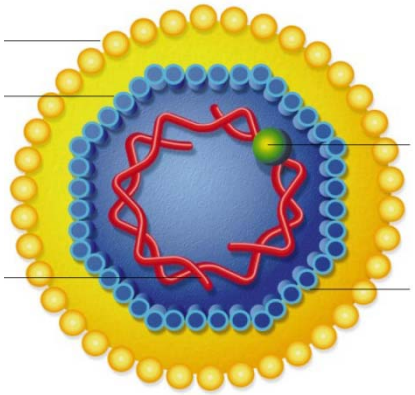
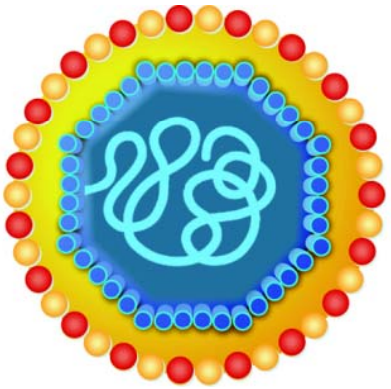
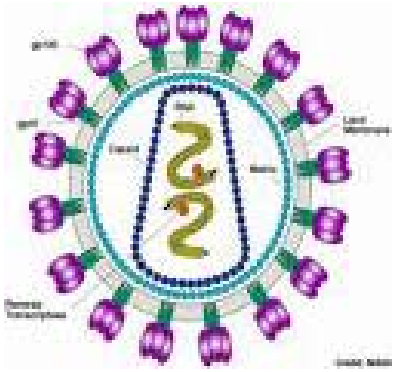
Screening for Bloodborne Pathogens in the Hemodialysis Unit

A Sarabia MD







Objectives

- To review the rationale for bloodborne pathogen screening
- To review relevant characteristics of bloodborne pathogen infections: virus, related infections, related sequelae
- To review the interpretation of hepatitis serologies

Rationale for Screening

- Proximity of patients undergoing procedures that require frequent vascular access and repeated opportunities for contamination of the environment
- Outbreaks of hepatitis reported in staff and patients shortly after introduction of hemodialysis in the 1960s
- Routine testing of dialysis patients for hepatitis B surface antigen and other precautionary measures began in 1970s
- Subsequent reduction in infections:

  eg UK 1976 – 1982

  patient prevalence 3% to 0.5%

  staff prevalence 2.6% to 0.5%

Health Canada 1997 “Preventing the Transmission of Bloodborne Pathogens in Health Care and Public Service Settings”

- Serologic surveillance of pts and staff for HBV infection, including monthly testing for all susceptible patients
- Isolation of patients in separate room
- Assignment of staff members to HBsAg positive and NOT HBV susceptible patients during same shift
- Assignment of dialysis equipment to HBsAg positive pts that is not shared by HBV-susceptible patients
- Glove use and changes between each patient
- Supply tray to each patient
- Routine cleaning and disinfection of equipment and environmental surfaces

Subsequent Recommendations

- CDC 2001 “Recommendations for Preventing Transmission Among Chronic Hemodialysis Patients”

More recently…

- June 2004 Health Canada notification of all hospitals and HD units regarding blood contamination of internal components of dialysis machines prompted inspections of machines with noted incidents of contamination of internal components with blood or saline
- The Canadian Society of Nephrology 2005 Recommendations from the Ad Hoc Committee on “The Prevention of Transmission of Bloodborne Pathogens in Hemodialysis Patients”

Annals of Internal Medicine | Re

Nonhospital Health Care–Associated Hepatitis B and C Virus Transmission: United States, 1998–2008

Nicola D. Thompson, PhD, MS; Joseph F. Perz, DrPH, MA; Anne C. Moorman, BSN, MPH; and Scott D. Holmberg, MD, MPH

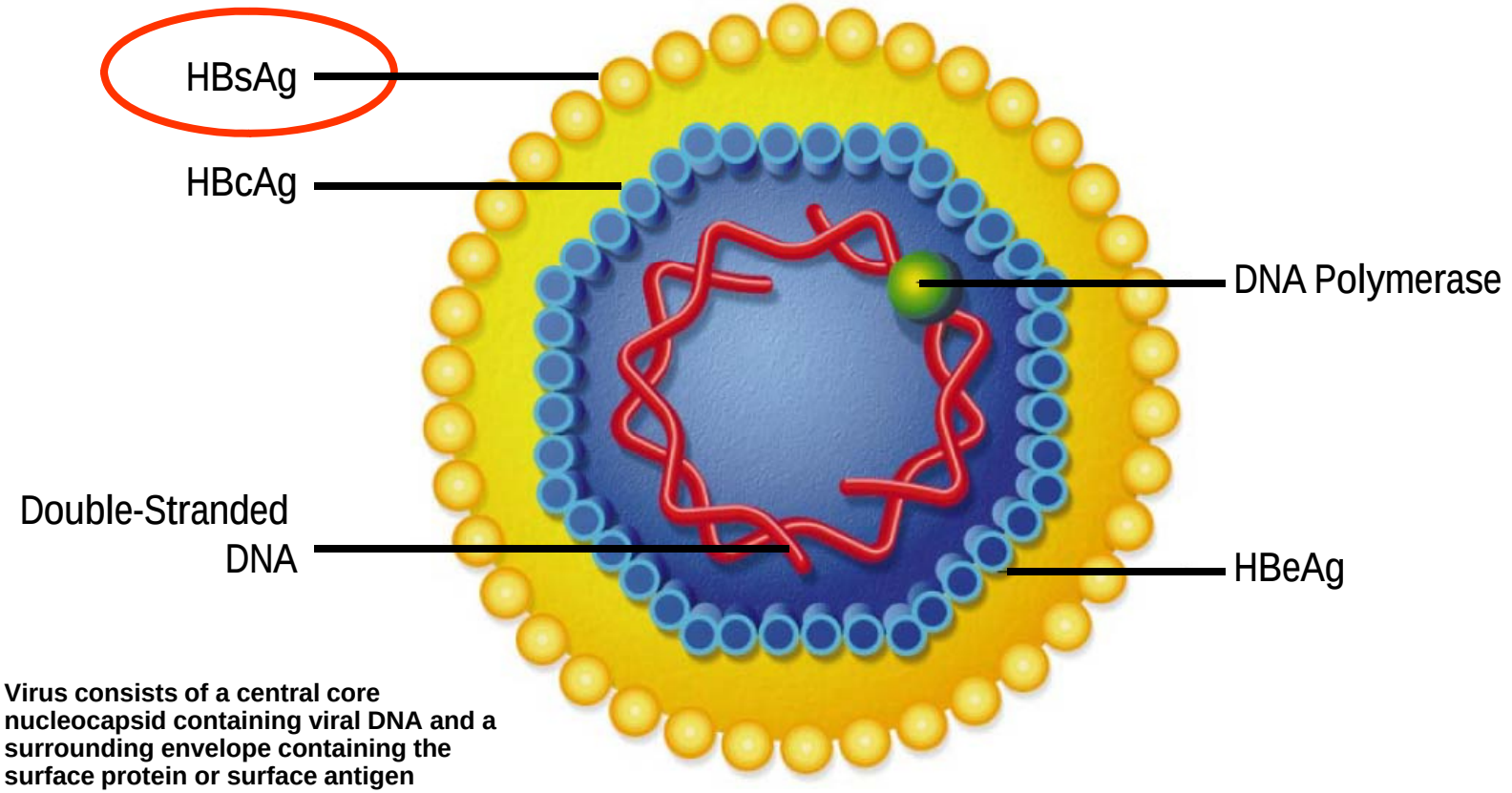
- Review of all reported outbreaks of HBV and HCV outbreaks between 1998 and 2008 in nonhealthcare facilities
- 33 outbreaks identified: 18 outbreaks results in 173 persons with incident HBV infections and 16 outbreaks resulting in 275 persons with incident HCV infection
- 6 hemodialysis centers accounted for 40 incident HCV infections; 500 patients receiving dialysis were potentially exposed ad screened for infection

Documented Outbreak of HBV or HCV Transmission in Nonhospital Hemodialysis Centres, US, 1998-2008

Pathogen	Persons Potentially at Risk, n	Persons with incident infection,n	Lapse considered responsible for transmission
HCV	51	7	Preparation of injections in a contaminated environment; failure to clean environmental surfaces between patients
HCV	95	5	Preparation of injections in a contaminated environment; failure to clean environmental surfaces between patients; use of mobile cart to transport clean and used supplies among multiple patients
HCV	24	3	Use of mobile cart to transport clean and used supplies among multiple patients
HCV	75	11	Preparation of injections in a contaminated environment; failure to separate clean and contaminated areas; failure to perform hand hygiene after handling contaminated dialysis equipment
HCV	183	7	Use of mobile cart to deliver injectable medications to multiple patients; reuse of single-dose epoetin alfa vials on multiple patients; failure to clean dialysis equipment between patients
HCV	64	7	Use of mobile cart to deliver injectable medications to multiple patients; reuse of single-dose epoetin alfa vials on multiple patients; failure to clean dialysis equipment between patients

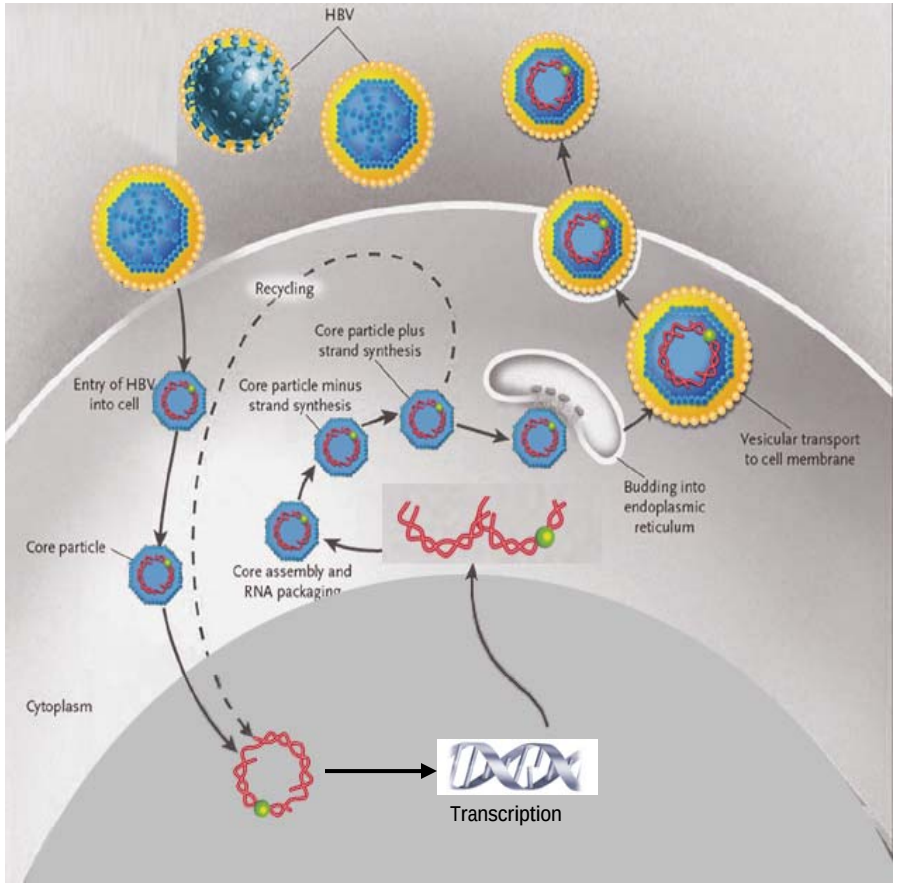
Hepatitis B Virus

Dane Particle and genome



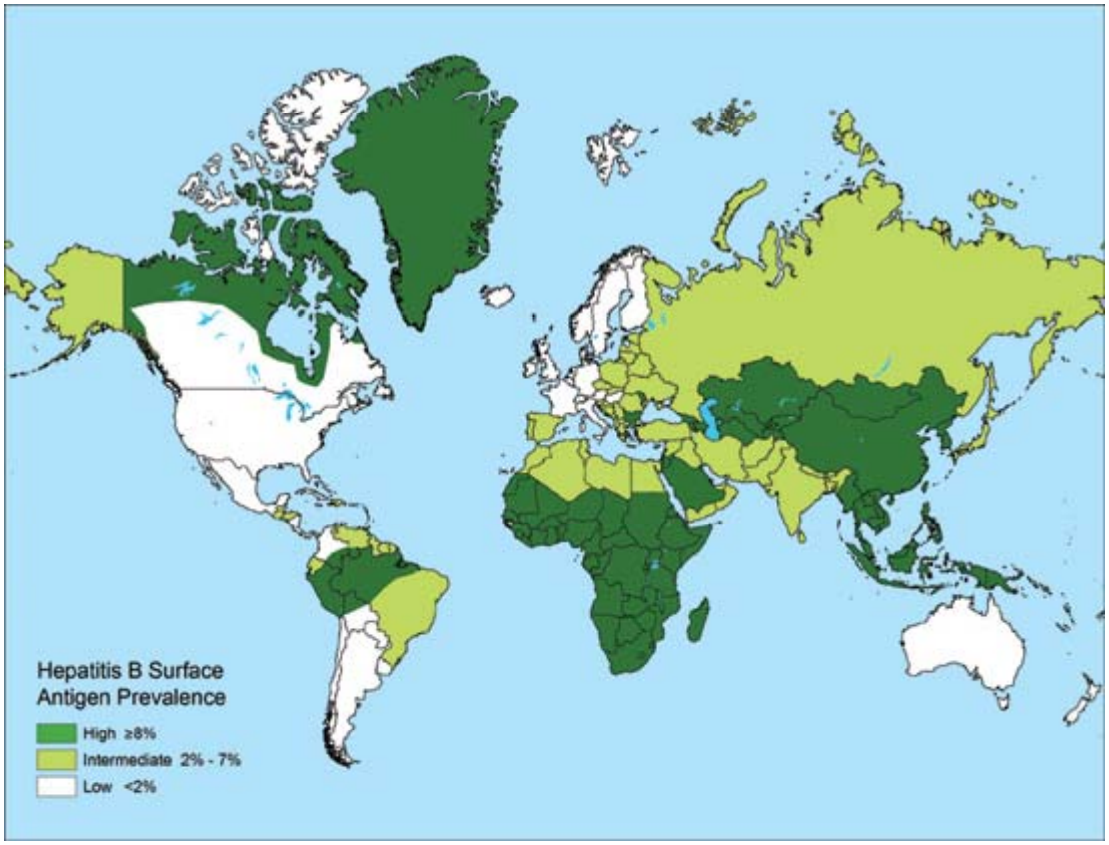
- **Virus consists of a central core nucleocapsid containing viral DNA and a surrounding envelope containing the surface protein or surface antigen**

Hepatitis B Virus
Mutations



- Hepatitis B Virus has a unique life cycle that results in the production of enormous viral loads during its active DNA replication
- Because HBV uses reverse transcription (without proofreading capacity) to copy its DNA genome, mutant viral genomes emerge frequently.
- Wide variety of genome variants exist in patients – in addition, HBsAg "escape" mutant are found despite the concurrent existence of anti-HBs.

Worldwide Distribution Hepatitis B Infections



Hepatitis B Virus
Clinical Course

- Incubation period averages 60 – 90 days
- clinical illness in 30 – 50 % of all individuals age five and older, but less than 10 % of those aged under five years
- 90 % of children less than five years of age and < 5% of the population over five years of age will progress to chronic infection
- Symptoms include anorexia, fatigue, nausea, vomiting, abdominal pains, muscle or joint aches, mild fever, dark urine, skin rashes, and jaundice
- Among all age groups, 15 – 25 percent of those who become chronically infected with HBV die prematurely as a result of chronic liver disease or liver cancer; potential extrahepatic complications of chronic HBV infection include polyarteritis nodosa and glomerulonephritis
- Death rate for dialysis patients with cirrhosis is 35% higher than those without it

HBV Transmission Risks

- Can exist in significant quantities in serum or blood of chronically infected patients
- can exist in contaminated environment in significant amounts for up to 7d at room temperature
- Has been detected in dialysis centers on clamps, scissors, machine control knobs, and doorknobs
- HCW can transfer virus to pts from contaminated surfaces by hands or gloves or through use of contaminated equipment and supplies

Hepatitis B:
Transmission Risks:

HBeAg status of source person

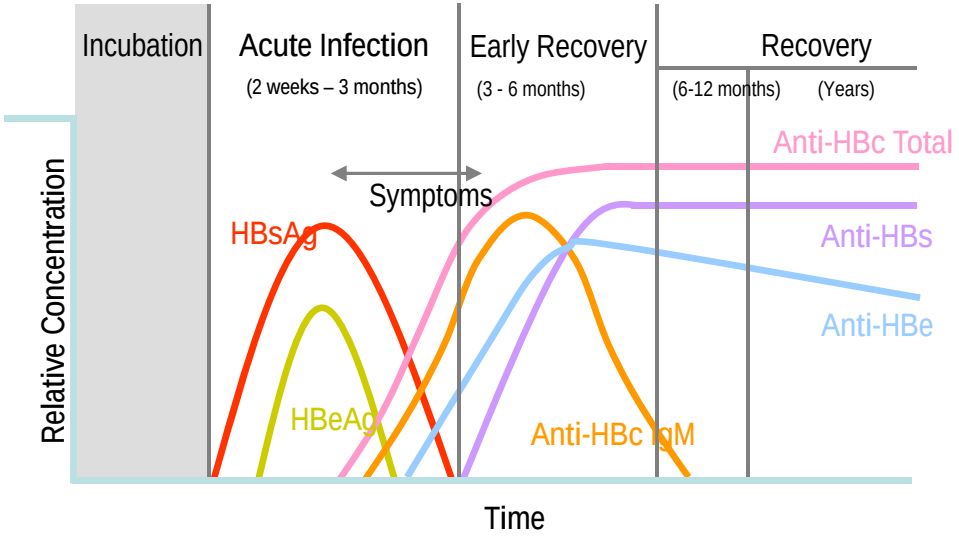
- risk of serologic conversion post needlestick 37 – 62% if source is eAg positive vs risk of 1-6% if source is eAg negative
- Frequency of eAg positive HD patients about 15 – 30%

Degree of contact with blood

- one third of infected HCP recall caring for HBsAg pt although most do not recall percutaneous injury; likely transmission from contaminated surfaces into nonintact skin

Hepatitis B Virus Markers, Acute Infections

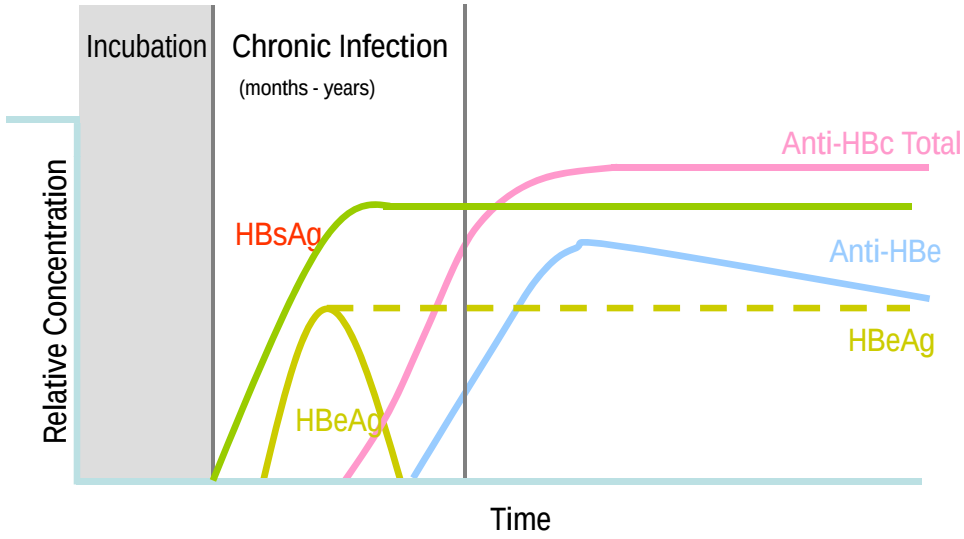
Acute HBV Infection with recovery, typical serologic course



HBsAg is the first screen marker for HBV Infection

Hepatitis B Virus Markers, Chronic Infections

Progression to Chronic HBV Infection
typical serologic course



Anti-HBs

- In persons who recover from HBV infection, sAg clears in 2 – 3 months, and anti-HBs develops
- Natural infection: anti-HBc also present
- Vaccination: anti-HBc not present
- Small proportion of pts eventually clear sAg and develop anti-HBs

More on Anti-HBc

- In some persons, the only marker detected is anti-HBc
  - 2% asymptomatic persons in U.S. tested for HBV were positive for isolated anti-HBc
  - 24% of IVDU
- Can occur due to:
  - False positive
  - After recovery from HBV when anti-HBs has waned (will respond to HBsAg vaccine with anamnestic response)
  - During persistent or chronic infection when antiHBs fails to develop; (will not respond to HBsAg vaccine); HBV DNA detected in <10% of persons with isolated anti-HBc, unlikely to be infectious to others exc under unusual circumstances ie blood transfusion; no outbreaks in HD reported
  - Surface mutants (instrument does not “pickup” sAg from mutated virus)

  Primary anti-HBs response develops in most of these persons after a three-dose series of Hep B vaccine; no data in HD patients

- Reinfection or reactivation of latent HBV has been reported among immunosuppressed patients
- These patients are positive for antiHBc, with or without anti-HBs, and subsequently developed HBsAg

Isolated Anti-HBc (neg anti-HBs and neg HBsAg)

- Test core IgM
  - If positive, consider recent infection
  - If negative,
    - follow recommendations for vaccination

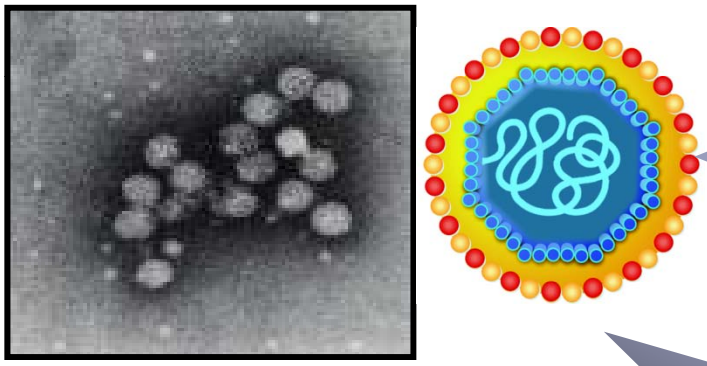
    Then:
    - If anti-HBs is <10 IU/ml, test for HBV DNA
      - If positive, no further testing – consider pt “low level” chronic infection or surface mutant
      - If negative, consider patient susceptible (ie anti-HBc false positive), and test monthly for HBsAg
- Isolation not necessary when HBsAg not detectable

TABLE 1. Interpretation of serologic test results for hepatitis B virus infection

Serologic Markers				Interpretation
HBsAg*	Total Anti-HBc†	IgM§ Anti-HBc	Anti-HBs¶	
–	–	–	–	Susceptible, never infected
+	–	–	–	Acute infection, early incubation**
+	+	+	–	Acute infection
–	+	+	–	Acute resolving infection
–	+	–	+	Past infection, recovered and immune
+	+	–	–	Chronic infection
–	+	–	–	False positive (i.e., susceptible), past infection, or "low-level" chronic infection
–	–	–	+	Immune if titer is ≥10 mIU/mL

* Hepatitis B surface antigen.
† Antibody to hepatitis B core antigen.
§ Immunoglobulin M.
¶ Antibody to hepatitis B surface antigen.
** Transient HBsAg positivity (lasting ≤18 days) might be detected in some patients during vaccination.

Hepatitis C Virus



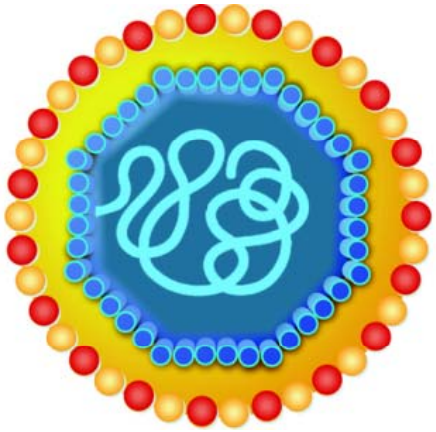
- Virus identified in 1989
- RNA virus from the Flaviviridae family

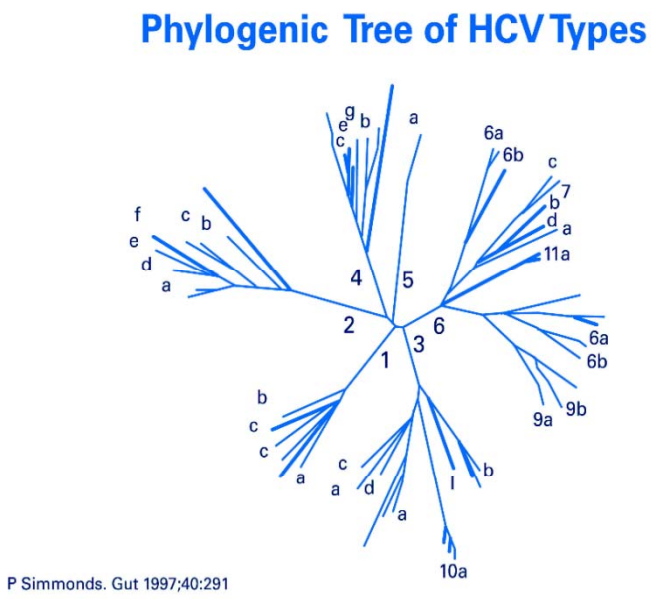
- Major global health issue (WHO)
- 227 MM people infected WW
- 150 MM are chronic HCV carriers

- Incubation period range 2 –26 weeks
- Develop chronic infection 60-85%
- Strong association with end stage liver disease and HCC (1-5%)

Single, positive-stranded RNA virus of approximately 10,000 nucleotides
Small (less than 50 nanometers in diameter); lipid-enveloped virus

Hepatitis C Virus Genomic Diversity

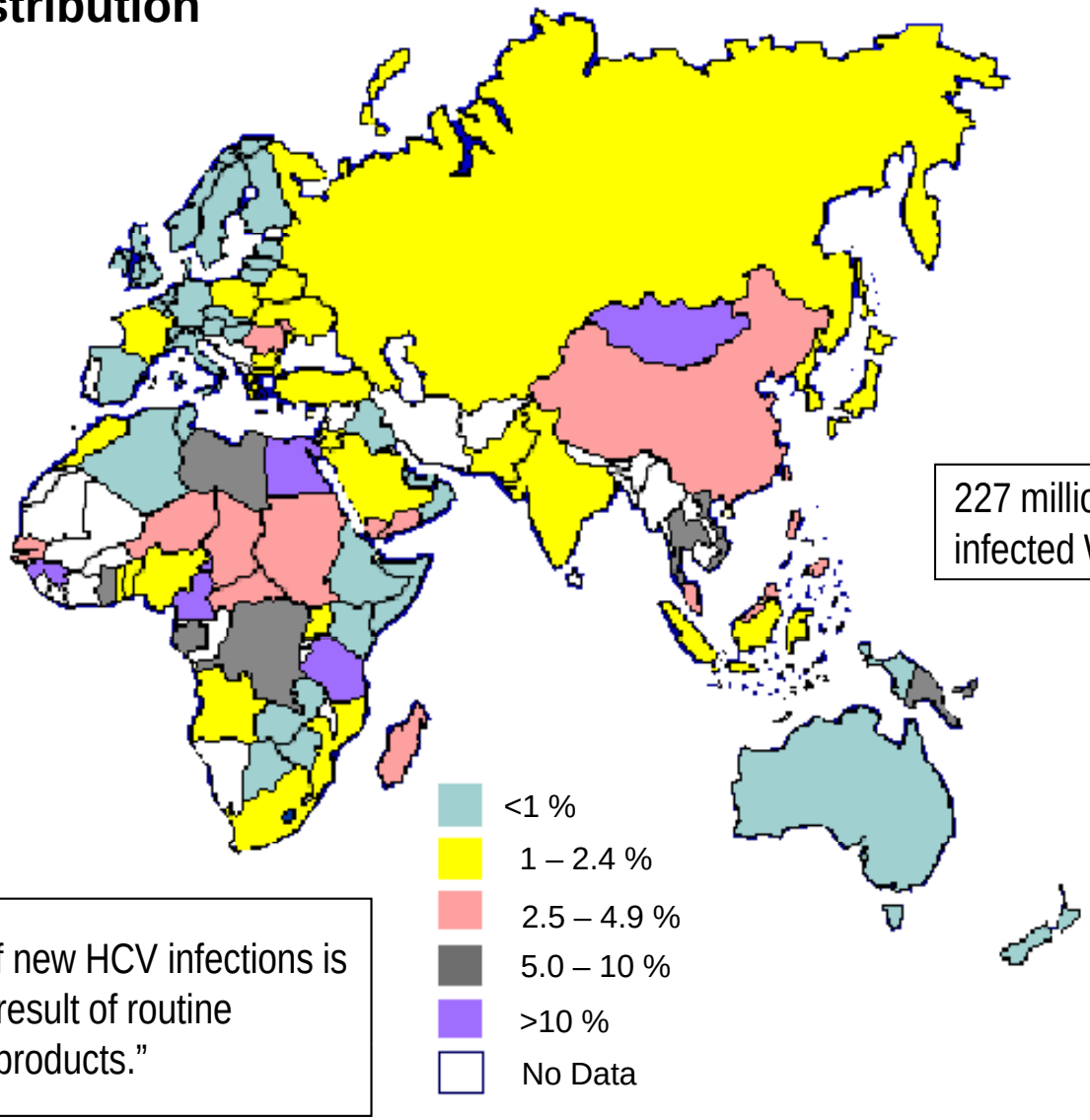




- HCV is a highly genetically diverse virus
- spontaneous mutations
- 6 major genotypes and more than 50 subtypes

Hepatitis C Virus

Geographical Distribution



227 million people infected WW

"Actual incidence of new HCV infections is now declining as a result of routine screening of blood products."

Hepatitis C Virus

Routes of Transmission

Percutaneous

- Contaminated needlestick (injecting drug use and occupational exposure)
- Hemodialysis
- Transplant or transfusion of unscreened blood or blood products
- Acupuncture, tattooing, and body-piercing with unsterilized needles

Permucosal

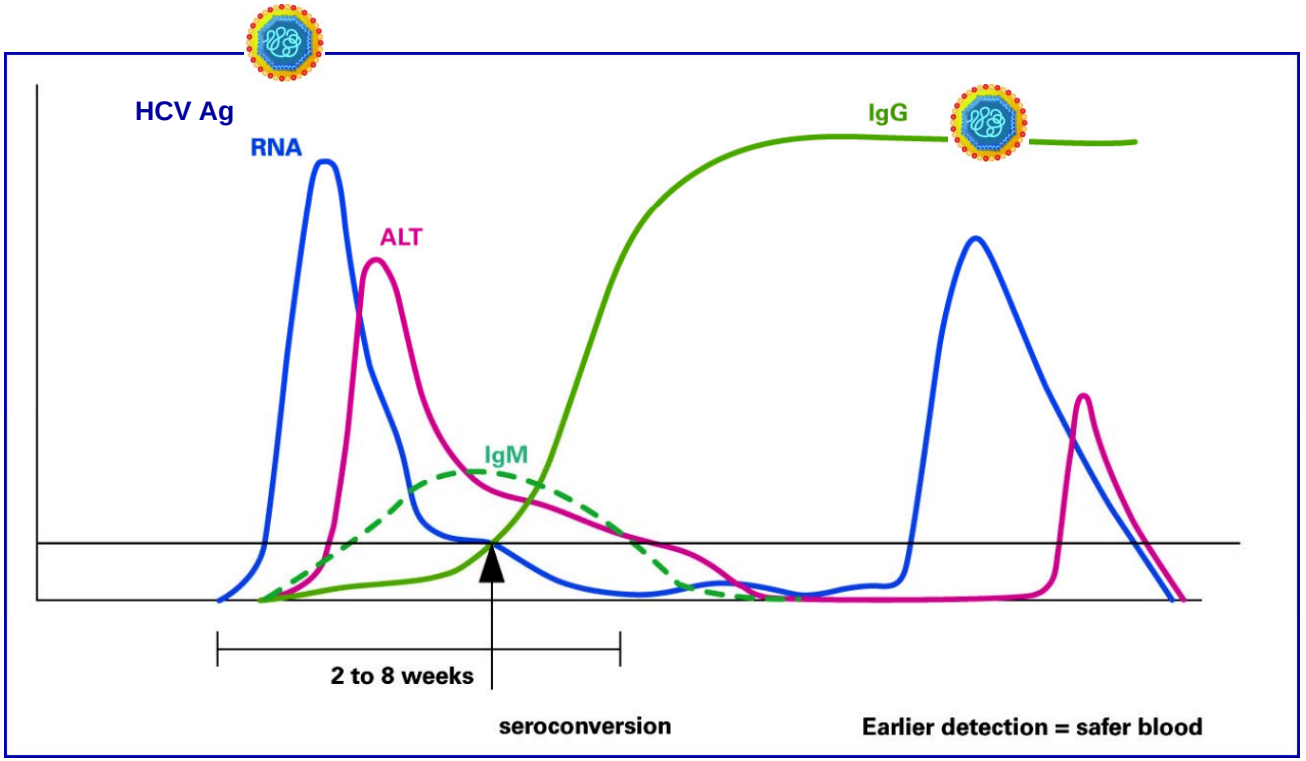
- Sexual intercourse
- Perinatal – infant born to HCV infected mother
- Contact with infected household objects

HCV
Natural History

- 25% of Immunocompetent persons will resolve their infection without sequelae
- 75% will develop chronic infection
- 10 – 20% will develop cirrhosis and 5% will develop carcinoma if infection >30 yrs
- Dialysis pts are less likely to have biochemical evidence of active disease

Hepatitis C Virus

Serologic Markers

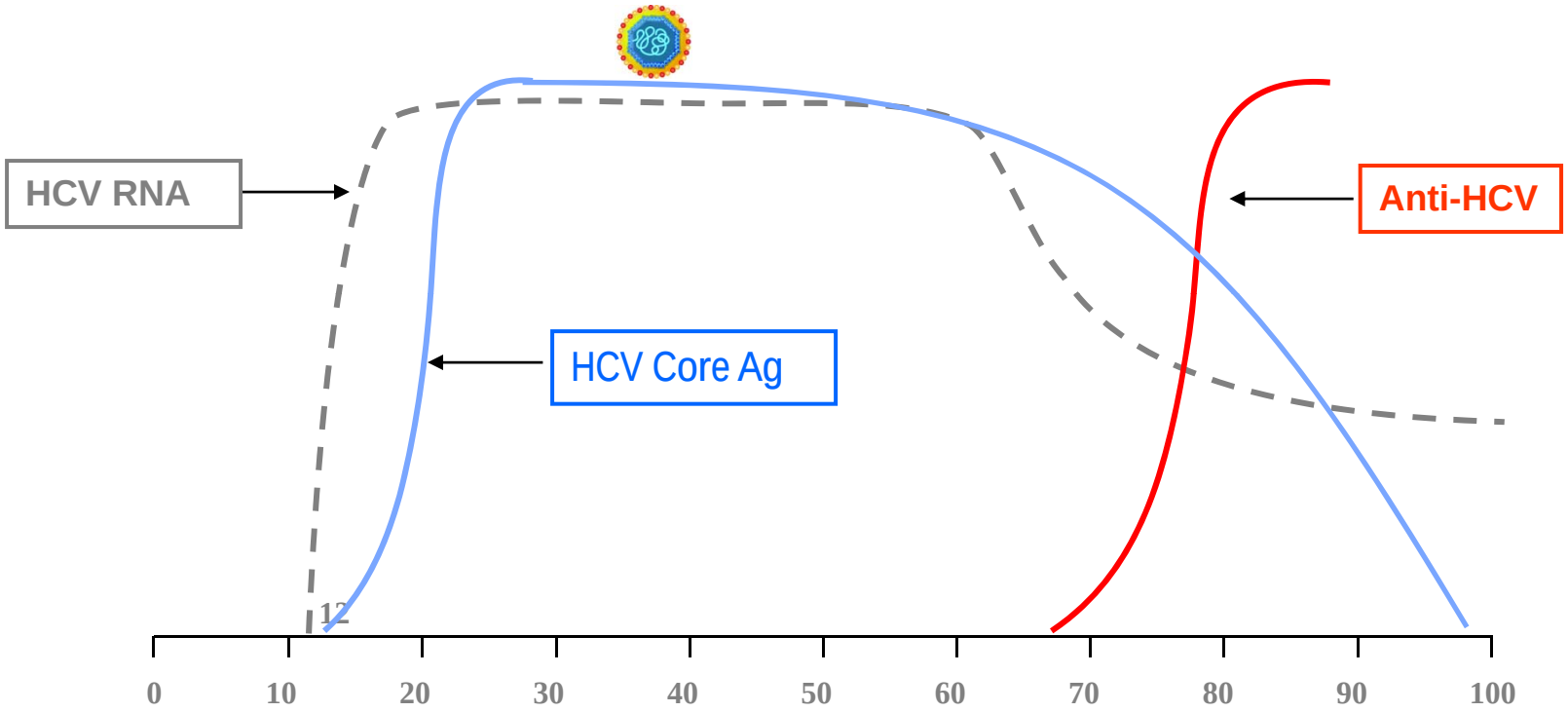


Acute HCV Infection → Chronic Infection

60 - 85 %

Hepatitis C Virus

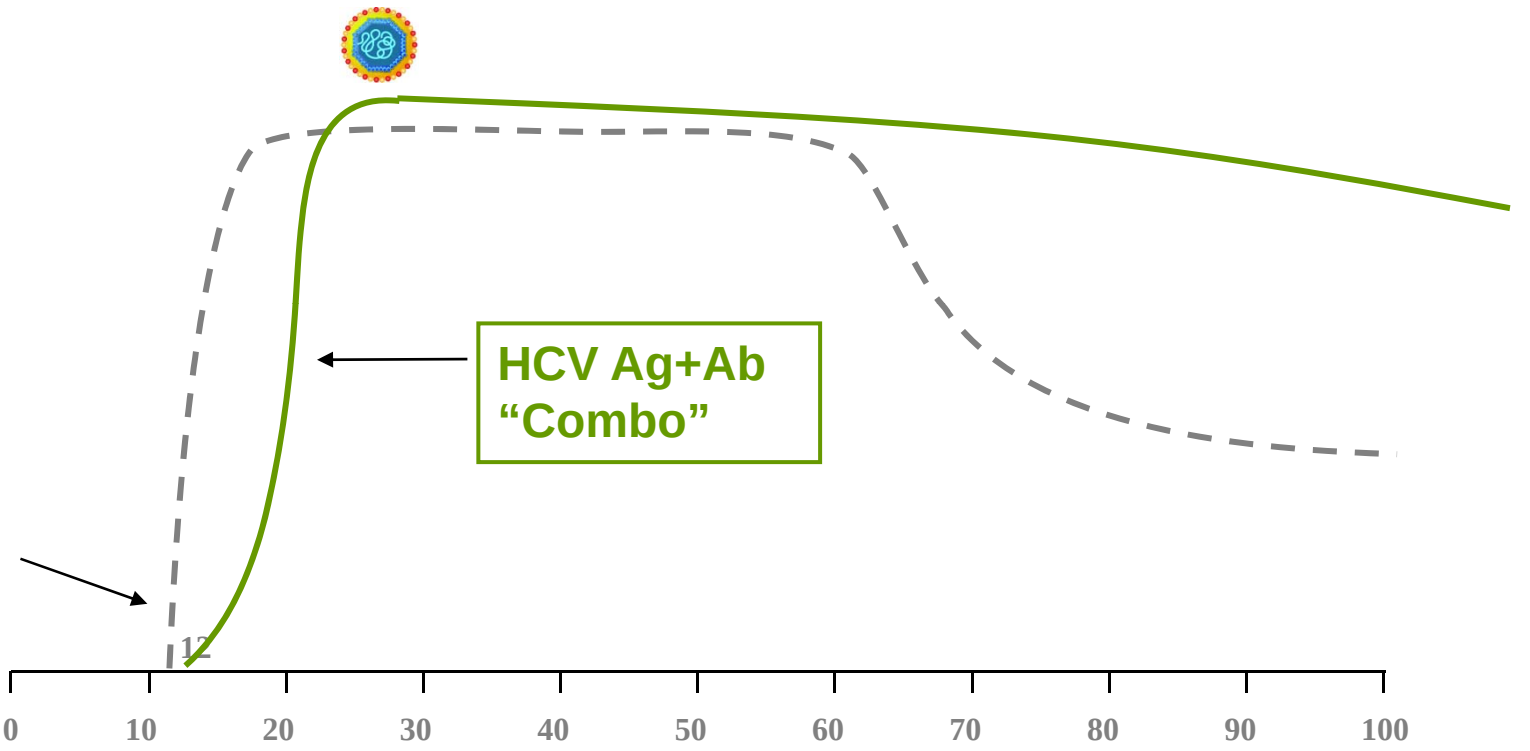
New HCV Marker: Core Antigen



Infection	Day 0
HCV RNA	Day 12
HCV Core antigen	Day 12-15
HCV Antibody	Day 70

Hepatitis C Virus

Simultaneous detection of HCV antibodies and core antigen



Infection	Day 0
HCV RNA	Day 12
HCV Core antigen	Day 12-15
HCV Antibody	Day 70

Screening

- Only available test for screening is anti-HCV
- Does not distinguish between resolved, acute or chronic infection
- Average time to seroconversion is 8 – 9 weeks; 90% within 5 months, 97% within 6 months
- HCV RNA testing available

HIV

- Same “standard practices” recommended for HIV patients
- CSN advises that routine testing for HIV is not necessary

Visit	**Comments**
Baseline	HIV HBsAg, antiHBc, antiHBs HCV
Monthly	ALT
Semiannual	HCV (if HCV neg) HBsAg (if HBV susc)
Annual	HBV immune: AntiHBs, HCV HBV susceptible: AntiHBs, antiHBc, HBsAg HCV HBV infected: HCV