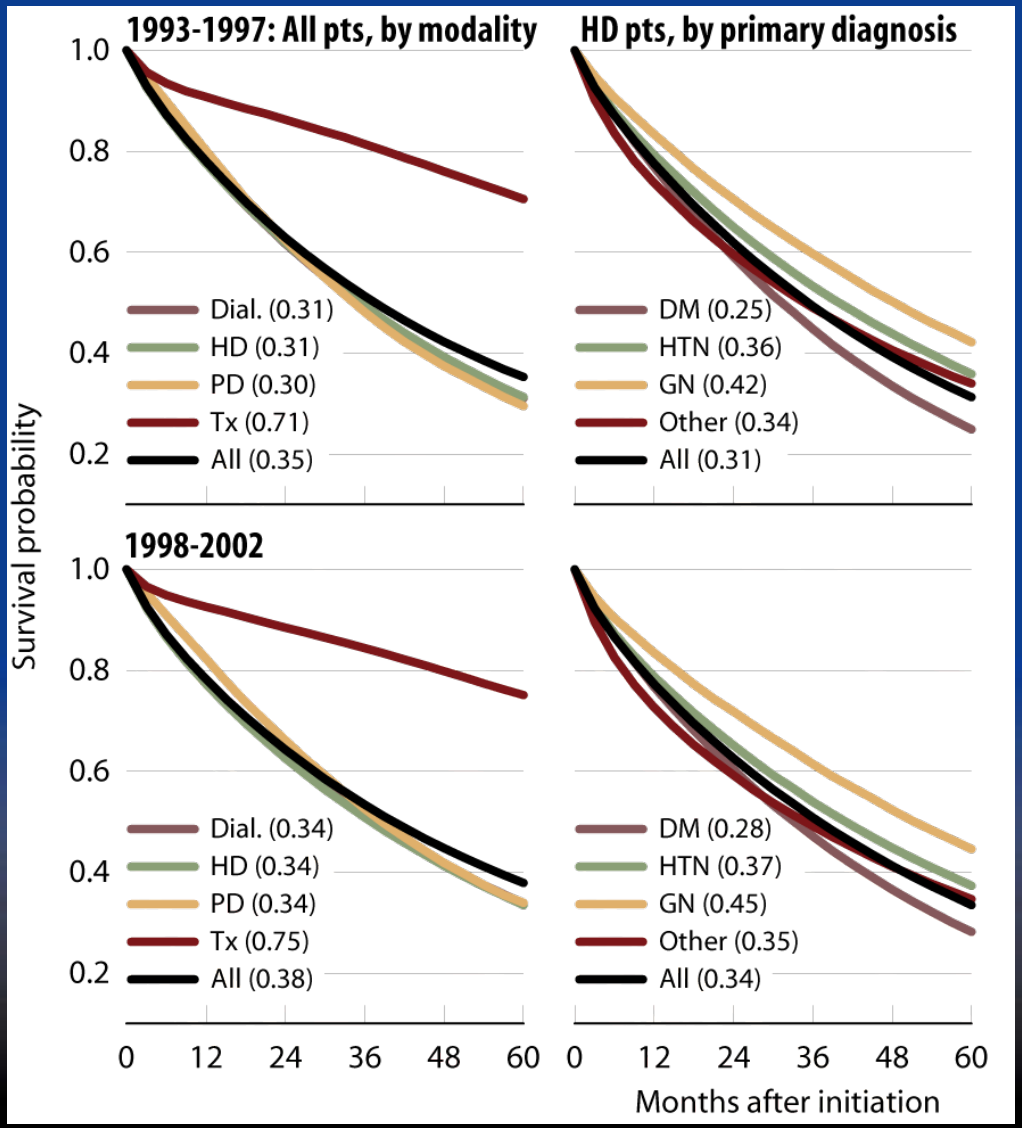


Period prevalent ESRD patients; adjusted for age, gender, race, & primary diagnosis. ESRD patients, 2005, used as reference cohort.

Overview

- Important trends
- Introduction: understanding the chain of infection some general epidemiology
- Important pathogens
- Interrupting transmission

Adjusted five-year survival, by modality & primary diagnosis



Adjusted five-year survival, by modality and primary diagnosis: 1993-1997 and 1998 -2002

USRDS 2009

Annual death rate: 23%

~36% alive at 5 years

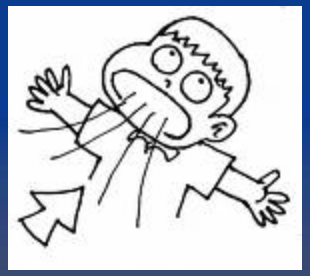
Chain of Infection

To cause an infection, an infectious agent must

Leave original host

Survive in transit (air, water, surfaces, biofilms, or other reservior)

Be delivered to a susceptible host ← direct/indirect

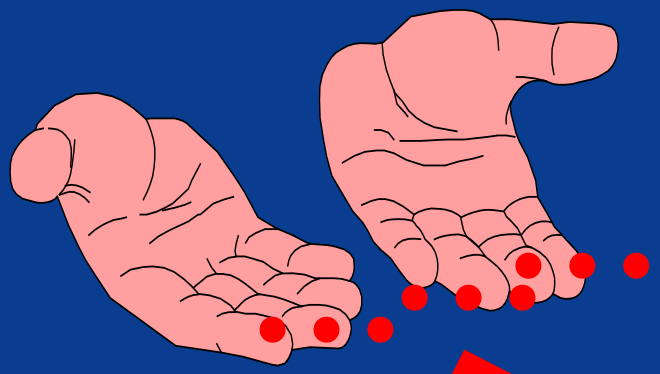


Reach a portal of entry into the host

Escape host defenses

Multiply and cause infection

Most Common Route of Spread



Workers' Hands

Bacteria

Patients

Infected or colonized

Becomes colonized

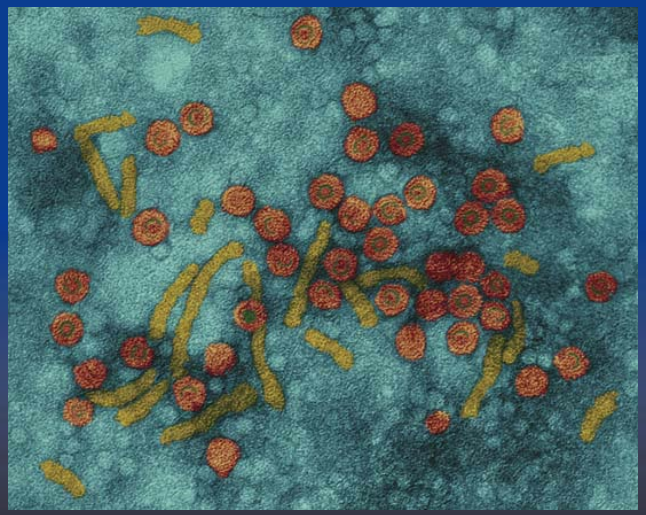
Epidemiology of Infections among Hemodialysis Patients

- Infections are the 2nd leading cause of death (15% of deaths)
- Site of infection
  - 57% vascular access
  - 23% wound
  - 15% lung
  - 5% urinary tract

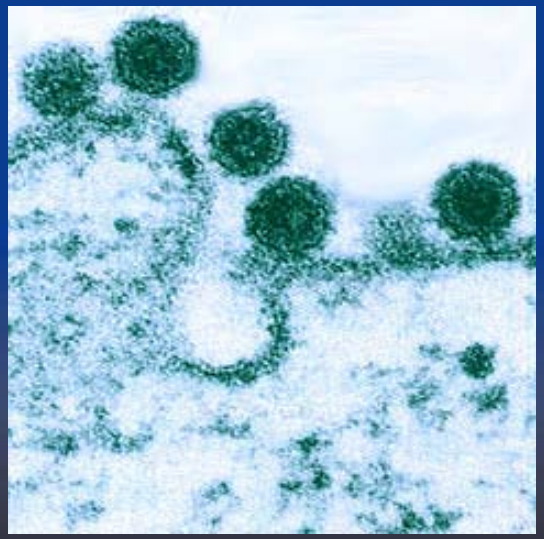
USRDS 2009
Tokars, Miller, Stein. AJIC 2002;30:288-295

Bloodborne Pathogens

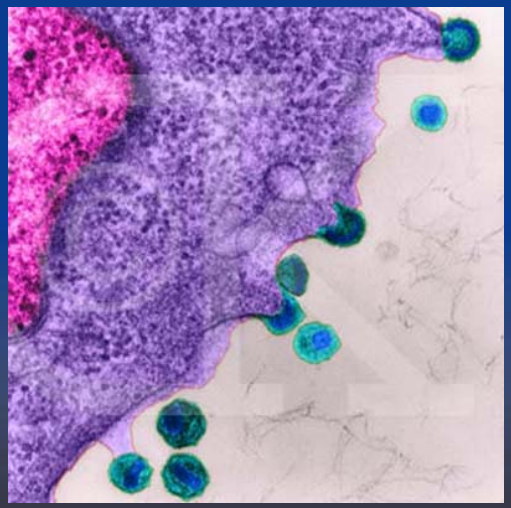
- Hepatitis B, C, and D Viruses
- Human Immunodeficiency Virus (HIV/AIDS)



HBV



HCV



HIV

Efficiency of HBV, HCV, HIV Transmission

Exposure	HBV	HCV	HIV
Transfusion	++++	++++	++++
IVDU	++++	++++	++++
Perinatal	++++	++	+++
Sexual	+++	+	+++
Needle Stick	+++	+	<1
Non-intact skin	++	+/-	+/-
Intact Skin	-	-	-

Relative Infectivity of HBV, HCV, and HIV

	HBV	HCV	HIV
Titer/ml	10^{8-11}	10^{5}	10^{3}
Environmental Stability	++++*	+**	-

*Can persist on environmental surfaces for at least 7 days

** Can persist for <24 hrs (CDC unpublished data)

Sources for Bloodborne Virus Infections in Hemodialysis Patients

- **External to the dialysis unit**
  - **Transfusion from unscreened blood or infected donor in the window where testing fails to detect the agent**
  - **Non-dialysis related healthcare procedures**
  - **Household/sex with infected contact**
  - **Illegal injection drug use (more common in western countries)**
- **Internal to the dialysis unit**
  - **Patient-equipment-patient (HBV contamination on devices, tubing, supplies, surfaces)**
  - **Patient-equipment-staff-patient (HBV contaminated surfaces touched by staff and transmitted with contaminated gloves or hands)**
  - **Patient-staff-patient (direct contamination of staff members' hands/gloves with blood)**

Infection Control Practices

Environmental Stability of HBV

- High titer of HBV: Blood can be diluted to below visible levels and still contain enough infectious particles that indirect transmission can still occur
- 3.3% of centers reported ≥1 patients with newly acquired (incident) HBV infection
- 24.1% of centers reported ≥1 patients with chronic (prevalent) HBV infection
- 25.5% of centers reported ≥1 patients with either acute or chronic HBV infection.

Identified Breaks in Infection Control Practices

- Failure to review lab results; HBsAg+ patients treated with susceptible patients
- Failure to isolate HBsAg+ patients
- Sharing of staff, equipment, and supplies among patients
- Failure to vaccinate susceptible patients against hepatitis B

Preparation of Injectable Medications

- In 2002, 52.8% of centers reported that medications from multi-dose vials were prepared for patient administration in a dedicated medication room or an area separate from the treatment area
- 24.6% reported that medications were prepared on a medication cart or a medication area within the treatment area, 3.7% at the dialysis station, and 18.9% in other areas
- the **incidence of HBV infection** was significantly higher among patients in centers where injectable medications were prepared on a medication cart or medication area located in the treatment area

8 hepatitis cases linked to clinic

Brooklyn Bug

Clinic linked to 8 cases of hepatitis C; 2,200 at risk

DISEASE A

Hepatitis C is a blood-borne viru
The Centers f
ely 4 million
available

Hepatitis C outbreak among clinic patients

Patients of Brooklyn Clinic Are Sought After Outbreak of Hepatitis C

A patient says a clinic is so clean that 'even the magazines are new.'

By DIANE CARDWELL

MEDICAL MYSTERY

Hepatitis C outbreak

Strikes 8 endoscopy patients of B'klyn clinic

Kim Young, 2, in an Astoria park sprinkler

Newsday
NEW YORK CITY

day.com WEDNESDAY, JULY 3, 2002 • CITY EDITION 50¢

2001 HEPATITIS OUTBREAK

DOCTOR DID IT

Newsday Photo / Ken Stevchuk

State: Anesthesiologist Contaminated Vial of Medication With Dirty Needle

Page A3

At least 19 people were infected at this Brooklyn clinic.

Photo by Arthur De Gaeta

Newsday
LONG ISLAND

WEDNESDAY, DEC. 12, 2007 | LONG ISLAND EDITION NEWSDAY.COM

★★★★ SPORTS FINAL

THE SYRINGE MESS

8,500 More At Risk

Every patient doc treated for 5 years should be tested, health officials say A5

Private Medical Practice: New York City, 2001

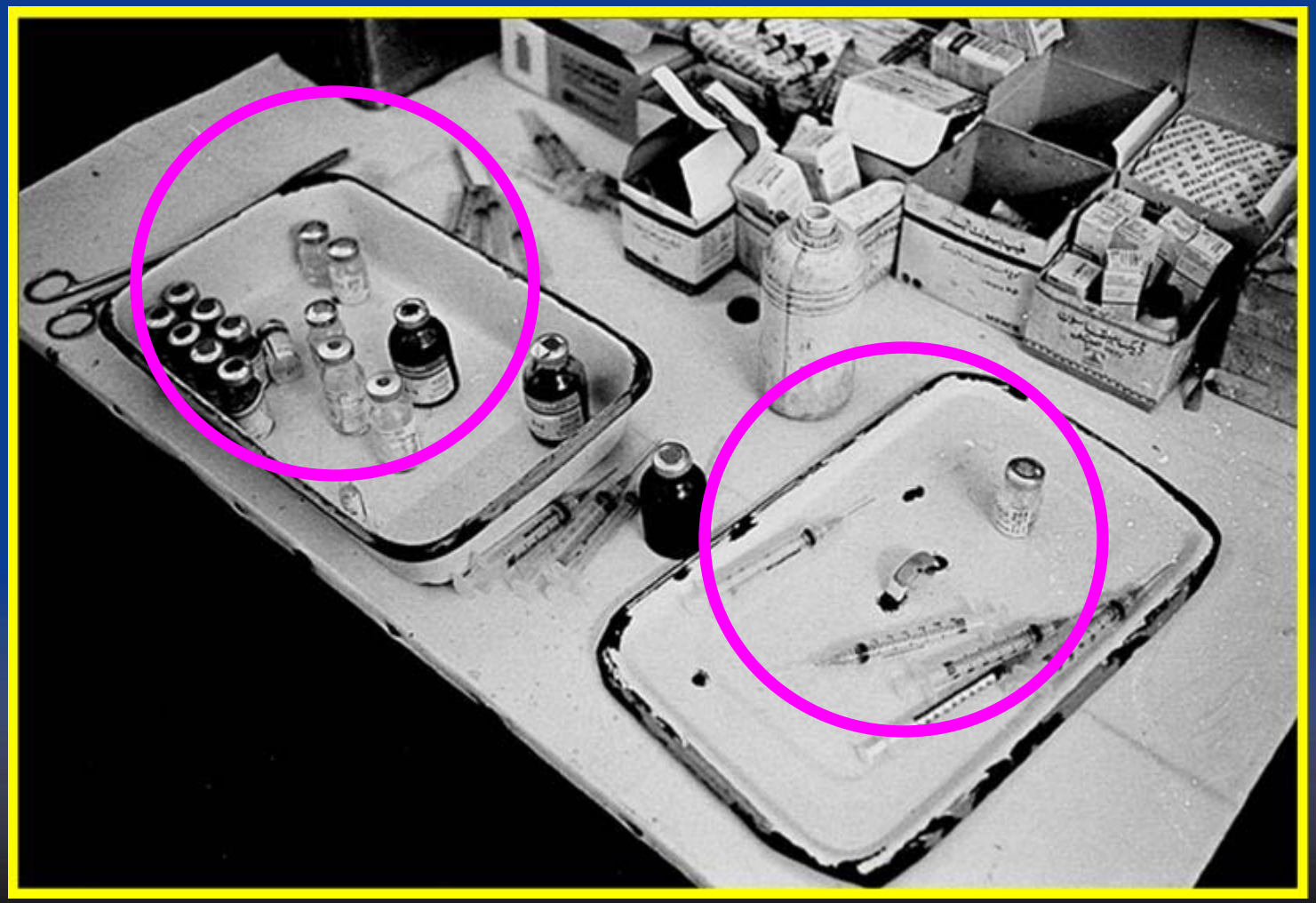
Injection Preparation and Disposal

Private Medical Practice: New York City, 2001

Injection Preparation and Disposal

Storage of multidose vials and preparation of injections in same area that used needles and syringes were dismantled and discarded

Injection Preparation Table, Pakistan



Joe Perz / CDC, Division of Viral Hepatitis

Hepatitis C Virus Infections in Dialysis

- Prevalence: 8-10%
  - (1.6% in general popn)
- Majority of infections are asymptomatic; majority develop chronic infection
- Isolation is not recommended, no vaccine
- Prevention requires strict attention to infection control practices

Hepatitis C Virus

- Most efficiently transmitted by direct percutaneous exposure to infectious blood
- Risk factors associated with HCV: history of blood transfusions, volume of blood transfused, and years on dialysis (≥5 years)
- There were no significant differences in HCV incidence or prevalence in centers that reused dialyzers compared to those who did not reuse dialyzers
- the decline in prevalence may be attributable in part to a decline in new infections among patients as a result of increased awareness of the potential for HCV transmission in this setting.

Place Where Injectable Medications Were Prepared and Association with Hepatitis C Virus Infection, 1999, United States

Place Where Medication is Drawn up in a Syringe	Anti-HCV Prevalence, No (%) Patients	Had Patients Who Became anti-HCV + in 1999, No (%) Centers
Separate medication room or area	6,898 (8.6)	145 (10.3)
Dialysis Station	1,178 (9.1)	23 (11.2)
Medication Cart	**2,623 (9.7)†**	**56 (15.8)†**

HCV Outbreaks, 1998-2006

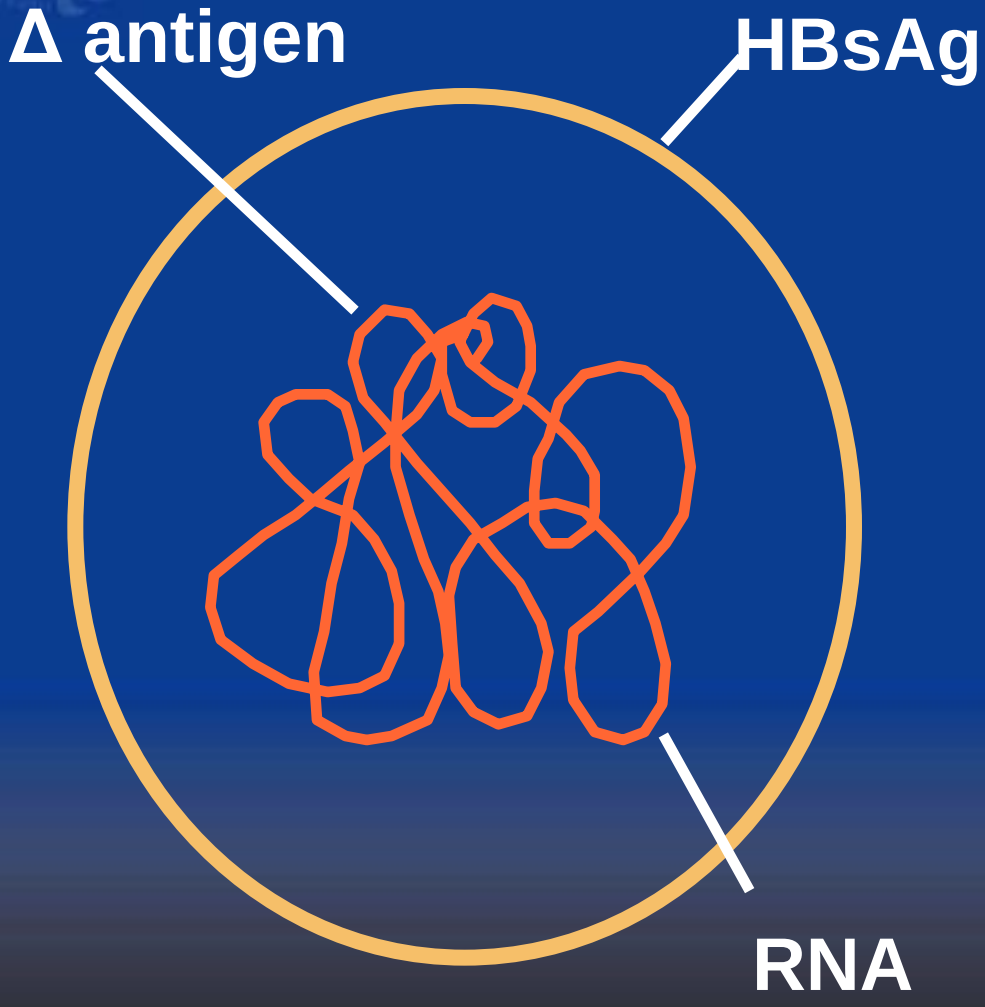
	% of patients with chronic HCV infection	% of susceptible patients that became newly infected
Maryland, 1998	22%	17.5%
Ohio, 2000	36%	8.2%
Wisconsin, 2000	4%	13%
Virginia, 2006	19%	13%

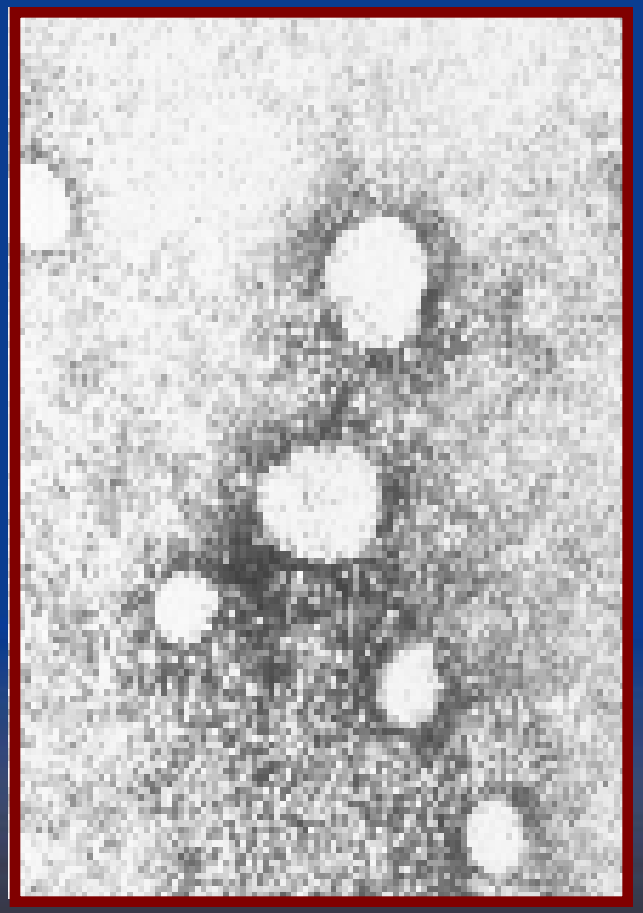
Thompson N, et al. ICHE 2009;30(9):900-3

Breaks in Infection Control

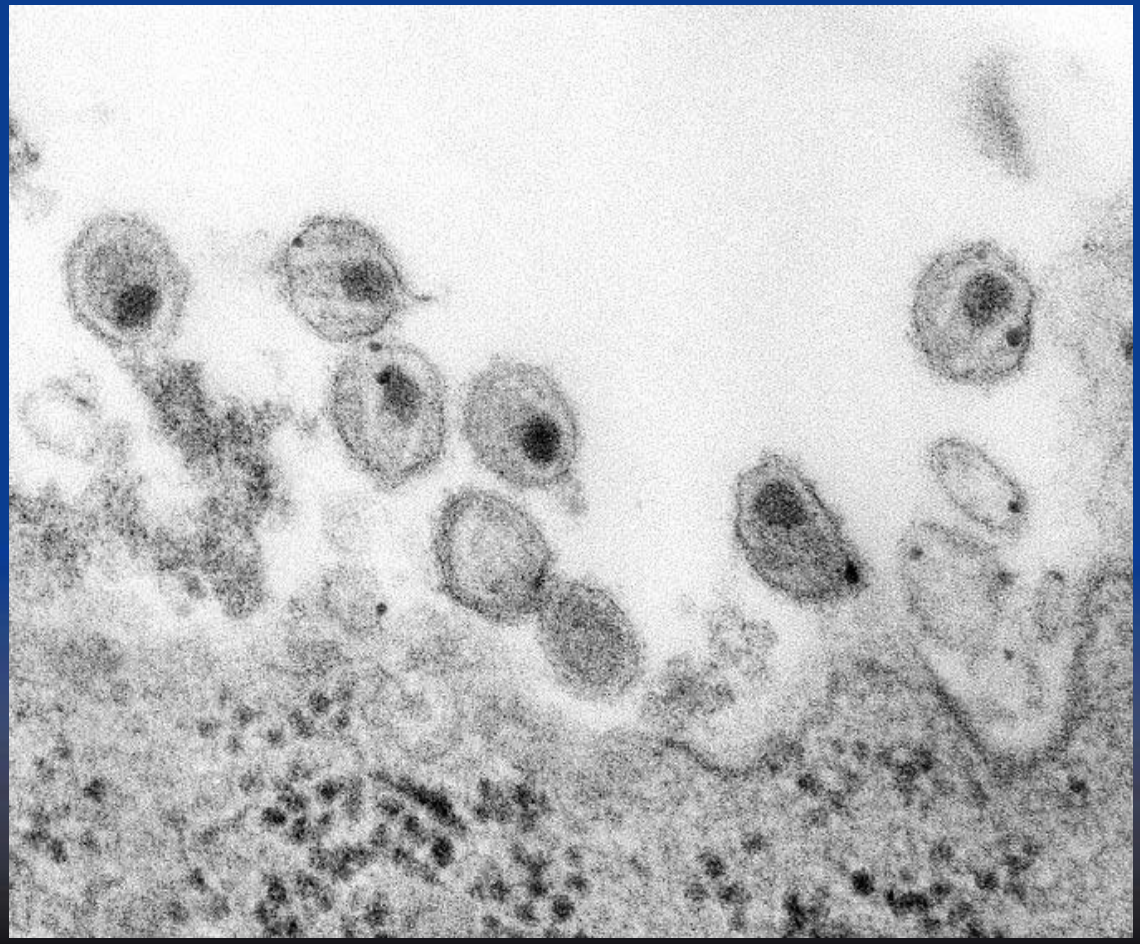
- Not cleaning blood spills or splatters; including prime buckets on side of machine
- Not cleaning or disinfecting commonly touched environmental surfaces between patients (e.g. machine, chair or station)
- Sharing equipment and supplies that were not disinfected; shared multidose vials placed on the top of the machines
- Sharing a common medication cart

Hepatitis D (Delta) Virus





Human Immunodeficiency Virus (HIV)

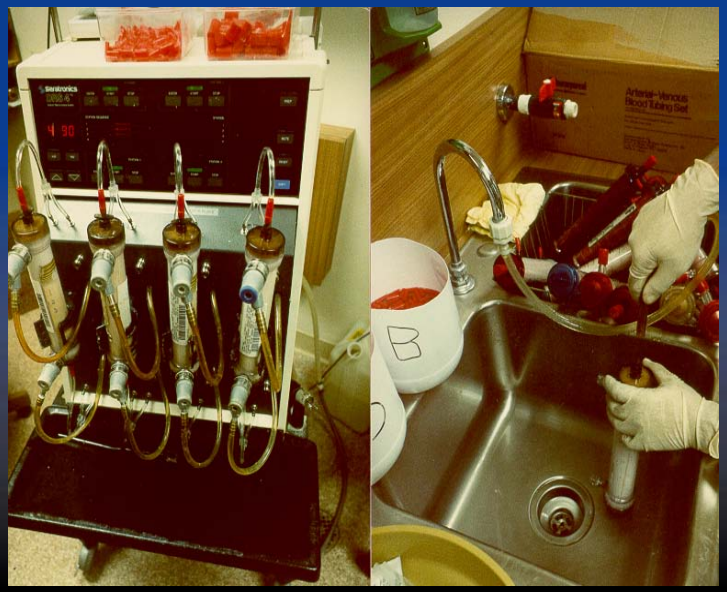


Hemodialysis-Associated Transmission of HIV

- In the U.S. there have been **no** patient infections, however there has been patient to healthcare worker transmission (1 definite, 3 possible) due to needlestick injuries (CDC. U.S. HIV and AIDS cases reported through June 2000. *HIV/AIDS Surveillance Report* 2001;12 (1))
- Outside U.S., transmission has occurred associated with reuse of vascular access needles, syringes, and injection practices (Argentina, Columbia, Ecuador, Egypt)

Bacterial/Fungal Infections

- Vascular access related
- Contaminated machines
- Reuse related
- Contaminated IV medications



Number Of Events And Event Rate By Type Of Vascular Access, Dialysis Surveillance, 1999 -2005

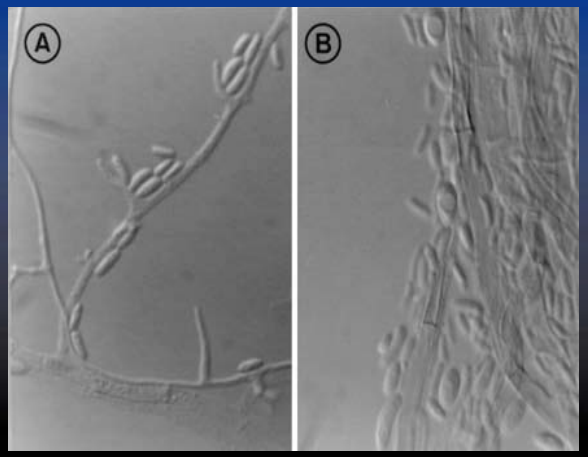
Event	Fistula Rate	Graft Rate	Cuffed Catheter Rate	Non-cuffed Catheter Rate	Port Rate
Hospitalization	8.7	12	18.6	26.6	17.7
IV Abx	2.3	3.2	9.4	9.3	12.6
+ Blood Culture	0.6	1.1	5.6	8.4	12.4
Access infection	0.6	1.6	7.6	10.1	13.7
Access related BSI	0.3	0.7	4.6	7.3	11.4
Outpatient Vanco Starts	1.2	1.9	6.4	6.7	10
Total Incidents	12,143	16,301	22,925	2,239	205

Rate=number of events/100 patient -months

Non-Cuffed Catheter

Contaminated Machines: Waste Handling Option

- **Several outbreaks since 1995 (U.S., Canada, and Israel)**
- ***Enterobacter cloacae, Pseudomonas aeruginosa, Escherichia coli, Candida parapsilosis***
- **Recent cluster in Chicago *Phialemonium curvatum* (two patients sequentially on the same machine became fungemic, WHO port was removed prior to the investigation); *Phialemonium* was isolated in the water feeding the machine**



Reuse Related Bacteremia/Fungemia

- **Organisms: *Burkholderia cepacia* complex, *Ralstonia pickettii, Ralstonia mannitolytica, Stenotrophomonas maltophilia, Candida parapsilosis***
- **Today most reuse related infections are associated with header removal "Header-sepsis"**
- **In the past, most were associated with wither poor water quality, or manual reuse**

Contamination of Multidose Medications

- *Serratia liquefaciens* infections associated with pooling of single-dose vials of EPO.
- Contamination of heparin lock solutions (*Pseudomonas fluorescens, Enterobacter cloacae, Klebsiella pneumoniae)*
- Transmission of HBV and HCV

Antimicrobial Resistance (An Emerging Problem)

MRSA = Methicillin-Resistant *S. aureus*

- Dialysis patients:
  - 0.1% of the U.S. population
  - 15% of all invasive MRSA infections
- Rate of invasive MRSA is 100x greater than in general population

CDC. MMWR 2007; 56(09):197-9

VISA AND VRSA in the United States, 2004

- As of July, 2004, there have been a total of 12 documented vancomycin-intermediate *S. aureus* (VISA) cases in the United States (changes to cell wall). Five of these were in patients who were treated with PD or hemodialysis.
- Since 2002, there have been 10 instances of patients infected with vancomycin-resistant *S. aureus* (6 due to genetic exchange with VRE).

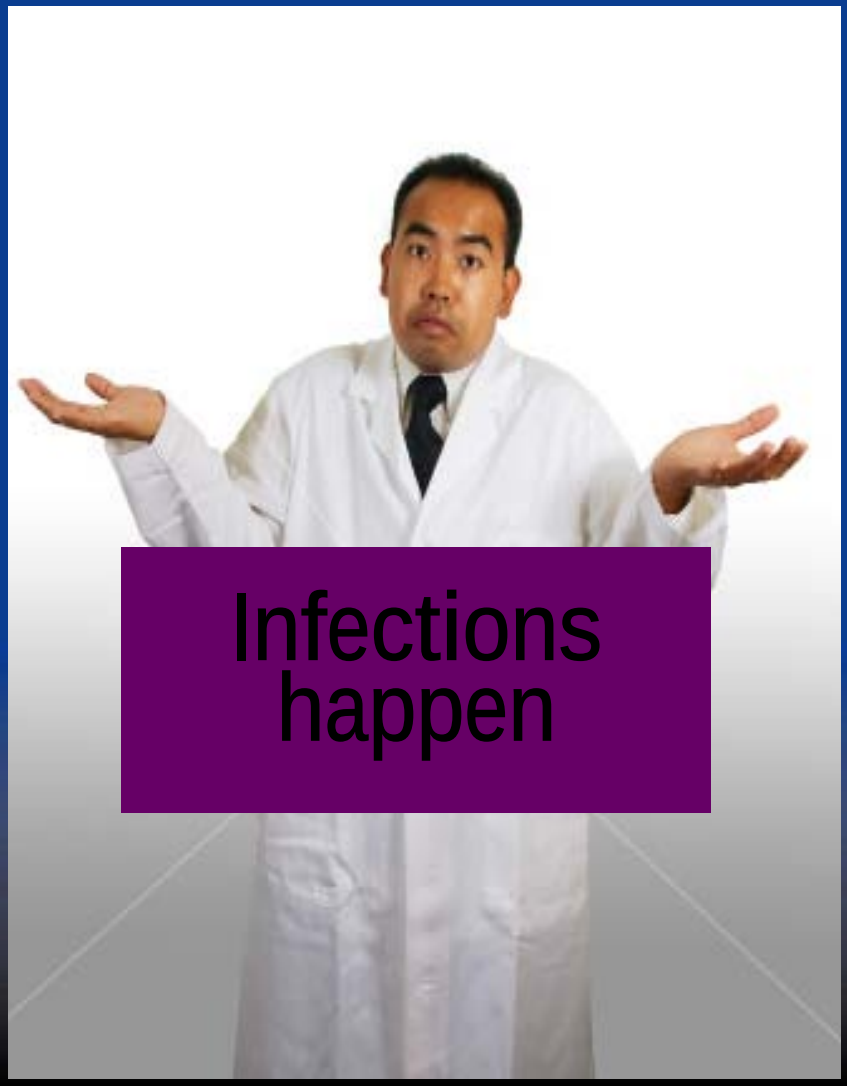
McDonald LC, Hageman JC. Vancomycin Intermediate and Resistant *Staphylococcus aureus:* What the nephrologist needs to know. *NNI* 2004; 18(11):63-4, 66-7, 71-2

Vancomycin Resistant *S. aureus* (VRSA) -- Case #1

- First case of *S. aureus* fully vancomycin resistant
- Michigan, June 2002
- 40 year old with diabetes mellitus, peripheral vascular disease, hemodialysis
- VRSA from foot ulcer and catheter exit site

MMWR July 5, 2002/51 (26) 565-566

But what can I do?

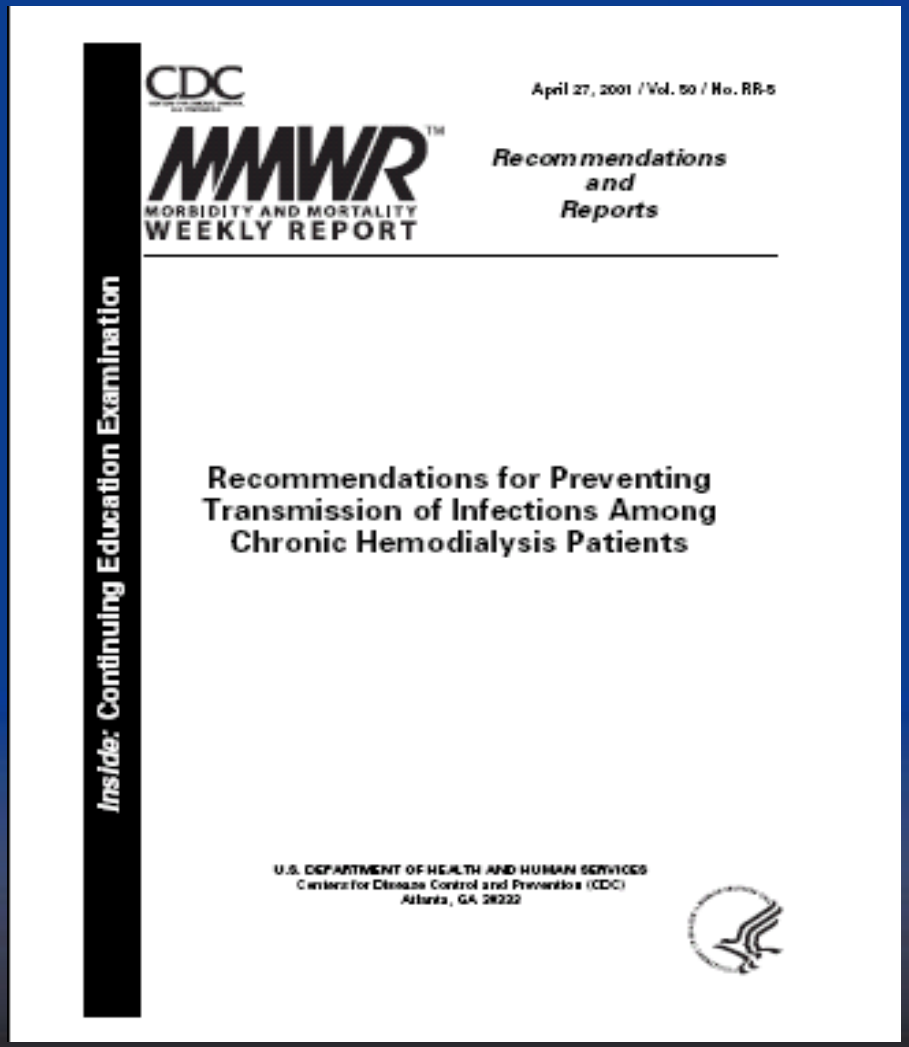


Comprehensive Infection Control Program For Dialysis Units

- **Infection control practices for hemodialysis units**
  - **infection control precautions specifically designed to prevent transmission of bloodborne viruses and pathogenic bacteria among patients;**
  - **hand hygiene and appropriate glove use**
  - **routine serologic testing for hepatitis B virus and hepatitis C virus infection;**
  - **vaccination of susceptible patients against hepatitis B;**
  - **isolation of hepatitis B surface antigen positive patients.**
- **Surveillance for infections and other adverse events.**
- **Infection control training and education.**

Published CDC Recommendations

- CDC. Recommendations for preventing transmission of infections among chronic hemodialysis patients. *MMWR* 2001; 50(RR05):1-43
- CDC, HICPAC. Guideline for hand hygiene in health-care settings. *MMWR* 2002; 51 (RR-16):1-56
- CDC, HICPAC. Guidelines for the prevention of intravascular catheter-related infections, 2002. *MMWR* 2002; 51(RR10);1-26



http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5005a1.htm
http://www.cdc.gov/hicpac/pubs.html

Infection Control Precautions for All Patients

- Wear disposable gloves when caring for the patient or touching the patient's equipment at the dialysis station; remove gloves and wash hands between each patient or station.
- Items taken into the dialysis station should either be disposed of, dedicated for use only on a single patient, or cleaned and disinfected before being taken to a common clean area or used on another patient.
  - Nondisposable items that cannot be cleaned and disinfected (e.g., adhesive tape, cloth-covered blood pressure cuffs) should be dedicated for use only on a single patient.
  - Unused medications (including multiple dose vials containing diluents) or supplies (e.g., syringes, alcohol swabs) taken to the patient's station should be used only for that patient and should not be returned to a common clean area or used on other patients.
- When multiple dose medication vials are used (including vials containing diluents), prepare individual patient doses in a clean (centralized) area away from dialysis stations and deliver separately to each patient. Do not carry multiple dose medication vials from station to station.
- Do not use common medication carts to deliver medications to patients. Do not carry medication vials, syringes, alcohol swabs, or supplies in pockets. If trays are used to deliver medications to individual patients, they must be cleaned between patients.

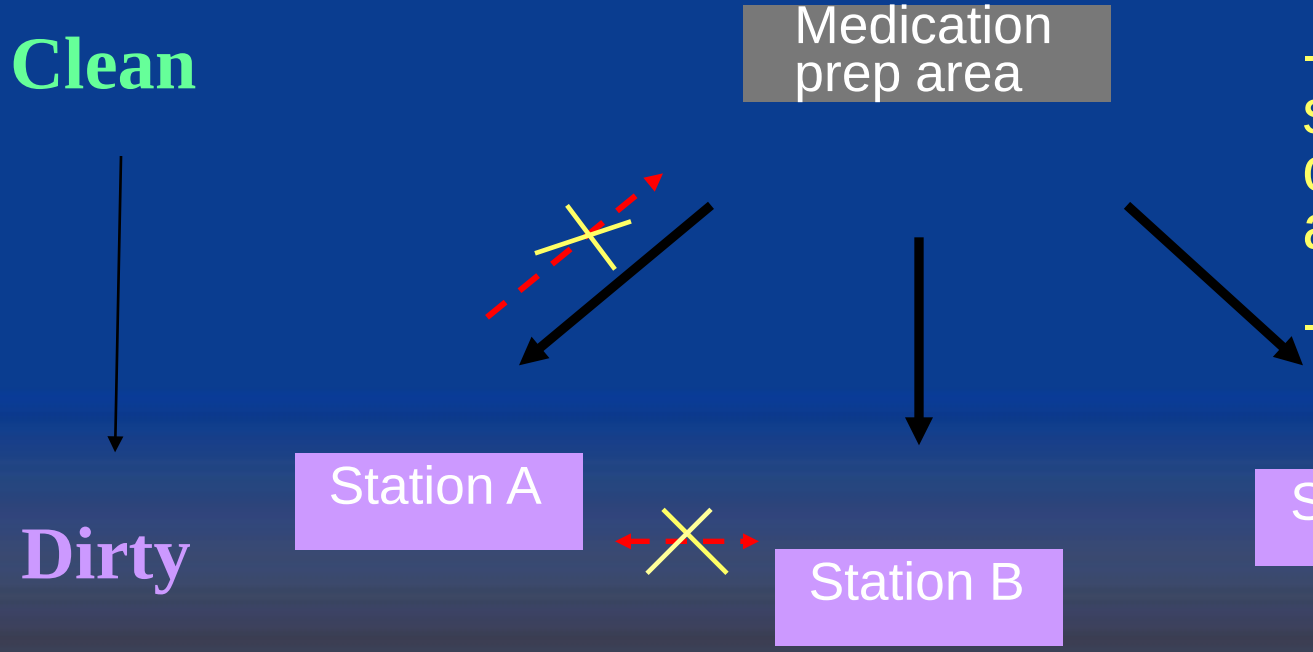
Schedule for Routine Testing for Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) Infections

Patient Status	On Admission	Monthly	Semiannual	Annual
All patients	HBsAg,* Anti-HBc* (total), Anti-HBs,* Anti-HCV, ALT†			
HBV-susceptible, including nonresponders to vaccine		HBsAg		
Anti-HBs positive (≥10 mIU/mL), anti-HBc negative				Anti-HBs
Anti-HBs and anti-HBc positive		No additional HBV testing needed		
Anti-HCV negative		ALT	Anti-HCV	

* Results of HBV testing should be known before the patient begins dialysis.
† HBsAg=hepatitis B surface antigen; Anti-HBc=antibody to hepatitis B core antigen; Anti-HBs=antibody to hepatitis B surface antigen; Anti-HCV=antibody to hepatitis C virus; ALT=alanine aminotransferase.

(Continued on page 21)

One-way Flow of Supplies



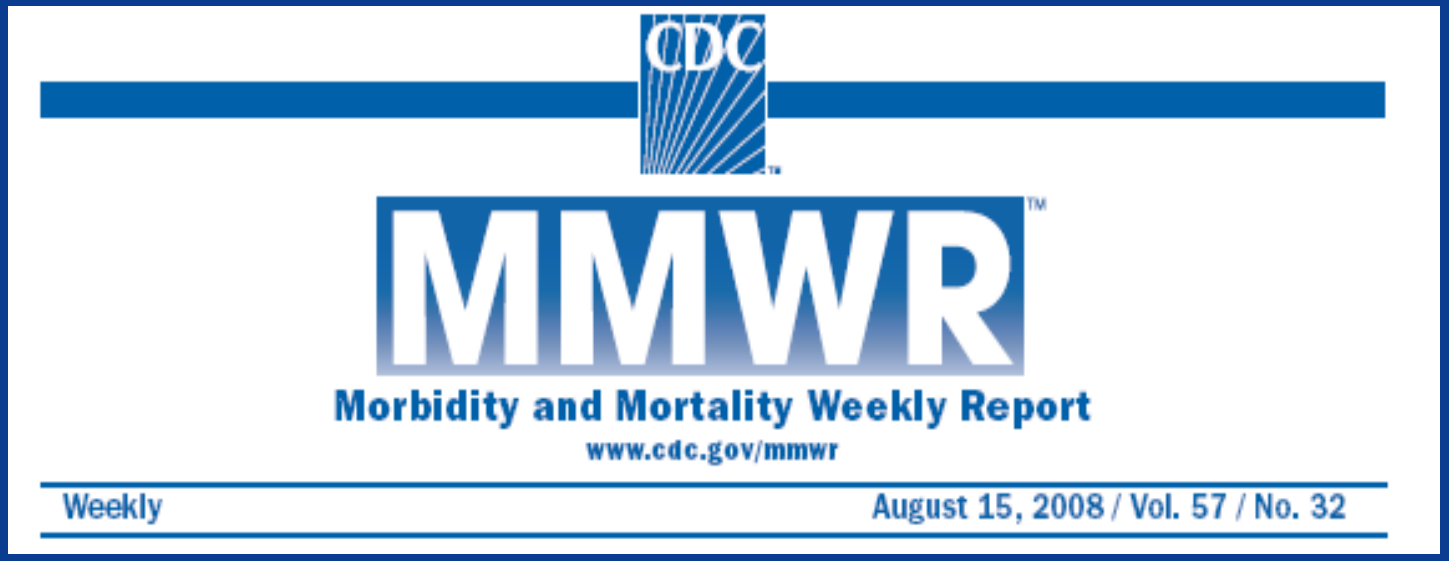
- No return of supplies
-No transfer of supplies from one station to another
- No mobile carts

Supplies

Items taken into a station:

- Dedicated for use on only a single patient at that station
- Disposed of
- Cleaned and disinfected before taken to a common area or used on another patient

Where is this Documented?



http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5732a3.htm

Medication Vials

Multidose vials

- Have preservative to prevent bacterial growth

preservative has no impact on HBV, HCV

Single dose vials

- No preservative

- Pooling of medications caused outbreak of *Serratia* bloodstream infections

Medication Options

- Medications in prepackaged, pre-filled syringes
- Single dose vial for single patient
- Multidose vial for single patient
- Multidose vial for > 1 patient

Infection Control Precautions for All Patients

- **For dialyzers and blood tubing that will be reprocessed, cap dialyzer ports and clamp tubing. Place all used dialyzers and tubing in leak-proof containers for transport from station to reprocessing or disposal area.**

Routine serologic testing for HBV and HCV

Patient Status	On-Admission	Monthly	Semi-Annually	Annually
All patients	HBsAg*, Anti-HBc (total) Anti-HBs, Anti-HCV, ALT			
HBV Susceptible including vaccine Nonresponders		HBsAg		
Anti-HBs positive (≥10 mIU/mL), Anti-HBc negative				Anti-HBs
Anti-HBs and anti-HBc positive		No additional HBV testing needed		
Anti-HCV negative		ALT	Anti-HCV	

* Results of HBsAg testing should be known before the patient begins dialysis.

HBV / HCV Testing

- HBV Testing
  - Required by CMS
  - Check total anti-HBc on admission
- HCV Testing
  - Not required or reimbursed by CMS
  - Only realistic way to identify transmission and rectify incorrect practices
  - Consider testing on admission, and annually (or with some regular frequency)

Must review and act upon results in a timely manner

Management of HBsAg-Positive Patients

- **Infection control practices for hemodialysis units for all patients.**
  - **Dialyze HBsAg-positive patients in a separate room using separate machines, equipment, instruments, and supplies.**
  - **Staff members caring for HBsAg-positive patients should not care for HBV susceptible patients at the same time (e.g., during the same shift or during patient change-over).**

Additional Precautions for Individuals Co-infected with HBV and HDV

- Patient needs to be isolated from ALL other dialysis patients
- Staff should not treat any other patients
- Screening for anti-HDV may be warranted

Why?

- Lack of patient-free period between shifts associated with HCV outbreaks
- KDIGO: “Unit should ensure that there is enough time between shifts for effective decontamination of the exterior of the machine and other shared surfaces”[1]
- Patient privacy concerns
- Patient should not be exposed to bleach or other disinfectant solution

[1]Kidney Disease: Improving Global Outcomes (KDIGO) Guideline 3: Preventing HCV transmission in hemodialysis units (2008)

Bringing This All Together

- Good Infection Control Can Make a Difference
  - Hand Hygiene
  - Environmental cleaning and disinfection
- Vascular Access Care
  - Fistula First, Catheter Removal
  - Vascular Access Site Care
  - Staff Training & Patient Education
  - Follow recommended practices, ensure policies reflect best practices
    - Chlorhexidine antisepsis
- Monitoring Infections /Active surveillance program

Protect patients,
Protect healthcare personnel,
Protect quality healthcare

Prevention Is Primary!


GERMS ARE GOD'S CREATURES TOO
GERMS HAVE RIGHTS
Hospital
GERMS HAVE RIGHTS