The Centers for Disease Control and Prevention’s Vessel Sanitation Program is proud to bring to you the following session:

**Swimming Pools and Whirlpool Spas**

While this presentation is primarily intended for cruise vessels under the jurisdiction of the Vessel Sanitation Program it may also be used by anyone who is interested in this topic.

This session should not be used as a replacement for existing interactive training but should be used as an adjunct to a comprehensive training program.
Swimming Pools and Whirlpool Spas

Vessel Sanitation Program
2007
Learning Objectives

- List the types of recreational water illnesses and the pathogens that cause them.
- List the ways in which a pool can be operated to control pathogens.
- List the parameters that should be monitored and controlled to ensure water quality in pools and whirlpool spas.
- List the safety features required for life saving at swimming pools.
Hazards and Recreational Water Illnesses (RWI) Associated with Recreational Water

- Injuries
- Gastrointestinal illnesses
- Respiratory illnesses
- Contact skin illnesses
- Ear infections
- Eye infections
- Wound infections
Recreational Water Use is Associated with a Spectrum of Illness in Treated Aquatic Venues

- Diarrheal illness
  - *Cryptosporidium*, toxigenic *E. coli*, *Giardia*, *Shigella*, noroviruses
- Skin infections
  - *Pseudomonas* dermatitis/folliculitis
- Outer ear and eye infections
  - *Pseudomonas*, adenoviruses
- Respiratory
  - *Legionella*
RWI Outbreaks, United States, 1993-2002; Diarrhea in Treated Venues (N=64)

Chlorine-sensitive:
- Poor pool maintenance

Other includes
- Cryptosporidium 65.6%
- E. coli O157:H7 6.3%
- Acute gastro 9.4%
- Norovirus 4.7%
- Giardia 3.1%
- Shigella 7.8%
- Chlorine resistant
- Other 3.1%

Other includes
- Campylobacter, Salmonella

Types of Pools

- Swimming
- Wading/Splash
  - Kid’s pool
Swimming Pool Operation

- Flow-through seawater pools
- Recirculated water pools
Flow-through Seawater Pools

- Vessel underway
- 20 kilometers (12 miles)
- Can be switched to recirculating pool
Flow Through Mode

- No treatment required
Recirculated Pools

- Anytime
- Anywhere
- Filtered
- Halogenated
Recirculated Swimming Pool Filtration

- Pressure Differentials
- Backwash or clean
- Inspection
- Change
Recirculated Pool Water Quality

- Filtration and flow rates
- pH
- Alkalinity
- Clarity
- Water Source
  - Potable
  - Seawater
Recirculated Pools

Halogenation

- Monitored every 4 hours
- 1.0-5.0 ppm
  - Bromine
  - Chlorine
Swimming Pool Safety Equipment

- Appropriate flotation device
  - Rope attached
- Shepherd’s hook
- Depth markers
Typical Pool Safety Signs
Public Whirlpool Spas
What’s In the Air?
What is *Legionella*?

- Mycobacterium legionella
- Widely distributed in natural and manmade water systems
  - Freshwater systems
  - Intracellular parasite of free-living ameba
Legionellosis

- Two forms of illness
  - Pontiac fever
    - Milder, flu-like symptoms
    - Incubation 2-48 hours
  - Legionellosis
    - Severe pneumonia
    - Incubation 2-14 days
Historical Perspective on *Legionella*

- 1976 American Legion convention in Philadelphia
- 182 cases of pneumonia, 29 deaths
- Outbreak associated with a new bacteria not previously linked to human illness
  - New bacterium named *Legionella pneumophila*
- Bacteria growing in cooling tower were introduced in the hotel HVAC system

*NEJM*, 297:1189-1197
Mechanisms of *Legionella* Transmission

- Showers
- Whirlpools
- Humidifiers
- Respiratory therapy equipment
- Faucets
- Cooling towers

VESSEL SANITATION PROGRAM
Charting a healthier course
Key Points Regarding Transmission

• No person-to-person transmission

• Natural environments (e.g., lakes, rivers) do NOT have sufficient quantities of Legionella to cause transmission
  – Many spas may have *Legionella* but levels are not high enough to cause disease

• Don’t need to get in the water—just breathe air in vicinity
Whirlpool Water Quality

- Clarity
- Alkalinity
- pH
- Filtration and flow rates
- Halogen residual
- Water changed daily
  - Spa Pools exempt from this requirement
Halogen Residuals and pH

- **Chlorine**
  - $\geq 3.0 - \leq 10.0$ ppm

- **Bromine**
  - $\geq 4.0 - \leq 10.0$ ppm

- **pH**
  - $7.2 - 7.8$
Halogen Monitoring

- Measured and recorded
  - Hourly
  or
  - Automated Analyzer
- Calibration checked and recorded daily
TC = FC + CC

- **Free chlorine**
  - active disinfectant available
- **Combined chlorine**
  - chlorine bound with ammonia or organic compounds
- **Combined chlorine**
  - 0.2-0.5 PPM
Break Point Chlorination

- Adding enough chlorine to eliminate problems associated with combined chlorine
- Does not affect organic combined chlorines
- 10 times amount of combined chlorine
  \[ 10 \times (TC-FC) = BPC \]
Protens Hydrogen (pH)

- Negative log of the hydrogen ion concentration
- Ideal pH for pool chemistry
  - 7.2-7.4
- Tears have a pH of 7.5
  - Ideal pH for bather comfort 7.4-7.6
- Acceptable pH for pools/spas
  - 7.2-7.8
pH Range vs. Chlorine Effectiveness

• pH 7.2 – 7.8
  – At pH 7.2 – 80% HOCl + 20% OCl-
  – At pH 8.0 – 20% HOCl + 80% OCl-
Total Alkalinity (80-120 PPM)

- Measure of water’s ability to resist changes in pH
  \[ \text{HCO}_3^- + \text{CO}_3^{2-} + \text{OH}^- \]
  Bicarbonate + Carbonate + Hydroxide

- Low Total Alkalinity (pH unstable)
  - Add sodium bicarbonate

- High Total Alkalinity (pH very stable)
  - Add an acid (muriatic or sodium bisulfate)
Total Dissolved Solids (TDS)

- Soluble matter in the water
- The longer the water is kept the higher the TDS level
- A high TDS level can mean a high organic contamination level
- No more than 1500 PPM higher than start up level of pool
Cartridge Filters

- At least one replacement
- Backwashed or cleaned as recommended by manufacturer
- Inspected weekly
Granular Filters

- Backwashed daily
  - Not by pressure differentials
- Inspected monthly
- Sedimentation Test
- Media replaced every 6 months
Backwashing Filters

• Can be automatic start but not automatic stop
  – Water must be clear at stop
Monthly Inspection and Sedimentation Test

• Backwash filter
• Stop pump(s)
• Drain water from filter
  – Inspect filter for cracks, holes, or mounds
• Collect core sample
  – Using appropriate tool
• Place filter media in clear jar with water
• Shake and let settle for 30 minutes
• Check for excessive organic material
Drain water in filter housing and inspect uniformity of sand
Collect a core sample of filter media
Place sample in clear jar
Add water and shake. Leave for 30 minutes to settle.
Daily Shock Treatment

- Raise halogen residual to 10 PPM
- Circulate for 1 hour
- Discharge to waste
- Maintain record
  - Seawater whirlpools exempt as Legionella does not grow well in seawater
Whirlpool Signs and Markings

- Risks
- Precautions
- Immunocompromised
Temperature Setting

• Maximum temperature

  – 40° C (104° F)
Pools and Whirlpools

- Anti-entrapment (anti-vortex) drain covers
Anti-entrapment Drain Covers

- Cover should be stamped with approval organization and maximum flow rate
- Letter attesting to covers meeting ASME/ANSI A 112.19.8M or equivalent standard can be substituted for stamp
It’s not just main drains that need to be anti-entrapment
Improperly installed, missing fasteners or damaged covers are not anti-entrapment even if stamped or certified.
Is this installation okay?
Multiple Drain Systems

FIGURE 4a. Dual Drain System

Minimum of 3 feet apart

Note: No valves are permitted between the drain slots and the "T."

Guidelines for Entrapment Hazards: Making Pools and Spas
FIGURE 4b. Channel System

Grate type cover would be attached to the channel
Pools and Whirlpools

- Fecal accident procedure
Fecal Accident Procedure

- CT = _____ppm X _____ minutes
  - Formed stools
    • CT=45
  - Loose stools, diarrhea
    • CT=9600
Diaper Restrictions

Children in diapers or who are not toilet trained are not permitted in swimming pools or whirlpool spas.
Resources and References

- www.cdc.gov
- www.epa.gov
- www.cpsc.org