Oswego – An Outbreak of Gastrointestinal Illness
Following a Church Supper Case Study
Jill Marshall
MPH 510 Applied Epidemiology
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Part I - Background

On April 19, 1940, the local health officer in the village of Lycoming, Oswego County, New York, reported the occurrence of an outbreak of acute gastrointestinal illness to the District Health Officer in Syracuse. Dr. A. M. Rubin, epidemiologist-in-training, was assigned to conduct an investigation.

When Dr. Rubin arrived in the field, he learned from the health officer that all persons known to be ill had attended a church supper held on the previous evening, April 18. Family members who did not attend the church supper did not become ill.

Accordingly, Dr. Rubin focused the investigation on the supper. He completed Interviews with 75 of the 80 persons known to have attended, collecting information about the occurrence and time of onset of symptoms, and foods consumed. Of the 75 persons interviewed, 46 persons reported gastrointestinal illness.

Question 1: Would you call this an epidemic? Would you call it an outbreak?

This would be called an epidemic as an epidemic is defined as the occurrence of an illness (or outbreak) with a frequency clearly in excess of normal expectancy (Friis and Sellers, 2014). This qualifies, as excess of normal expectancy as there were 46 of the 75 interviewed that became ill with gastroenteritis during a 24-hour period of time. This meets exceeds a normal expectancy within the community. This also meets the definition of an outbreak, as a "localized disease epidemic" (Friis and Sellers, 2014, page 20). With the information provided above, this epidemic appears to be localized to this particular community.

References:

Friis, R. Sellers, T. (2014). *Epidemiology for Public Health Practice.* Jones and Bartlett Learning LLC. Pages 18, 20.

Question 2: Review the steps of an outbreak investigation.

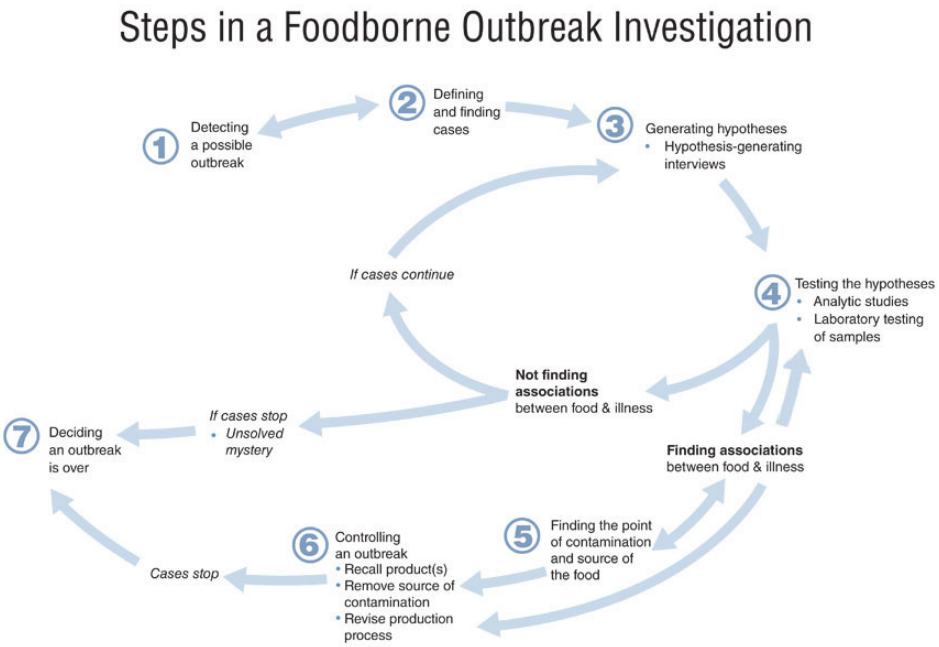
The steps in a field investigation include:

1. Establish the existence of an epidemic (or outbreak)
2. Confirm the diagnosis
3. Establish criteria for case identification
4. Search for missing cases
5. Count cases
6. Orient the data according to person, place, and time
7. Classify the epidemic
8. Determine who is at risk of becoming a case

9. Analyze the data
10. Formulate a hypotheses
11. Test hypotheses
12. Develop reports and inform those who need to know
13. Execute control and prevention measures
14. Administration and planning activities (Field Epidemiology A Brief Overview, 2010).

The steps of a food-borne outbreak investigation are as follows:

1. Detecting a possible outbreak
2. Defining and finding cases
3. Generating hypotheses about likely sources
4. Testing the hypotheses
5. Finding the point of contamination and source of the food
6. Controlling an outbreak
7. Deciding an outbreak is over (CDC Foodborne Outbreak Investigations, 2012)



CDC Foodborne Outbreak Investigations, 2012

References:

CDC Foodborne Outbreak Investigations (2012) Retrieved May 22, 2013 from http://www.cdc.gov/outbreaknet/investigations/investigating.html

Field Epidemiology A Brief Overview (2010). Power Point Jones and Bartlett. Retrieved from MPH 510 Field Epidemiology & Outbreak Investigations.pptx

Clinical Description
The onset of illness in all cases was acute, characterized chiefly by nausea, vomiting, diarrhea, and abdominal pain. None of the ill persons reported having an elevated temperature; all recovered within 24 to 30 hours. Approximately 20% of the ill persons visited physicians. No fecal specimens were obtained for bacteriologic examination.

Question 3: List the broad categories of diseases that must be considered in differential diagnosis of an outbreak of gastrointestinal illness.

The broad categories of disease that must be considered in the differential diagnosis outbreak of gastrointestinal illness includes: 1) food infection (e.g., salmonella), 2) food poisoning (e.g., botulism), and 3) chemical poisoning (e.g., vitamin toxicity) (Field Epidemiology A Brief Overview, 2010).

References:

Field Epidemiology A Brief Overview (2010). Power Point Jones and Bartlett. Retrieved from MPH 510 Field Epidemiology & Outbreak Investigations.pptx

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The investigators suspected that this was a vehicle-borne outbreak, with food as the vehicle.

Question 4: In epidemiologic parlance, what is a vehicle? What is a vector? What are other modes of transmission?

A vehicle is defined as an inanimate object or material that becomes contaminated with an infectious agent. This agent (such as a virus) may or may not develop on the vehicle. When the vehicle contacts the person's body by ingestion, touching of the skin, or internally (e.g., during surgery) the vehicle can transmit the disease (CDC Special Pathogens Branch, 2012).

A vector is any living creature which carries a host of different infections agents (CDC, Special Pathogens Branch, 2012).

The other modes of transmission include direct and airborne transmission (CDC, Special Pathogens Branch, 2012).

Direct transmission is transmission occurs through personal contact, touching, biting, kissing or sexual intercourse. In cases such as these the infections agent will enter the body through the

skin, mouth, open cut or sore, or through the sexual organs. The infectious agent may also be spread through droplet spread. This type of spreading occurs by tiny droplets of spray entering the mucus membranes of the eyes, nose or mouth during sneezing, coughing, spitting, singing, or talking (CDC, Special Pathogens Branch, 2012). .

Airborne transmission is when infective agents are spread as aerosols. They usually enter a person thorough the respiratory tract as they are tiny particles suspended in air that consist partially or completely of the infectious agent. A person becomes infected when they breathe in these particles (CDC, Special Pathogens Branch, 2012).

References:
Special Pathogens Branch Glossary of Terms (2012)
http://www.cdc.gov/ncidod/dvrd/spb/mnpages/glossary.htm

Question 5: If you were to administer a questionnaire to the church supper participants, what information would you collect? Group the information into categories.

1. Case Number
2. Date of Report
3. Age
4. Gender/Sex
5. Time of Meal
6. If they became ill or not
7. Onset of illness
8. Date of Onset
9. Time of Onset
10. Presenting Symptoms
11. Duration of Symptoms
12. Severity
13. Foods consumed
14. Outcome (Types of Variables in Line Listing, n.d.)

References:

Types of Variables in Line Listing (n.d.) Retrieved May 22 from
https://wiki.ecdc.europa.eu/fem/w/fem/types-of-variables-and-line-listing.aspx

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Dr. Rubin put his data into a line listing.

Question 6: What is a line listing? What is the value of a line listing?

A line listing is a table for which each column represents an important variable (e.g., name identification number, age, sex, etc.) while each row represents a different case, by number (as new cases are identified) (CDC Excite, 2004).

The value of a line listing is that it allows the investigator to “scan key information on every case and update it easily.”

References:
CDC Excite (2004) Steps of an Outbreak Investigation Retrieved May 23, 2013 from
http://www.cdc.gov/excite/classroom/outbreak/steps.htm

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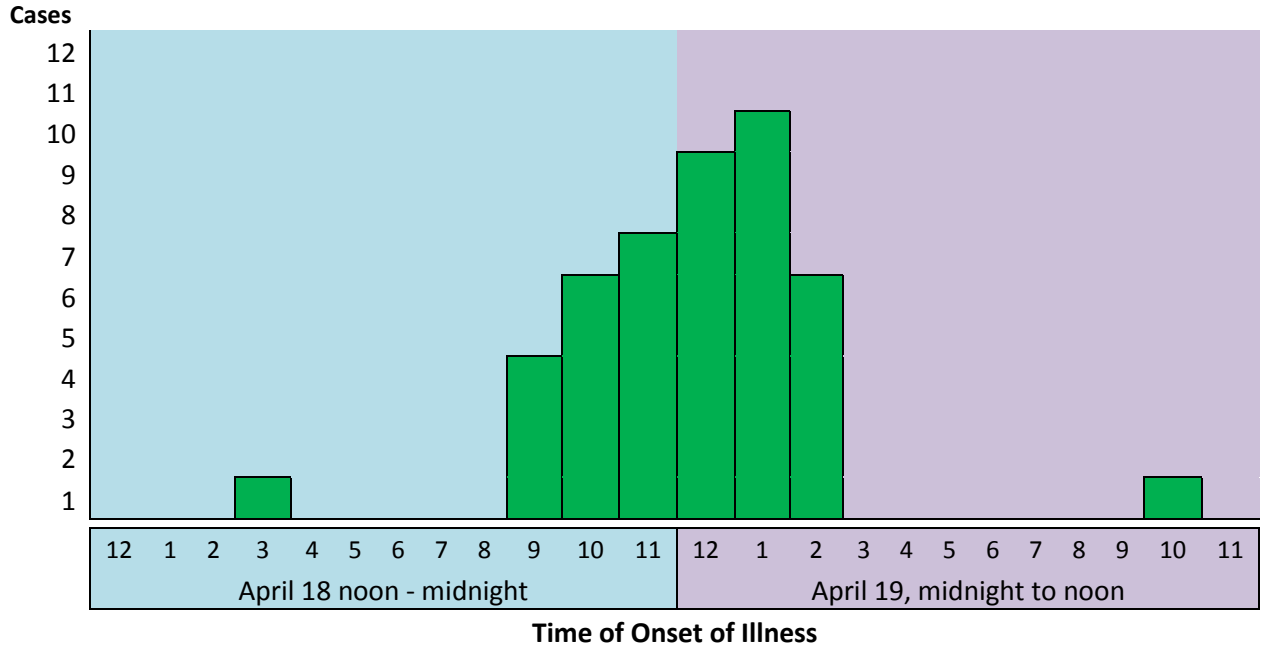
PART II - Description of the Supper
The supper was held in the basement of the village church. Foods were contributed by numerous members of the congregation. The supper began at 6:00 p.m. and continued until 11:00 p.m. Food was spread out on a table and consumed over a period of several hours. Data regarding onset of illness and food eaten or water drunk by each of the 75 persons interviewed are provided in the attached line listing. The approximate time of eating supper was collected for only about half the persons who had gastrointestinal illness.

Question 7: What is the value of an epidemic curve?

The value of an epidemic curve is to show the time course of an epidemic. It is drawn using a graph of the number of cases by their date of onset. This provides a visual display of the magnitude of the outbreak as well as a time trend (CDC Excite, 2004).

CDC Excite (2004) Steps of an Outbreak Investigation Retrieved May 23, 2013 from http://www.cdc.gov/excite/classroom/outbreak/steps.htm

Question 8: Using the graph paper provided, graph the cases by time of onset of illness (include appropriate labels and title). What does this graph tell you?



The graph above demonstrates that the onset of illness occurred primarily between 8:00 pm on April 18 and 3:00 pm on April 19.

Question 9: Are there any cases for which the times of onset are inconsistent with the general experience? How might they be explained?

There are two cases for which the times of onset are inconsistent with the general experience? This might be explained by the time of meal, as the person identified as having the earliest onset of symptoms is recorded as having the earliest time for consuming the meal/food. Additional factors may include the personal characteristics of the two outliers such as age, race, sex, and amount of exposure/ingestion or basic susceptibility each person has to the illness (CDC Excite, 2004).

CDC Excite (2004) Steps of an Outbreak Investigation Retrieved May 23, 2013 from http://www.cdc.gov/excite/classroom/outbreak/steps.htm

Question 10: How could the data in the line listing be better presented?

The data in the line listing could better be presented by including, the presenting symptoms, and the duration and severity of those symptoms (Types of Variables in Line Listing, n.d.).

References:

Types of Variables in Line Listing (n.d.) Retrieved May 22 from https://wiki.ecdc.europa.eu/fem/w/fem/types-of-variables-and-line-listing.aspx

Part III Continued Below

PART III

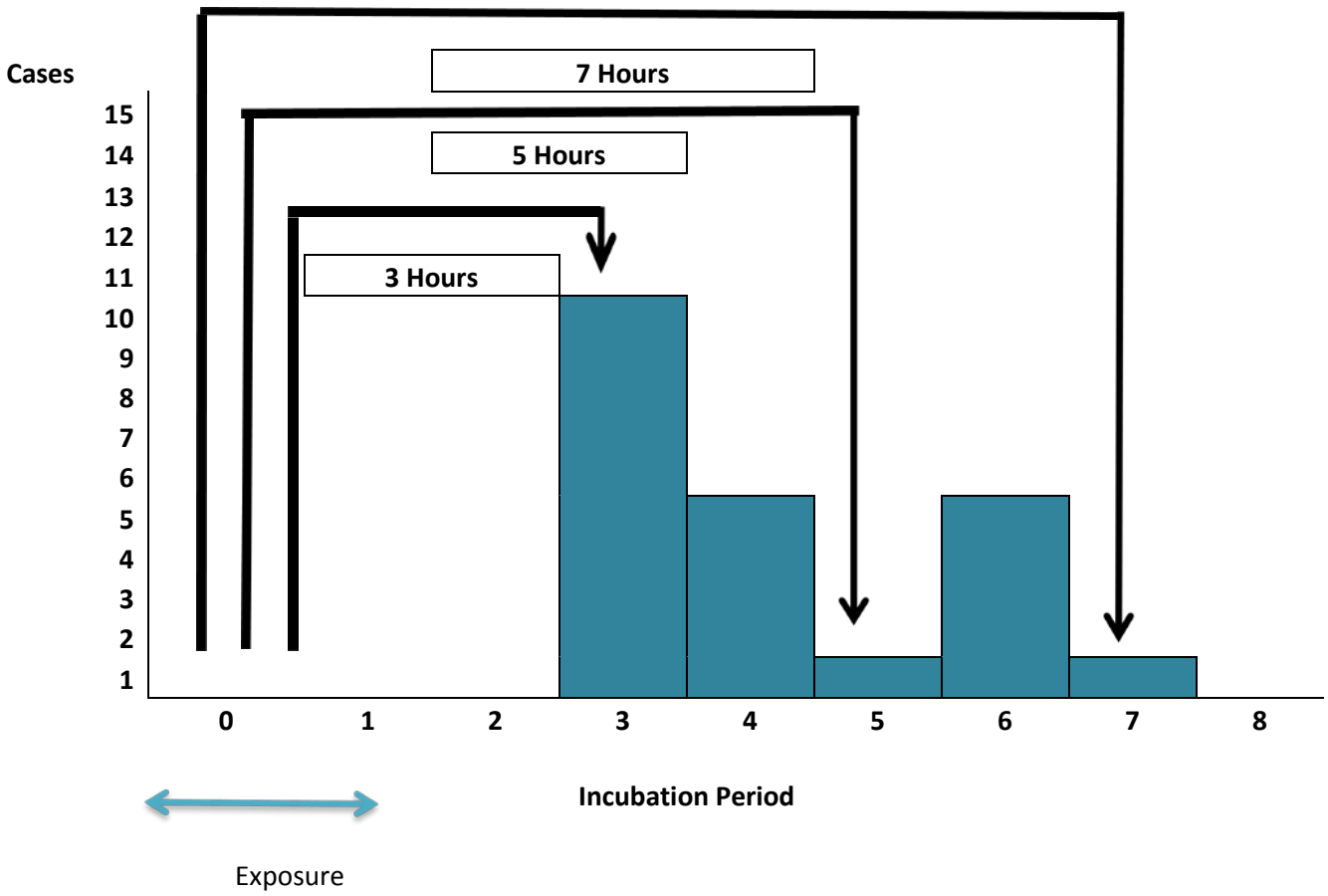
Attached is the line listing sorted by illness status (ill or well), and by time of onset.

<u>Question 11:</u> Where possible, using the new line listing, calculate incubation periods and illustrate their distribution with an appropriate graph.

Table of Calculations

Time of Meal	Time of Onset	Incubation (in hours)
11:00 AM	3:00 PM	4
7:30 PM	10:30 PM	3
7:30 PM	10:30 PM	3
7:00 PM	11:00 PM	4
7:30 PM	11:30 PM	4
7:30 PM	12:00 AM	4.5
8:00 PM	12:30 AM	4.5
6:30 PM	12:30 AM	6
6:30 PM	12:30 AM	6
7:30 PM	1:00 AM	5.5
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
7:00 PM	1:00 AM	6
10:00 PM	1:00 AM	3
10:00 PM	1:00 AM	3
7:30 PM	2:00 AM	6.5
7:30 PM	2:00 AM	6.5
7:30 PM	2:00 AM	7

Graph of Calculations Below



<u>Question 12:</u> Determine the range and median of the incubation period.

Range	Median
4 Hours	4 Hours

Calculations completed in Table Below

Time of Meal	Time of Onset	Incubation (in hours)	Range = lowest - highest	Range	Median (Middle)
7:30 PM	10:30 PM	3	Lowest Number	4 Hours	4 Hours
7:30 PM	10:30 PM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
10:00 PM	1:00 AM	3			
11:00 AM	3:00 PM	4			
7:00 PM	11:00 PM	4	Median = 4+4/2		
7:30 PM	11:30 PM	4			
7:30 PM	12:00 AM	4.5			
8:00 PM	12:30 AM	4.5			
7:30 PM	1:00 AM	5.5			
6:30 PM	12:30 AM	6			
6:30 PM	12:30 AM	6			
7:00 PM	1:00 AM	6			
7:30 PM	2:00 AM	6.5			
7:30 PM	2:00 AM	6.5			
7:30 PM	2:00 AM	7	Highest Number		

<u>Question 13:</u> How does the information on incubation period, combined with the data on clinical symptoms, help in the differential diagnosis of the illness? (If necessary, refer to attached Compendium of Acute Foodborne Gastrointestinal Disease).

Having the information on incubation period, combined with the data on clinical symptoms, helps in the differential diagnosis of the illness. It does so by making it easier to identify or rule out what may or may not be the agent. This is based on the already established criteria of incubation periods, clinical syndrome pathophysiology, characteristic foods and specimens for the agents outlined in the Compendium of Acuter Foodborne Gastrointestinal Disease.

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<u>Question 14:</u> Using the data in the attached line listing, complete the table below. Which food is the most likely vehicle of infection?

Food Items Served	Number of Persons who ATE specified food				Number of Persons who did NOT eat specified food				Attack Rate Ratio
	Ill	Not Ill	Total	Percent Ill (Attack Rate)	Ill	Not Ill	Total	Percent Ill (Attack Rate)	
Baked ham	25	17	42	59.52%	21	12	33	63.64%	0.94
Spinach	27	18	45	60.00%	19	11	30	63.33%	0.95
Mashed potato	23	16	39	58.97%	23	13	36	63.89%	0.92
Cabbage salad	18	10	28	64.29%	28	19	47	59.57%	1.07
Jell-O	16	7	23	69.57%	30	22	52	57.69%	1.21
Rolls	21	16	37	56.76%	25	13	38	65.79%	0.86
Brown bread	18	9	27	66.67%	28	20	48	58.33%	1.16
Milk	2	2	4	50.00%	44	27	71	61.97%	0.81
Coffee	19	17	36	52.78%	27	19	46	58.70%	0.95
Water	13	11	24	54.17%	33	18	51	64.71%	0.83
Cakes	27	13	40	67.50%	19	16	35	54.29%	1.26
Ice cream, vanilla	43	11	54	79.63%	3	18	21	14.29%	5.71
Ice cream, chocolate	25	22	47	53.19%	20	7	27	74.07%	0.72
Fruit salad	4	2	6	66.67%	42	27	69	60.87%	1.10

The food that is the most likely vehicle of infection is Vanilla Ice Cream.

Question 15: Outline further investigations that should be pursued.

The investigations that should further be pursued investigating the possibility of contamination along the food production chain of the ice cream. The including:

- processing,
- distribution,
- preparation, and
- handling (from initial production to the church) (CDC Outbreak Investigations, 2011).

References:

CDC Outbreak Investigations (2011). The Food Production Chain – How Food Gets Contaminated Retrieved May 24, 2013 from http://www.cdc.gov/outbreaknet/investigations/production_chain.html

Question 16: What control measures would you suggest?

If this outbreak occurred today some suggested control measures include:

- Requiring the processing plan to clean and disinfect food facilities and temporarily closing the plant if needed;
- Recalling the ice cream and other foods processed in the same facility;
- Telling the public to discard/throw away any food items processed in this plant especially ice cream; and
- Informing the public of any signs and symptoms and where and how to seek treatment options (CDC Foodborne Outbreak Investigations, 2009).

References:

CDC Foodborne Outbreak Investigations (2009). Controlling an Outbreak. Retrieved May 24, 2013 from http://www.cdc.gov/outbreaknet/investigations/control.html

Question 17: Why was it important to work up this outbreak?

It is important to work up this outbreak, as it provides a very comprehensive walk through consistent with the steps of an outbreak investigation as outlined by the CDC. It teaches the methodology and practical application of the steps, so that they could be implemented to address another outbreak in the future.

Question 18: Refer to the steps of an outbreak investigation you listed in Question 2. How does this investigation fit that outline?

To this point this investigation fits almost exactly within the parameters of the steps (1-6) of an outbreak investigation listed in Question 2. This exercise allowed for 1) detecting a possible

outbreak in determining the number of people affected with the symptoms and illness within a specific location and time; 2) defining and finding 46 cases of illness with similar symptoms; 3) generating hypotheses about likely sources as all of those affected by determining who attended the church meal, who became ill had a symptoms, 4) Using (interviews) line listing, an epidemic curve, calculation of the incubation period, and a comparison of the types of food served and the incubation period to the compendium of acute foodborne and waterborne disease to test the hypothesis; 5) finding the point of contamination by calculating the attack rate of the foods consumed and not consumed by those affected and not affected with the illness; and 6) determining methods for controlling the outbreak.

PART IV – CONCLUSION

The following is quoted verbatim from the report prepared by Dr. Rubin: "The ice cream was prepared by the Petrie sisters as follows: "On the afternoon of April 17 raw milk from the Petrie farm at Lycoming was brought to boil over a water bath, sugar and eggs were then added and a little flour to add body to the mix. The chocolate and vanilla ice cream were prepared separately. Hershey's chocolate was necessarily added to the chocolate mix. At 6 p.m. the two mixes were taken in covered containers to the church basement and allowed to stand overnight. They were presumably not touched by anyone during this period. "On the morning of April 18, Mr. Coe added five ounces of vanilla and two cans of condensed milk to the vanilla mix, and three ounces of vanilla and one can of condensed milk to the chocolate mix.
Then the vanilla ice cream was transferred to a freezing can and placed in an electrical freezer for 20 minutes, after which the vanilla ice cream was removed from the freezer can and packed into another can which had been previously washed with boiling water. Then the chocolate mix was put into the freezer can which had been rinsed out with tap water and allowed to freeze for 20 minutes. At the conclusion of this both cans were covered and placed in large wooden receptacles which were packed with ice. As noted, the chocolate ice cream remained in the one freezer can.

"All handlers of the ice cream were examined. No external lesions or upper respiratory infections were noted. Nose and throat cultures were taken from two individuals who prepared the ice cream. "Bacteriological examinations were made by the Division of Laboratories and Research, Albany, on both ice creams. Their report is as follows: 'Large numbers of *Staphylococcus aureus* and *albus* were found in the specimen of vanilla ice cream. Only a few staphylococci were demonstrated in the chocolate ice cream.' "Report of the nose and throat cultures of the Petries who prepared the ice cream read as
follows: '*Staphylococcus aureus* and hemolytic streptococci were isolated from nose culture and *Staphylococcus albus* from throat culture of Grace Petrie. *Staphylococcus albus* was isolated from the nose culture of Marian Petrie. The hemolytic streptococci were not of the type usually associated with infections in man.' "Discussion as to Source: The source of bacterial contamination of the vanilla ice cream is not clear. Whatever the method of the introduction of the staphylococci, it appears reasonable to assume it must have occurred between the evening of April 17 and the morning of April 18. No reason for contamination peculiar to the vanilla ice cream is known.

"In dispensing the ice creams, the same scooper was used. It is therefore not unlikely to assume that some contamination to the chocolate ice cream occurred in this way. This would

appear to be the most plausible explanation for the illness in the three individuals who did not eat the vanilla ice cream.

"Control Measures: On May 19, all remaining ice cream was condemned. All other food at the church supper had been consumed. "Conclusions: An attack of gastroenteritis occurred following a church supper at Lycoming. The cause of the outbreak was contaminated vanilla ice cream. The method of contamination of ice cream is not clearly understood. Whether the positive *Staphylococcus* nose and throat cultures occurring in the Petrie family had anything to do with the contamination is a matter
of conjecture." Note: Patient #52 was a child who while watching the freezing procedure was given a dish of vanilla ice cream at 11:00 a.m. on April 18.
Addendum: Certain laboratory techniques not available at the time of this investigation might prove very useful in the analysis of a similar epidemic today. These are phage typing, which can be done at CDC, and identification of staphylococcal enterotoxin in food by immuno-diffusion or by enzyme-linked immunosorbent assay (ELISA), which is available through the Food and Drug Administration (FDA).

One would expect the phage types of staphylococci isolated from Grace Petrie's nose and the vanilla ice cream and vomitus or stool samples from ill persons associated with the church supper to be identical had she been the source of contamination. Distinctly different phage types would mitigate against her as the source (although differences might be observed as a chance phenomenon of sampling error) and suggest the need for further investigation, such as cultures of others who might have been in contact with the ice cream in preparation or consideration of the possibility that contamination occurred from using a cow with mastitis and that the only milk boiled was that used to prepare chocolate ice cream. If the contaminated food had been heated sufficiently to destroy staphylococcal organisms but not toxin, analysis for toxin (with the addition of urea) would still permit detection of the cause of the epidemic. A Gram stain might also detect the presence of nonviable staphylococci in contaminated food.

Reference

Gross MB. Oswego County revisited. *Public Health Reports* 1976;91:160-70.