Hepatitis
## Conditions that Cause Hepatitis in Humans

### Hepatitis Viruses
- Hepatitis A virus
- Hepatitis B virus
- Hepatitis C virus
- Hepatitis D virus
- Hepatitis E virus

### Nonviral Infectious Agents
- Pneumococcal pneumonia
- Leptospirosis
- Syphilis
- Coxiella burnetti
- Toxoplasmosis

### Other Viruses
- Epstein-Barr virus
- Human immunodeficiency virus
- Lassa fever virus
- Yellow fever virus
- Adenovirus
- Herpes simplex virus
- Human herpes-6 virus
- Ebola virus

### Noninfections
- Alcohol
- Medications
- Dilantin
- Isoniazid
- Ritonavir
- Chlorpromazine
- Rifampin, etc.
- Anesthesia (halothane)

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Primary causes of chronic liver disease

Note: Based on data for Jefferson County, Alabama.
Source: CDC/NCID.
Hepatitis (Liver-Attacking) Viruses

**Hepatitis A** – fecal/oral, contaminated food, vaccine available

**Hepatitis B** – blood, semen, vertical (mother-child), vaccine available

**Hepatitis C** – blood (IV drug use, transfusion, organ donation, unsterile injecting equipment, sexual intercourse)

**Hepatitis D** – survives only in cells co-infected with hepatitis B

**Hepatitis E*** – contaminated food or water, fecal/oral

*causes short-term disease and is not a chronic carrier state
<table>
<thead>
<tr>
<th>Virus</th>
<th>Nucleic Acid</th>
<th>Routes of Transmission</th>
<th>Mortality</th>
<th>Risk of Chronic Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAV</td>
<td>Unenveloped single-stranded RNA</td>
<td>Fecal-oral</td>
<td>Low</td>
<td>None</td>
</tr>
<tr>
<td>HBV</td>
<td>Enveloped double-stranded DNA</td>
<td>Parenteral (sex, perinatal)</td>
<td>Moderate-high</td>
<td>High</td>
</tr>
<tr>
<td>HCV</td>
<td>Enveloped single-stranded RNA</td>
<td>Parenteral (sex, perinatal)</td>
<td>Moderate-high</td>
<td>High</td>
</tr>
<tr>
<td>HDV</td>
<td>Enveloped single-stranded RNA</td>
<td>Parenteral (sex)</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>HEV</td>
<td>Unenveloped single-stranded RNA</td>
<td>Fecal-oral</td>
<td>Low-moderate</td>
<td>None</td>
</tr>
</tbody>
</table>

Viral Hepatitis

• When they occur, the signs and symptoms of viral hepatitis can include:
  – Fever
  – Fatigue
  – Loss of appetite
  – Nausea
  – Vomiting
  – Abdominal pain
  – Jaundice
  – Dark urine
  – Clay-colored stool
  – Joint pain
Viral Hepatitis

Course of Symptoms in Typical Acute Viral Hepatitis

- Exposure
- Incubation Period
- Pre-icteric
- Icteric
- Convalescent Period

- Fever, Rash, Arthritis (15%)
- Jaundice
- Dark Urine
- Malaise (95%)
- Anorexia (90%)
- Nausea (80%)
- RUQ Pain (60%)
- Itching (10%)

Acute Disease
Viral Hepatitis

- Viral hepatitis is the leading cause of liver cancer and the most common reason for liver transplantation

- In the United States, an estimated 1.2 million Americans are living with chronic Hepatitis B and 3.2 are living with chronic Hepatitis C
  - Many do not know they are infected

- Each year an estimated 21,000 persons become infected with Hepatitis A; 35,000 with Hepatitis B, and 17,000 with Hepatitis C
Hepatitis A

Hepatitis A Virus - Picornavirus

Capsid
VPG

ss RNA (2.5 x 10^0 daltons)

Viral Polypeptides

VP1
VP2
VP3
VP4
Hepatitis A
Epidemiology

Hepatitis A. Incidence,* by county --- United States, 2009

* Per 100,000 population.
Hepatitis A Epidemiology

Prevalence of antibody to hepatitis A virus, 2010

Source: CDC YellowBook
Hepatitis A

- Hepatitis A has an incubation period of approximately 28 days (range: 15–50 days)
- HAV replicates in the liver and is shed in high concentrations in feces from 2 weeks before to 1 week after the onset of clinical illness
- HAV infection produces a self-limited disease that does not result in chronic infection or chronic liver disease
- Humans are the only natural host
Hepatitis A Features

Incubation period: 28-30 days

Symptoms: None (especially children <5 years old)
   Fever
   Malaise
   Anorexia
   Nausea
   Jaundice
   Fulminant $\rightarrow$ death (acute)
   Likelihood of clinical disease increases with age

Duration: 25-30 days
Hepatitis A

Acute Illness

• In children aged <6 years, 70% of infections are asymptomatic; if illness does occur, it is typically not accompanied by jaundice.

• Among older children and adults, infection is typically symptomatic, with jaundice occurring in >70% of patients.

• Symptoms usually last less than 2 months, although 10%–15% of symptomatic persons have prolonged or relapsing disease for up to 6 months.
Diagnosis, Treatment & Reservoir of Hepatitis A

**Diagnosis:** Anti-IgM detectable 5-10 days before symptoms; disappears by six months
Anti-IgG – convalescent, life-long, confers protection

**Treatment:** Supportive
Hepatitis A Diagnosis

Hepatitis A Virus Infection; Typical Serologic Course

- Titer
- Months After Exposure
- Symptoms
- Fecal HAV
- ALT
- Total Anti-HAV
- IgM Anti-HAV

Adapted by CTLT from CDC.
Hepatitis A—United States, 1990-2000
Risk Factors

- Unknown: 45%
- Sexual/household: 14%
- Int'l travel: 5%
- MSM: 10%
- IDU: 6%
- Child care: 2%
- Outbreak: 4%
- CC contact: 6%
- Other: 8%
Transmission & Risk Groups for Hepatitis A

**Transmission**: fecal-oral, contaminated food, water, sexual

**Risk groups**: international travellers, MSM, child care-givers, persons with chronic liver disease, injection drug users

**Period of communicability**: 1-2 weeks before symptoms, to one week after onset of jaundice

**Endemic areas**: Central & South America, Middle East, Asia, and western Pacific

**Reservoir**: Humans
Hepatitis A Incidence By Age Group, 1990-2004
Hepatitis A Epidemiology


- 1995 vaccine licensure
- 1996 ACIP recommendations
- 1999 ACIP recommendations
- 2006 ACIP recommendations

Source: National Notifiable Diseases Surveillance System (NNDSS)
Hepatitis A Vaccines

- Inactivated whole virus vaccines
- Pediatric and adult formulations
  - pediatric formulations approved for persons 12 months through 18 years
  - adult formulations approved for persons 19 years and older
Hepatitis A Vaccine Immunogenicity

- Adults
  - >95% seropositive after one dose
  - 100% seropositive after two doses

- Children (>12 months) and Adolescents
  - >97% seropositive after one
  - 100% seropositive after 2 doses
ACIP Recommendation for Routine Hepatitis A Vaccination of Children

- All children should receive hepatitis A vaccine at 12-23 months of age
- Vaccination should be integrated into the routine childhood vaccination schedule
- Children who are not vaccinated by 2 years of age can be vaccinated at subsequent visits
Hepatitis A Vaccine Recommendations

- International travelers
- Close contact with an international adoptee from a country of high or intermediate endemicity
- Men who have sex with men
- Persons who use illegal drugs
- Persons who have a clotting factor disorder
- Persons with occupational risk
- Persons with chronic liver disease
Hepatitis A Postexposure Prophylaxis

- For healthy persons 12 months through 40 years of age:
  - single-antigen hepatitis A vaccine should be administered as soon as possible after exposure

- For persons older than 40 years:
  - immune globulin is preferred
  - vaccine can be used if IG cannot be obtained

*MMWR 2007;56(No.41):1080-4*
Hepatitis A Prevention

• Hepatitis A vaccine is the best protection.
• Good sanitation measures are essential for preventing environmental contamination.
• Good personal hygiene is also essential for prevention and control including:
  – Hand washing with soap:
    • After using the bathroom
    • After changing a diaper
    • Before preparing and eating food
Hepatitis B

• Hepatitis B is caused by infection with the Hepatitis B virus (HBV), the prototype member of the hepadnavirus family
  – HBV is the only human representative of this family.
  – It has a circular DNA genome of 3.2 kb
• Currently, eight genotypes (A–H) are identified by a divergence of >8% in the entire genome
Hepatitis B Characteristics

- A Hepadnaviridae – partially double-stranded DNA virus
- HBsAg – stimulates protective antibodies, a marker for current infection
- HBcAg – localized within liver cells, identifies acute infection, anti-HBcAg persists for life and is a marker of past infection
- HBeAG – a marker of active replication and infectivity
Hepatitis B
Hepatitis B Virus

- Hepadnaviridae family (DNA)
- Numerous antigenic components
- Humans are only known host
- May retain infectivity for more than 7 days at room temperature
Hepatitis B Virus Infection

- More than 350 million chronically infected worldwide
- Established cause of chronic hepatitis and cirrhosis
- Human carcinogen—cause of up to 80% of hepatocellular carcinomas
- More than 600,000 deaths worldwide in 2002
Hepatitis B

Geographic Distribution of Hepatitis B Virus Genotypes

Hepatitis B
Epidemiology

• Worldwide, HBV is the primary cause of liver cancer
  – For males, it is the third leading cause of cancer mortality
  – For females, it is the sixth leading cause of cancer mortality
Hepatitis B
Epidemiology

• An estimated 800,000–1.4 million persons in the United States have chronic HBV infection.
• Chronic infection is an even greater problem globally, affecting approximately 350 million persons.
• An estimated 620,000 persons worldwide die from HBV-related liver disease each year.
Hepatitis B
Epidemiology

- The incubation period from the time of exposure to onset of symptoms is 6 weeks to 6 months.
- HBV is found in highest concentrations in blood and in lower concentrations in other body fluids (e.g., semen, vaginal secretions, and wound exudates).
- HBV infection can be self-limited or chronic.
Hepatitis B

In adults, only approximately half of newly acquired HBV infections are symptomatic, and approximately 1% of reported cases result in acute liver failure and death.
Hepatitis B Diagnosis

- Hepatitis B is detected by looking for a number of different antigens and antibodies:
  - **Hepatitis B surface antigen (HBsAg):**
    - A protein on the surface of HBV; it can be detected in high levels in serum during acute or chronic HBV infection.
    - The presence of HBsAg indicates that the person is infectious.
    - The body normally produces antibodies to HBsAg as part of the normal immune response to infection.
    - HBsAg is the antigen used to make Hepatitis B vaccine.
Hepatitis B Diagnosis

- Hepatitis B is detected by looking for a number of different antigens and antibodies:
  - **Hepatitis B surface antibody (anti-HBs):**
    - The presence of anti-HBs is generally interpreted as indicating recovery and immunity from HBV infection.
    - Anti-HBs also develops in a person who has been successfully vaccinated against Hepatitis B.
  - **Total Hepatitis B core antibody (anti-HBc):**
    - Appears at the onset of symptoms in acute Hepatitis B and persists for life.
    - The presence of anti-HBc indicates previous or ongoing infection with HBV in an undefined time frame.
Hepatitis B Diagnosis

- Hepatitis B is detected by looking for a number of different antigens and antibodies:
  - **IgM antibody to Hepatitis B core antigen (IgM anti-HBc):**
    - Positivity indicates recent infection with HBV (≤6 months).
    - Its presence indicates acute infection.
  - **Hepatitis B e antigen (HBeAg):**
    - A secreted product of the nucleocapsid gene of HBV that is found in serum during acute and chronic Hepatitis B.
    - Its presence indicates that the virus is replicating and the infected person has high levels of HBV.
Hepatitis B Diagnosis

• Hepatitis B is detected by looking for a number of different antigens and antibodies:
  
  – **Hepatitis B e antibody (HBeAb or anti-HBe):**
    
    • Produced by the immune system temporarily during acute HBV infection or consistently during or after a burst in viral replication.
    
    • Spontaneous conversion from e antigen to e antibody (a change known as seroconversion) is a predictor of long-term clearance of HBV in patients undergoing antiviral therapy and indicates lower levels of HBV.
## Hepatitis B

Typical interpretation of serologic test results for hepatitis B virus infection

<table>
<thead>
<tr>
<th>Serologic Marker</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{HBsAg} ) ^1</td>
<td>( \text{Total anti-HBc} ) ^2</td>
</tr>
<tr>
<td>( - )</td>
<td>( - )</td>
</tr>
<tr>
<td>( +,6,7 )</td>
<td>( - )</td>
</tr>
<tr>
<td>( + )</td>
<td>( + )</td>
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<td>( - )</td>
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<td>( - )</td>
<td>( - )</td>
</tr>
</tbody>
</table>

FIGURE 22-8  Progression to chronic hepatitis B infection. 
Source: Division of Viral Hepatitis, Centers for Disease Control and Prevention.
Figure 22-9  Acute hepatitis B infection with recovery.
Source: Division of Viral Hepatitis, Centers for Disease Control and Prevention.
Hepatitis B Clinical Features

- Incubation period 45-160 days (average 120 days)
- Nonspecific prodrome of malaise, fever, headache, myalgia
- Illness not specific for hepatitis B
- At least 50% of infections asymptomatic
Hepatitis B Complications

- Fulminant hepatitis
- Hospitalization
- Cirrhosis
- Hepatocellular carcinoma
- Death
Chronic Hepatitis B Virus Infection

- Chronic viremia
- Responsible for most mortality
- Overall risk 5%
- Higher risk with early infection
Risk of Chronic HBV Carriage by Age of Infection
Hepatitis B Epidemiology

- **Reservoir**: Human
- **Transmission**: Bloodborne Asymptomatic infections transmit
- **Communicability**: 1-2 months before and after onset of symptoms, Chronic infection
Hepatitis B Perinatal Transmission*

- If mother positive for HBsAg and HBeAg
  - 70%-90% of infants infected
  - 90% of infected infants become chronically infected

- If positive for HBsAg only
  - 5%-20% of infants infected
  - 90% of infected infants become chronically infected

*in the absence of postexposure prophylaxis
Global Patterns of Chronic HBV Infection

- **High (≥8%)**: 45% of global population
  - lifetime risk of infection >60%
  - early childhood infections common
- **Intermediate (2%-7%)**: 43% of global population
  - lifetime risk of infection 20%-60%
  - infections occur in all age groups
- **Low (<2%)**: 12% of global population
  - lifetime risk of infection <20%
  - most infections occur in adult risk groups
Hepatitis B—United States, 1978-2010

Figure is a line graph depicting cases of Hepatitis B in the United States from 1978 to 2010.
Risk Factors for Hepatitis B

- Unknown: 16%
- Other: 5%
- IDU: 16%
- MSM: 24%
- Heterosexual, multiple partners: 39%
Adults at Risk for HBV Infection

- **Sexual exposure**
  - sex partners of HBsAg-positive persons
  - sexually active persons not in a long-term, mutually monogamous relationship*
  - persons seeking evaluation or treatment for a sexually transmitted disease
  - men who have sex with men

* persons with more than one sex partner during the previous 6 months
Adults at Risk for HBV Infection

- Percutaneous or mucosal exposure to blood
  - current or recent IDU
  - household contacts of HBsAg-positive persons
  - residents and staff of facilities for developmentally disabled persons
  - healthcare and public safety workers with risk for exposure to blood or blood-contaminated body fluids
  - persons with end-stage renal disease
  - persons with diabetes mellitus
Adults at Risk for HBV Infection

- Others groups
  - international travelers to regions with high or intermediate levels (HBsAg prevalence of 2% or higher) of endemic HBV infection
  - persons with HIV infection
Hepatitis B Virus Infection by Duration of High-Risk Behavior

- IV drug user
- HCWs
- Homosexual men
- Heterosexual

Percent infected vs. Years at Risk
Hepatitis B Treatment

• For acute infection, no medication is available; treatment is supportive.
• For chronic infection, several antiviral drugs (adefovir dipivoxil, interferon alfa-2b, pegylated interferon alfa-2a, lamivudine, entecavir, and telbivudine) are available.
  – Persons with chronic HBV infection require medical evaluation and regular monitoring to determine whether disease is progressing and to identify liver damage or hepatocellular carcinoma.
Hepatitis B Elimination

• CDC’s national strategy to eliminate transmission of HBV infection includes:
  – Prevention of perinatal infection through routine screening of all pregnant women for HBsAg and immunoprophylaxis of infants born to HBsAg-positive mothers and infants born to mothers with unknown HBsAg status
  – Routine infant vaccination
  – Vaccination of previously unvaccinated children and adolescents through age 18 years
  – Vaccination of previously unvaccinated adults at increased risk for infection
Hepatitis B Vaccine

- **Composition**: Recombinant HBsAg
- **Efficacy**: 95% (Range, 80%-100%)
- **Duration of Immunity**: 20 years or more
- **Schedule**: 3 Doses
- **Booster doses not routinely recommended**
**Protection* by Age Group and Dose**

<table>
<thead>
<tr>
<th>Dose</th>
<th>Infants**</th>
<th>Teen and Adults***</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16% - 40%</td>
<td>20%-30%</td>
</tr>
<tr>
<td>2</td>
<td>80%-95%</td>
<td>75%-80%</td>
</tr>
<tr>
<td>3</td>
<td>98%-100%</td>
<td>90%-95%</td>
</tr>
</tbody>
</table>

* Anti-HBs antibody titer of 10 mIU/mL or higher

** Preterm infants less than 2 kg have been shown to respond to vaccination less often

*** Factors that may lower vaccine response rates are age older than 40 years, male gender, smoking, obesity, and immune deficiency
Hepatitis B Vaccine Long-term Efficacy

- Immunologic memory established following vaccination
- Exposure to HBV results in anamnestic anti-HBs response
- Chronic infection rarely documented among vaccine responders
# Hepatitis B Vaccine Routine Infant Schedule

<table>
<thead>
<tr>
<th>Dose+</th>
<th>Usual Age</th>
<th>Minimum Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary 1</td>
<td>Birth</td>
<td>---</td>
</tr>
<tr>
<td>Primary 2</td>
<td>1-2 months</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Primary 3</td>
<td>6-18 months*</td>
<td>8 weeks**</td>
</tr>
</tbody>
</table>

* Infants who mothers are HBsAg+ or whose HBsAg status is unknown should receive the third dose at 6 months of age.

** At least 16 weeks after the first dose.

+ An additional dose at 4 months is acceptable if the clinician prefers to use a combination vaccine that contains hepatitis B vaccine.
Hepatitis C

• Hepatitis C virus (HCV) infection is the most common chronic blood-borne infection in the United States; approximately 3.2 million persons are chronically infected.

• By contrast to Chronic HBV, patients with chronic hepatitis C almost always develop HCC in the presence of established cirrhosis.

• The annual risk of HCC development in HCV patients with cirrhosis is in the range of 1–4%, and an estimated 1–3% of patients chronically infected with HCV will develop HCC after 30 years.
Hepatitis C Characteristics

- Flavivirus – small, enveloped, single-stranded RNA virus, six genotypes
- Replicates in liver cells, lymphocytes and monocytes
- Replicates >1 trillion progeny per day
- Mutates rapidly (error-prone RNA polymerase)
- Down-regulates stimulatory receptors on NK cells
- Increases inhibitory receptors on NK and CD8+ killer cells
- Produces TGF-beta, which blocks activation of T cells and inhibits production of IFN-gamma
Hepatitis C Epidemiology

• Transmission of HCV occurs through:
  – Percutaneous
    • Injecting drug use
    • Clotting factors before viral inactivation
    • Transfusion, transplant from infected donor
    • Therapeutic (contaminated equipment, unsafe injection practices)
    • Occupational (needlestick)
  – Permucosal
    • Perinatal
    • Sexual
Hepatitis C Epidemiology

• The following persons are at known to be at increased risk for HCV infection:
  – Current or former injection drug users, including those who injected only once many years ago
  – Recipients of clotting factor concentrates made before 1987, when more advanced methods for manufacturing those products were developed
  – Recipients of blood transfusions or solid organ transplants before July 1992, when better testing of blood donors became available
  – Chronic hemodialysis patients
  – Persons with HIV infection
  – Children born to HCV-positive mothers
Hepatitis C
Epidemiology

Source: CDC DVH
Hepatitis C

• Although only 850 cases of confirmed acute Hepatitis C were reported in the United States in 2010, CDC estimates that approximately 16,000 new HCV infections occurred that year, after adjusting for asymptomatic infection and underreporting.

• Persons newly infected with HCV are usually asymptomatic, so acute Hepatitis C is rarely identified or reported.
Hepatitis C

Incidence of acute Hepatitis C, by year
United States, 1982-2010

Source: CDC DVH
Hepatitis C
Natural History of Infection

- Exposure (Acute Phase)
  - Resolved 15% (15)
  - Chronic 85% (85)
  - HIV and Alcohol
- Chronic 20% (17)
  - Cirrhosis
  - Slowly Progressive 75% (13)
  - HCC Transplant
  - Death 25% (4)
Hepatitis C
Prevalence of chronic infection with hepatitis C virus

Source: CDC YellowBook 2012
Hepatitis C

Source: Nature Reviews Gastroenterology & Hepatology 8, 69-71 (February 2011)
Hepatitis C Diagnosis

Serologic Pattern of Acute HCV Infection with Recovery

- ALT
- Anti-HCV

Symptoms +/-

HCV RNA

Titer

0 1 2 3 4 5 6 1 2 3 4

Months

Years

Time After Exposure

Adapted by CTLT from CDC.
Hepatitis C Diagnosis

Serologic Pattern of Acute HCV Infection with Progression to Chronic Infection

- ALT
- Anti-HCV

Symptoms +/-
HCV RNA

Time After Exposure

Adapted by CTLT from CDC.
Hepatitis C Virus (HCV) Infection Testing for Diagnosis

Anti-HCV

NEGATIVE

STOP

POSITIVE

Confirmed
High s/co ratio\(^1\)
or RIBA positive
or HCV RNA positive

Unconfirmed
and no other
test done

Unconfirmed
and HCV RNA
negative

NAT for HCV RNA or RIBA for anti-HCV

pos or neg

pos or neg

STOP

Indeterminate

Repeat anti-HCV
in \( \geq 1 \) month

NAT for HCV RNA

pos or neg

STOP

Medical evaluation for active infection and liver disease

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\(^1\) Samples with high signal-to-cut-off ratios usually (>95%) confirm positive, but supplemental serologic testing was not performed. Less than 5 of every 100 might represent false-positives; more specific testing should be requested, if indicated.

Anti-HCV: Antibody to HCV
NAT: Nucleic acid testing
RIBA: Recombinant immunoblot assay
RNA: Ribonucleic acid

DEPARTMENT OF HEALTH & HUMAN SERVICES
Centers for Disease Control and Prevention
Division of Viral Hepatitis

www.cdc.gov/hepatitis
Hepatitis C Diagnosis

- Sixty to 70% of persons newly infected with HCV typically are usually asymptomatic or have a mild clinical illness.
- HCV RNA can be detected in blood within 1–3 weeks after exposure.
- The average time from exposure to antibody to HCV (anti-HCV) seroconversion is 8–9 weeks, and anti-HCV can be detected in >97% of persons by 6 months after exposure.
Hepatitis C
Chronic Illness

- 75-85% of those infected with HCV will develop chronic infection.
- 60-70% of those infected with HCV will develop chronic liver disease.
- 5-20% of those infected will develop cirrhosis over a period of 20-30 years
- 1-5% will die from the consequences of chronic infection (liver cancer or cirrhosis)
Hepatitis C Treatment

• Interferon-based therapy is currently the standard of care for patients with chronic HCV, and has been proven to be effective in eliminating HCV.
• Both conventional and pegylated interferon (IFN) therapy have been used widely, with the aim of achieving a sustained virological response (SVR).
Hepatitis C Prevention

• Unlike HBV, there is currently no vaccine for HCV.

• However, with the screening of HCV in blood transfusion services, transfusion-related HCV infection has been lowered to almost zero.
Hepatitis C Prevention

• It may be possible to develop a preventive vaccine for HCV:
  – 30% of persons clear the virus spontaneously
  – The genome of HCV is not integrated into the host genome
  – After HCV infection, CD-8 CTL responses and antibodies appear, but the “protective immune response” or critical epitopes are not known
  – Persons who clear HCV and become re-infected have low viral loads and are more likely to clear HCV
Hepatitis D

- Hepatitis D (HDV), also known as "delta hepatitis," is a single-stranded circular RNA virus structurally unrelated to the Hepatitis A, B, or C viruses.
- Hepatitis D, which can be acute or chronic, is uncommon in the United States.
Hepatitis D

• HDV is an incomplete virus that requires the helper function of HBV to replicate and only occurs among people who are infected with the Hepatitis B virus (HBV).

• HDV is transmitted through percutaneous or mucosal contact with infectious blood and can be acquired either as a coinfection with HBV or as superinfection in persons with HBV infection.
Hepatitis E

- Hepatitis E virus (HEV), the major etiologic agent of enterically transmitted non-A hepatitis worldwide, is a spherical, non-enveloped, single stranded RNA virus that is approximately 32 to 34 nm in diameter.

- HEV is the sole member of the genus *Hepevirus*.
  - Two major species of the virus are recognized:
    - Mammalian HEV, a virus that causes acute hepatitis in humans and has a reservoir in pigs and possibly a range of other mammals
    - Avian HEV, causing big liver and spleen disease in chickens
Hepatitis E

- Hepatitis E is a serious liver disease caused by the Hepatitis E virus (HEV) that usually results in an acute infection.
- It does not lead to a chronic infection.
- While rare in the United States, Hepatitis E is common in many parts of the world.
- Hepatitis E is transmitted through the fecal oral route and outbreaks are usually associated with contaminated water supplies in countries with poor sanitation.
Hepatitis E
Acute Illness

• The incubation period following exposure to HEV ranges from 15 to 60 days (mean, 40 days).

• Typical clinical signs and symptoms of acute hepatitis E are similar to those of other types of viral hepatitis and include abdominal pain, anorexia, dark urine, fever, hepatomegaly, jaundice, malaise, nausea, and vomiting.
Hepatitis E

- Most people with Hepatitis E recover completely.
- The overall case-fatality rate is ≤4%.
- However, for pregnant women, Hepatitis E is more serious and the disease is fatal in 10%–30% of pregnant women, particularly those in their third trimester.
Hepatitis E Diagnosis

Hepatitis E Virus Infection - Typical Serologic Course

- ALT
- IgM Anti-HEV
- IgG Anti-HEV

Symptoms

Virus in Stool

Titer

Week After Exposure
Hepatitis E
Epidemiology

- The highest attack rate is seen among persons aged 15-40 years.
  - In most hepatitis E outbreaks, the highest rates of clinically evident disease have been in young to middle-age adults; lower disease rates in younger age groups may be the result of an icteric and/or subclinical HEV infection.
- The case fatality rate overall is 1%-3%.
  - In pregnant women, the case fatality rate can be as high as 15%-25%.
- HEV is found in the stool (feces) of persons and animals with hepatitis E.
- HEV is spread by eating or drinking contaminated food or water.
- Transmission from person to person occurs less commonly than with hepatitis A virus.
Hepatitis E
Levels of Endemicity, 2010

Source: CDC DVH
Hepatitis E Prevention

• A Hepatitis E vaccine was just approved for use (but only in China).

• Good sanitation measures are essential for preventing environmental contamination.

• Good personal hygiene is also essential for prevention and control including:
  – Hand washing with soap:
    • After using the bathroom
    • After changing a diaper
    • Before preparing and eating food