Coming Clean About Norovirus: How to Dodge the Spread

NEHA-BIA Webinar

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Norovirus Structure and Classification

- Small (35 nm), non-enveloped, SS (+) RNA
- Member of *Caliciviridae* family, genus Norovirus
- Species specific and tissue tropic
- Role of GII.4 epidemic strain

Epidemiological Significance and Costs

» Leading cause of acute gastroenteritis worldwide (Lopman et al., 2016)

» Approx. 20 million cases annually in US
  • 1 in every 15 persons, 5-7 times in a lifetime
  • 75% person-to-person transmission
  • 15-25% foodborne transmission

» High prevalence, low mortality

» Overall cost of norovirus = $64.5B globally
  ◊ Cost of a single foodborne outbreak = $3911 to $2.05M (Bartsch et al., 2018)
  ◊ Cost of individual case = $888-$1766 (Scharf et al., 2015)
Role of Retail and Food Service

» Leading cause of foodborne illness in the US (5.5 million cases per year)
  • Infected food handlers cause about 70% of reported norovirus outbreaks from contaminated food (when a cause is found)
  • In over half of these cases the workers had bare hand contact with ready-to-eat foods (Hall et al., 2014)

» Based on analysis of CDC NORS data (Hall et al., 2012)
  • 64% Restaurants
  • 17% Catering/banquet facilities
  • 13% Other
  • 4% Homes
  • 2% Schools, daycare, and healthcare facilities
Cultivation and Surrogates

--Human norovirus cannot be readily cultivated *in vitro*!!!!!
--No small animal model
--Limits ability to study
--Surrogates for infectivity (study, regulatory approval)
--Surrogates do not always behave the same as human norovirus
--This complicates matters
Infectivity

- Low infectious dose (~100 viral particles?) (Atmar et al., 2008)
- Copious shedding ($10^5$ – $10^{11}$ genome copies/g feces)
- Prolonged and even asymptomatic shedding
RESEARCH ARTICLE

Vomiting as a Symptom and Transmission Risk in Norovirus Illness: Evidence from Human Challenge Studies

Amy E. Kirby*, Ashleigh Streby, Christine L. Moe

Hubert Department of Global Health, Rollins School of Public Health, Emory University, Atlanta, GA, United States of America

Table 3. Norovirus Titers in Emesis.

<table>
<thead>
<tr>
<th>Study</th>
<th># Subjects with Emesis Specimens</th>
<th># Emesis Specimens</th>
<th>% Subjects with $\geq$ 1 Positive Emesis</th>
<th>% Positive Samples</th>
<th>Sample Mean Titer (GEC$^d$/ml)(SEM$^e$)</th>
<th>Subject Mean Cumulative Shed (GEC$^d$)(SEM$^e$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>16</td>
<td>50%</td>
<td>63%</td>
<td>$5.8 \times 10^5 (2.6 \times 10^5)$</td>
<td>$1.3 \times 10^8 (9.1 \times 10^7)$</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>20</td>
<td>75%</td>
<td>90%</td>
<td>$9.2 \times 10^5 (3.1 \times 10^5)$</td>
<td>$3.1 \times 10^8 (1.7 \times 10^8)$</td>
</tr>
<tr>
<td>All GI</td>
<td>14</td>
<td>36</td>
<td>64%</td>
<td>78%</td>
<td>$8.0 \times 10^5 (2.2 \times 10^5)$</td>
<td>$2.3 \times 10^8 (1.0 \times 10^8)$</td>
</tr>
<tr>
<td>3</td>
<td>4$^a$</td>
<td>8</td>
<td>25%</td>
<td>38%</td>
<td>$1.6 \times 10^5 (4.5 \times 10^4)$</td>
<td>$1.8 \times 10^7 (1.8 \times 10^7)$</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>13</td>
<td>100%</td>
<td>92%</td>
<td>$5.0 \times 10^3 (2.7 \times 10^3)$</td>
<td>$2.3 \times 10^5 (ND)^b$</td>
</tr>
</tbody>
</table>
Detection and Quantification of Airborne Norovirus During Outbreaks in Healthcare Facilities

Laetitia Bonifait,1 Rémi Charlebois,1 Allison Vimont,2 Nathalie Turgeon,1 Marc Veillette,1 Yves Longtin,3 Julie Jean,2,4 and Caroline Duchaine1,5

1Centre de recherche de l’institut universitaire de cardiologie et de pneumologie de Québec, and 2Institut sur la nutrition et les aliments fonctionnels, Laval University, Quebec, 3Lady Davis Institute of Medical Research at the Jewish General Hospital and McGill University Faculty of Medicine, Montreal, 4Département des sciences des aliments et de nutrition, Faculté des sciences de l’agriculture et de l’alimentation, and 5Département de biochimie, de microbiologie et de bio-informatique, Faculté des sciences et de génie, Laval University, Quebec, Canada

Table 1. Detection and Concentration of Norovirus GII RNA Recovered From the Air in Patient Rooms, Hallways, and Nursing Stations During 8 Confirmed Norovirus Outbreaks—Quebec, 2012

<table>
<thead>
<tr>
<th>Healthcare Center Location</th>
<th>No. of Positive Samples Detected in Air</th>
<th>Range of Norovirus GII, Genomes/m³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients’ rooms</td>
<td>14/26</td>
<td>$1.46 \times 10^1 - 2.35 \times 10^3$</td>
</tr>
<tr>
<td>Nurses’ stations</td>
<td>3/6</td>
<td>$1.35 \times 10^1 - 1.22 \times 10^2$</td>
</tr>
<tr>
<td>Hallway/common areas</td>
<td>6/16</td>
<td>$1.54 \times 10^1 - 5.43 \times 10^2$</td>
</tr>
</tbody>
</table>

Air samples were taken with the Coriolis μ, set at 200 L/minute for 10 minutes.
Hand carriage on experimentally-infected individuals (Liu et al., 2013)

• While more common with those with symptoms, there was a case of hand contamination in an uninfected person who had been in the room of someone who was infected.
Virus Persistence

- Surfaces
  - Room temperature: Days/ weeks

- Foods and water
  - Refrigeration: Weeks/months/ years
  - Freezing: Months/ years

- Transferability
  - Variable (0.1%->90%)
  - Depends on moisture, surfaces, pressure, virus
  - Sequential (10X)

- Environmental contamination
  - Outbreaks
  - Endemic
  - Virus concentrations

- Relative importance of hands, surface, air to foodborne transmission (attribution)
Surface Disinfection

- Formulation matters
- Efficacy impacted by concentration, contact time, soil
- Active compounds (ingredients)
  - Chlorine, 1,000-5,000 ppm (+)
  - Benzalkonium chloride chloride (-)
  - Phenols
  - Hypochorous acid, up to 250 ppm
  - Silver dihydrogen citrate
  - Activated hydrogen peroxide
  - Emerging technologies
- Soft surfaces?
- Label claim issues-surrrogates
Hand Sanitizers

- Formulation matters
- Product type [actives]
  - Alcohol [70-90%, ethanol, isopropanol, n-propanol] (-)
  - Benzalkonium chloride chloride (-)
  - Triclosan (-)
  - *Emerging actives*
- Product application (volume and time)
- Validation/methodological issues
- Regulatory/licensing/use issues
- Never a substitute for hand-washing
- Could be a useful addition.....
Is Human Norovirus a ‘Perfect’ Pathogen?

- The perfect pathogen?
  - Highly infectious
  - Moderately virulent
  - Rapidly and efficiently spread
  - Rapid evolution, limited immunity
  - Environmentally persistent
  - Resistant to many sanitizers, disinfectants, and processing technologies
  - Difficult to detect and control
  - **DOES NOT GROW OUTSIDE HOST**
Sandra M. Long, REHS/RS
Environmental Health Manager
Town of Addison, TX
Regulatory/Health

- Norovirus - description
- Written clean up procedures
- Foodservice employee protocols
  - Exclusion
  - Restriction
  - Reporting
- Health Dept investigations
What is Norovirus?

- Various Names
- On-set time

Symptoms of norovirus illness usually begin about 24 to 48 hours after ingestion of the virus, but they can appear as early as 12 hours after exposure.
Who gets Norovirus?

• Anyone can become infected with these viruses. There are many different strains of norovirus.
• Because of these differences in genetic factors, some people are more likely to become infected and develop more severe illness than others.
How it Spreads

- Eating food or drinking liquids that are contaminated with norovirus;
- Touching surfaces or objects contaminated with norovirus, and then placing their hand in their mouth;
- Direct contact with another person who is infected and showing symptoms;
- Persons working in day-care centers or nursing homes should pay special attention to children or residents who have norovirus illness.
Where is it?
Contagious?

- People infected with norovirus are contagious from the moment they begin feeling ill to at least 3 days after recovery. Some people may be contagious for as long as 2 weeks after recovery.
- It is particularly important for people to use good handwashing and other hygienic practices after they have recently recovered from norovirus illness.
Prevention

• Frequently wash your hands
• Wash fruits and vegetables, and steam oysters before eating them.
• Clean and disinfect contaminated surfaces
• Remove and wash clothing or linens that may be contaminated.
• Flush or discard any vomitus and/or stool
Regulatory Protocols

• **Locations:**
  - Food Establishment,
  - Care facility,
  - Public areas

• **Personal Protective Equipment**
• **Environmental Cleaning**
• **Staff Policies**
• **Visitor Policies**
• **Health Dept Investigations**
What Can I Use?

- [https://www.epa.gov/pesticide-registration/list-g-epas-registered-antimicrobial-products-effective-against-norovirus](https://www.epa.gov/pesticide-registration/list-g-epas-registered-antimicrobial-products-effective-against-norovirus)
What Can I Use?

- 6836-77  LONZA FORMULATION S-18
- 6836-78  LONZA FORMULATION R-82
- 11346-2  Clorox HL
- 11346-3  Clorox HW
- 11346-4  Clorox QS
- 11346-6  Clorox HS
- 34810-36  CLEAN-CIDE WIPES
- 71654-7  VIRKON
- 71847-2  KLOR-KLEEN
- 71847-6  KLORSEPT
- 71847-7  KLORKLEEN 2
Help Prevent the Spread of Norovirus ("Stomach Bug")

IF NOROVIRUS IS AFFECTING YOUR COMMUNITY, HERE ARE SOME ACTIONS YOU CAN TAKE TO HELP PREVENT FURTHER ILLNESS

1. **Clean up surfaces**
   - a. Clean frequently touched surfaces with soapy water
   - b. Rinse thoroughly with plain water
   - c. Wipe dry with paper towels
   - d. Dispose of paper towels

   **DON'T STOP HERE!** SERUMS CAN REMAIN ON SURFACES EVEN AFTER CLEANING!

2. **Disinfect surfaces**
   - a. Prepare and apply a chlorine bleach solution
     - Mix bleach solution: 3/4 cup of concentrated bleach per gallon of water
     - If using regular strength bleach daily, increase the amount of bleach to 1 cup.
   - b. Leave surface wet for at least 5 minutes
   - c. Rinse all surfaces intended for food or mouth contact with plain water before use

3. **Wash your hands thoroughly with soap and water**
   - Hand sanitizers may not be effective against norovirus.

Facts about Norovirus

- Norovirus is the leading cause of outbreaks of diarrhea and vomiting in the US and it spreads quickly.
- Norovirus spreads by contact with an infected person or by touching a contaminated surface or eating contaminated food or drinking contaminated water. Norovirus particles can even float through the air and settle on surfaces, spreading contamination.
- Norovirus particles are extremely small and billions of them are in the stool and vomit of infected people.
- Any utensil or dishware that comes into contact with norovirus should be treated as though it is contaminated.
- People can transfer norovirus to others for at least three days after being sick.

Scientific experts from the U.S. Centers for Disease Control and Prevention (CDC) helped to develop this poster. For more information on norovirus prevention, please see http://www.cdc.gov/novirus/preventing-infection.html.
Posters

**Did you wash your hands?**
- Use soap & water.
- Rub hands for 20 seconds.
- Rinse.
- Dry with paper towel.
- Use towel to turn off faucet.

Clean

Your health is in your hands

**ATTACK OF THE NOROVIRUS**

* a group of highly contagious viruses that cause “stomach flu” or gastroenteritis (Gas-ter-ee-ner-ri-tis)

- Most individuals recover from norovirus in 1-2 days on their own by treating symptoms and staying hydrated.
- Symptoms can begin suddenly, and may include:
  - Vomiting
  - Diarrhea
  - Stomach cramping
  - A low-grade fever
  - Headache
  - Muscle aches
  - General sense of discomfort

www.health.arizona.edu

**CAMPUS HEALTH SERVICE**
Traci Slowinski, REHS
Sr. Manager, Quality Assurance & Food Safety
Brinker International
Dallas, TX
Retail/Food Service Programs

- Employee Illness & Reporting Policy
- Emetic Event (vomit & diarrhea) Cleanup Procedures
- Norovirus Disinfection Protocol
- Internal/External FBI Monitoring & Reporting
- FBI Outbreak Investigation & Response

Prevention = Protecting Ourselves & Our Brands
**Norovirus & Restaurant Outbreaks:**

1. **#1** Cause of Foodborne Illness
2. **64%** Outbreaks attributed to Restaurants
3. **70%** Caused by Infected Food Workers

Source: CDC Vital Signs June 2014

**Employee Illness & Reporting Policy**

- Reporting & Exclusion Policy
- Condition Reporting Agreement
- Policy Acknowledgement
- Medical Referral Form
Emetic Event (vomit & diarrhea) Cleanup Procedures

- Personal Protective Equipment
- Clean Up Materials
- Disinfectant Product
- Disposal
- Personal Hygiene (post cleanup)
Norovirus Disinfection Protocol

- **When:**
  - Spike in Norovirus in community
  - Suspect introduction from employee or guest
  - Other outbreak/illness spread concerns
  - During peak Norovirus season

- **Where:**
  - High guest touch points
  - Known V&D locations

- **How:**
  - Utilize proper disinfectant
  - Ensure proper dwell time
  - Determine additional steps for food contact surfaces
Internal/External FBI Monitoring & Reporting

Reporting Sources
- Guest Relations/Engagement
- Operations/Risk
- Social Media Streams
- Iwaspoisoned.com

Monitoring Tools
- Spreadsheets (pivot tables, graphs)
- Dashboards (tableau, heat maps)
- Summary Reports (Word, Excel)
FBI Outbreak Investigation & Response

- Monitor reporting systems to identify any emerging situations
- Work with health department on any investigations
- Review food safety programs and practices to identify gaps or causes
- Initiate response plan – disinfection protocol, employee illness monitoring, guest FBI monitoring
- Prepare for media and guest response
CONTACT INFORMATION

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