INFECTION CONTROL ABOARD CRUISE SHIPS

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Voyager Medical Seminars

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North American Cruise Market

- Accounts for 75% of world cruise market
- 8.2 % annual growth rate since 1980
- 180 ships now sailing
- Median age of passengers is 51 years
- Ships typically sail at > 95% capacity

North American Cruise Market

- More than 10 MILLION passengers in 2005
- More than $10 BILLION in revenue in 2005
- 50% of cruises to Bahamas & Caribbean
- Europe, Alaska, Mexico, Trans-Panama Canal, Hawaii and South America account for another 40% of all cruises

Expectations of Cruisers

- Beautiful ship
- Comfortable stateroom
- Great food
- Exciting activities
- Competent medical care
- Safe & sanitary environment

Cruise Ship Medicine

- The practice of medicine aboard cruise ships designed to provide passengers and crew members with timely access to quality medical services for minor to severe illness and injury

Cruise Ship Medicine

- Cardiorespiratory arrest
- Acute MI
- CVA
- Asthma/COPD
- Trauma
- GI bleed
- Acute abdomen
- Epidemics
- Sepsis
- Status epilepticus
- Alcohol & other drug abuse
- Psychiatric disorders

Cruise Ship Medicine

- Infirmary versus hospital
- Limited staff for acute care patients
- Logistics of emergency disembarkations
- 24 / 7 / 365 responsibilities
- The "Hell Cruise"
- ...and nowhere to go!

Cruise Ship Medicine

- On a typical 1 week cruise, the medical staff will see 1% of the total population onboard each day
- 50% crew, 50% passengers
- 90% non-urgent problems
- 5% urgent problems
- 5% emergent/life-threatening problems

Cruise Ship Medicine

Ten Most Common Diagnoses by Organ System

Cruise Ships		U.S. Emergency Departments	
	%		%
Respiratory	26-29	Injury Related and Poisoning	25.6
Injury Related	12-18	Respiratory	12.3
Nervous and Sense Organs	9	Nervous and Sense Organs	5.4
Gastrointestinal	12-16	Gastrointestinal	5.8
Cardiovascular	3-7	Musculoskeletal	5.4
Genitourinary	3	Cardiovascular	3.9
Musculoskeletal	3	Genitourinary	4.4
Skin and Subcutaneous Tissue	3-13	Skin and Subcutaneous Tissue	2.8
Endocrine and Immune	0.8	Mental Disorders	3.3
Mental Disorders	0.7	Endocrine and Metabolic	1.6

Cruise Ship Medicine

- Cruise ship doctors and nurses are an integral part of the ship's safety, health and hygiene team
  - Prevention of illness and injury
  - Surveillance
  - Incident response
  - Diagnosis
  - Treatment

Shipboard Sanitation

- International maritime regulations
- Cruise industry guidelines
- Corporate policies and procedures
- Multi-departmental shipboard protocols
- CDC Vessel Sanitation Program
- Disease surveillance and reporting

Shipboard Sanitation

- Food, water, air
- Living quarters (passenger and crew)
- Public areas
- Waste (trash, garbage, sewerage, HAZMAT)
- Pests (vermin, insects)

Shipboard Sanitation Department Collaboration

- Industry guidelines and standards
- Corporate policies & procedures
- Ship's Command
- Hotel
- Food & Beverage
- Housekeeping
- Engineering
- Environmental
- Medical

Shipboard Sanitation - Food

- HACCP Program
- Reliable suppliers
- Strict quality control
- Proper food storage
- Inventory control
- Food separation

Shipboard Sanitation - Food

- Sanitary preparation and serving areas
- Appropriate cooking and serving temps
- Clean-rinse-sanitize process for cookware and dinnerware
- Strict hygiene protocols for food handlers

Shipboard Sanitation - Water

- Bunkering of water only from safe sources
- Water desalination
  - Distillation
  - Reverse osmosis
- Filtering
- Halogenation
- Continuous monitoring of water quality

Shipboard Sanitation - Air

- Filtering
- Air exchange
- Temperature control
- Humidity control
- Duct cleaning

Passenger Living Quarters

- Passenger staterooms are cleaned at least twice daily
- Disinfectants routinely used on bathroom and high hand-contact areas

Crew Living Quarters

- Daily cleaning
- Crew sanitation regulations
- Weekly inspections

Public Areas

- Daily cleaning
- Repeat cleaning with additional use
- Disinfection of heavy hand-contact and soiled/contaminated areas

Waste Management

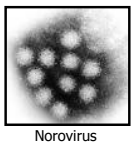
- Adherence to international regulations
- Separation & recycling
- Incineration
- Bilge, waste water & sewerage treatment
- Off-loading of hazardous materials

Pests

- Rare on modern cruise ships due to the strict sanitation protocols in place
- Rats, mice, flies, ants, cockroaches, silverfish
- Continuous surveillance
- Pesticides as needed

Norovirus

- Norwalk Virus, Norwalk-like virus, NLV
- SRSV (Small Round Structured Virus)
- 2002
  - Family – Caliciviridae
  - Genus – Norovirus
  - Genogroups – I, II, III, IV
  - Multiple clusters/strains



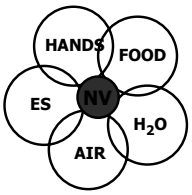
Norovirus
Electron Micrograph

Norovirus

- Non-enveloped ssRNA virus
- 27-35 nm in size (SRSV)
- Infectious dose of 10-100 virus particles
- Viral shedding of 3 weeks or more
- Survives 0˚C, 60˚C, chlorine 10 ppm
- Limited (few months) immunity

Norovirus Transmission

- "Fecal-oral" route
- Mouth ⟷ Gut (Replication) ⟶ Anus
- Food
- Water
- Air
- Environmental surfaces
- Hands

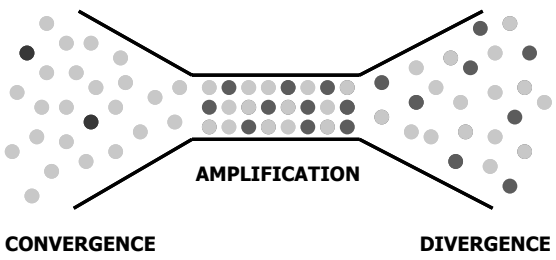


Norovirus Transmission

- Food (39%)
- Hands (12% "person to person")
- Water (3%)
- Air (aerosolization with vomitus)
- Environmental surfaces (fomites)
- 46% unknown or no data available

MMWR 2001; 50: RR-9

Amplification of Disease Transmission



Norovirus Infection

- "Stomach flu"
- "Lurgy"
- "Winter vomiting disease"
- 24-48 hour incubation period
- 12-60 hour duration of illness
- A "mild" and short lived illness

Norovirus Infection Symptoms

- **Diarrhea**
- **Vomiting**
- Nausea
- Abdominal cramps
- Headache, muscle aches
- Fever (minority)
- Dehydration in young and elderly victims
- Up to 30% may be asymptomatic

Norovirus Detection

- Reverse transcriptase polymerase chain reaction (RT-PCR) of stool, vomitus and environmental surfaces
  - Sequencing for genotype and cluster ID
- ELISA test kit (IDEIA™ NLV)
- Direct & immune EM of stool samples
- 4-fold increase in acute and convalescent IgG serum antibodies

Norovirus Infection Treatment

- Symptomatic therapy
  - PO, IV fluids
  - Antispasmodics
  - Analgesics
  - Antipyretics

Norovirus Containment

- Isolation of infected persons
- Environmental disinfection
- Handwashing

Influenza

- Influenza A
  - Surface antigen based subtypes
    - Hemagglutinin
    - Neuraminidase
- Influenza B
- New variants due to antigenic drift
- Seasonal epidemics

Influenza Transmission

- Respiratory droplets
- Person to person
- Environmental surface contamination

Influenza Infection

- Incubation period of 1-4 days
- Fever, myalgia, headache, malaise, sore throat, rhinitis, nonproductive cough, nausea, vomiting
- Duration of acute illness is typically 3-7 days
- Infectious period of 1 day prior to and 5 days after onset of symptoms

Influenza Diagnosis

- Clinical symptoms
- Viral testing
  - Culture
  - Immunofluorescence DFA Antibody Staining
  - RT-PCR
  - Serology
  - Enzyme Immunoassay
  - Rapid (Point of Care) Diagnostic Tests

Influenza Treatment

- Rest, fluids
- Acetaminophen, aspirin, NSAID
- Antihistamines, decongestants, anti-tussives
- Antiviral medications
  - Amantadine (Influenza A)
  - Rimantadine (Influenza A)
  - Oseltamivir (Tamiflu, Influenza A & B)
  - Zanamivir (Relenza, Influenza A & B)

Influenza Prevention

- Isolation
- Environmental disinfection
- Handwashing
- Vaccine
- Antiviral medication prophylaxis
  - Amantatine
  - Rimantatine
  - Oseltamivir (Tamiflu)
  - Zanamivir (Relenza)

Legionnaires' Disease

- Caused by Legionella pneumophila
- Aerosol transmission via contaminated water sources
  - Whirlpool spas, hot tubs, showers, cooling systems
  - Humidifiers, fountains, respiratory therapy equipment
- No person to person transmission
- Incubation period 2-14 days
- Fever, chills, cough, pneumonia, headache, myalgias
- 2-4 week duration of illness
- 10-25% mortality rate (multi-system organ failure)

Pontiac fever

- Fever, chills, cough, headache, myalgias
- No pneumonia
- Incubation period 1-2 days
- 2-5 days duration of illness
- Self-limited illness

Legionnaires' Disease Diagnosis

- Signs and symptoms with associated pneumonia
- Multiple cases
- Urinary antigen assay
- Indirect fluorescent antibody assay serology
- Direct fluorescent antibody stain of exudate
- Culture of the organism
- Fourfold rise in acute/convalescent serum antibody titers

Legionnaires' Disease Treatment

- Erythromycin (with or without rifampin)
- Azithromycin
- Levofloxacin
- Doxycycline
- Respiratory and general support measures

Legionnaires' Disease Prevention

- Proper maintenance of potential sources
  - Whirlpool spas, hot tubs, showers, cooling systems
  - Humidifiers, fountains, respiratory therapy equipment
- Disinfection of equipment
- Water halogenation
- Cooling system reservoir UV light exposure
- Filter flushing/replacement
- Biofilm prevention

For Additional Information

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