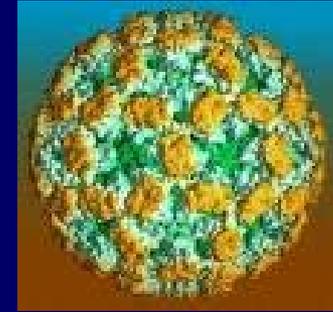


Investigating Noroviruses: A Case Study

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Norovirus Facts



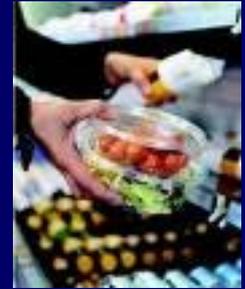
- Small, round-structured viruses from *Caliciviridae* family
- First recognized as pathogenic cause of gastroenteritis in 1968, Norwalk, Ohio
- Transmitted via fecal-oral route
- Highly contagious—as few as 10 viral particles can cause infection

Symptoms

- Incubation period ~ 24-48 hours, can be less
- Vomiting
- Watery non-bloody diarrhea
- Abdominal cramps
- Nausea
- Low-grade fever
- Symptoms typically resolve ~ 24-60 hours (1-3 days)



Documented Modes of Transmission



- Foodhandler contamination of items in restaurant
- Daycare centers
- Secondary person-to-person
- Aerosolized (vomiting and diarrhea)
- Cleaning up after ill person in a bathroom



Immunity & Epidemiology

- Seems to be strain-specific and temporary (few months)
- CDC estimates 23 million cases of acute gastroenteritis annually in U.S. due to noroviruses
- CDC estimates noroviruses cause ~50% of all foodborne disease outbreaks

Detection

- Best method is via reverse transcriptase polymerase chain reaction (RT-PCR)
- Viral RNA
- Adults can shed viral particles for up to 2 weeks after symptoms resolve
- Infants and toddlers may shed longer

Case Study

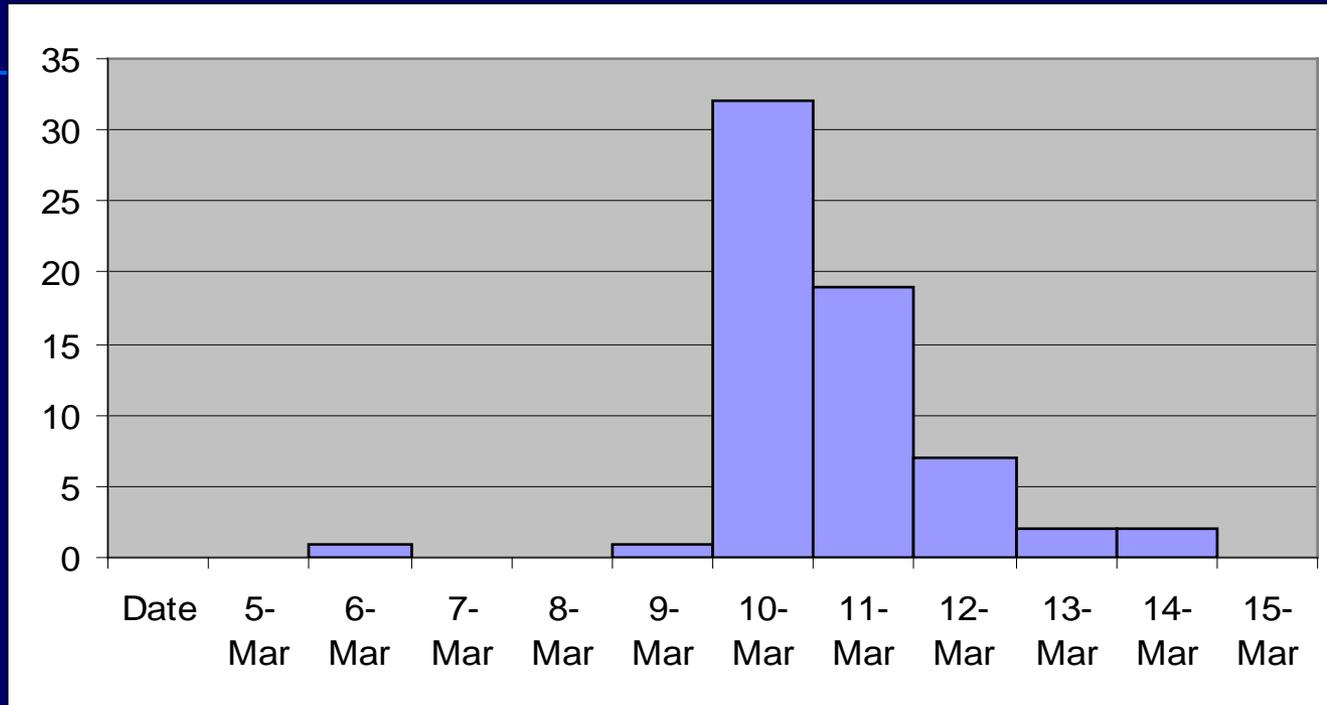
- Small state university north of Houston, TX
- Student body ~ 10,000 students
- 2,054 students owned meal plans
- 125 students present to student health center and local hospital with gastrointenteritis in 24 hr period



Symptoms

- 125 ill students on March 10-11 1998
- 23 admitted to hospital
- 91% reported vomiting
- 85% reported diarrhea (3+ loose stools in 24 hours)
- 68% reported abdominal cramps

Epidemic Curve



Cases by Onset Date

Laboratory Investigation

- 62 stool samples sent to Texas Department of Health Lab in Austin
- All negative for *Salmonella*, *Shigella*, *Campylobacter*, *Yersinia*, *E. coli* O157:H7, *Bacillus cereus*, and *Staphylococcus aureus*
- 18 samples tested for Norovirus by RT-PCR; 9 were positive

Challenges of Cafeteria Outbreaks

- Verifying Exposures
- Identifying potential healthy controls
- Finding people to interview them
- Hundreds of food items
- Rule in/out other exposures



Rapid Action

- Outbreak occurred toward end of week, right before Spring Break
- Sanitarians from local health department investigated, realized cafeteria was about to close for week and perform massive cleaning/maintenance
- Locked down all present food items, instructed staff not to throw anything out

Epidemiologic Investigation

- Unmatched Case-control study by Texas Dept. of Health
- 36 ill subjects
- 136 well controls
- Matched Case-control study by CDC
- 29 ill subjects
- 29 well controls

Findings – Matched Study

Exposure	Odds Ratio	Confidence Intervals	<i>P</i> value
Deli sandwich 3/9 lunch	11.0	1.6-473	< 0.01
Deli sandwich 3/9 supper	6.0	0.7-276	0.06
Deli sandwich 3/10 lunch	8.0	1.1-355	0.02
Deli sandwich 3/10 supper	1.0	0.01-79	.75

Findings – Unmatched Study

Exposure	Odds Ratio	Confidence Intervals	<i>P</i> value
Deli sandwich 3/9 lunch	11.1	3.9-32	< 0.001
Deli sandwich 3/9 supper	7.1	1.6-33	<0.01
Deli sandwich 3/10 lunch	5.7	2-16	<0.001
Deli sandwich 3/10 supper	3.3	0.6-20	.11
Any deli sandwich on 3/9 or 3/10	16.8	6.2-47	<0.001

Interpretation

- Both studies implicated deli sandwiches on 3/9 and 3/10
- The more controls in a study, the better statistical power you have
- No other restaurants or food items showed any association

Cafeteria Staff Investigation

- Sanitarians and epidemiologists interviewed foodhandlers
- All denied illness
- All except one submitted stool samples for testing
- One refused; cafeteria manager fired her
- She was responsible for slicing deli meats and making deli sandwiches

Discussion

- CDC and TDH epidemiologists were disappointed with cafeteria manager decision to fire the one employee
- Much more difficult to get cooperation
- Eventually did interview her
- She denied illness, but had infant with diarrhea
- Stool sample from infant was PCR positive for Norovirus

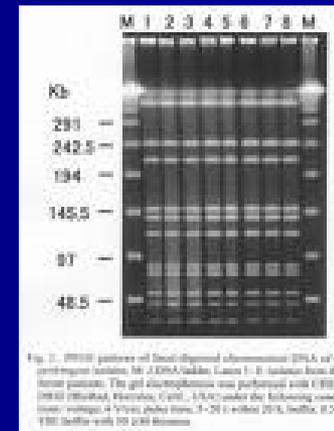
Chance to Learn Something



- Researchers at Baylor College of Medicine agreed to try to find virus RNA on deli meat
- Never been done before

Success!

- Lab successful in designing protocol for recovering virus RNA from deli meat
- Pulsed-Field Gel analysis of PCR results showed identical pattern between infant, ill students, and deli meats



Take Home Points

- Viral gastroenteritis is easy to spread
- Foodhandlers must be extremely careful, even when they are not sick, with hygiene
- It is possible to recover Norovirus from food
- Quick reaction by local health department sanitarians preserved food samples
- Collaboration with research lab advanced science of food safety research