

Steps of an Outbreak Investigation: Back to Basics

Communicable Disease Branch
North Carolina Division of Public Health

Principles of Outbreak Investigations

- Be systematic
 - Follow the same steps for every type of outbreak
 - Write down case definitions
 - Ask the same questions of everybody
- Stop often to re-assess what you know
 - Line list and epidemic curve provide valuable information; many investigations never go past this point
 - Consider control measures to be applied
- Coordinate with partners (e.g., environmental)

10 Steps of an Outbreak Investigation

1. Identify investigation team and resources
2. Establish existence of an outbreak
3. Verify the diagnosis
4. Construct case definition
5. Case finding: Find cases systematically / develop line list
6. Perform descriptive epidemiology / develop hypotheses
7. Evaluate hypotheses / perform additional studies (as necessary)
8. Implement control measures
9. Communicate findings
10. Maintain surveillance

Steps of an Outbreak Investigation

- These steps may occur simultaneously or be repeated as new information is received

What is an outbreak?

- Increase in cases above what is expected in that population in that area
- Occurrence of 2 or more 'epi-linked' cases

Descriptive Epidemiology

- Person
- Place



Line List

- Time



Epidemic curve ('Epi curve')

Line List

- Method to systematically record information
- Simple to review, update, summarize
- Each row represents data for a single 'case'
- Information to include:
 - Identifying information
 - Demographics
 - Clinical
 - Exposure / risk factor

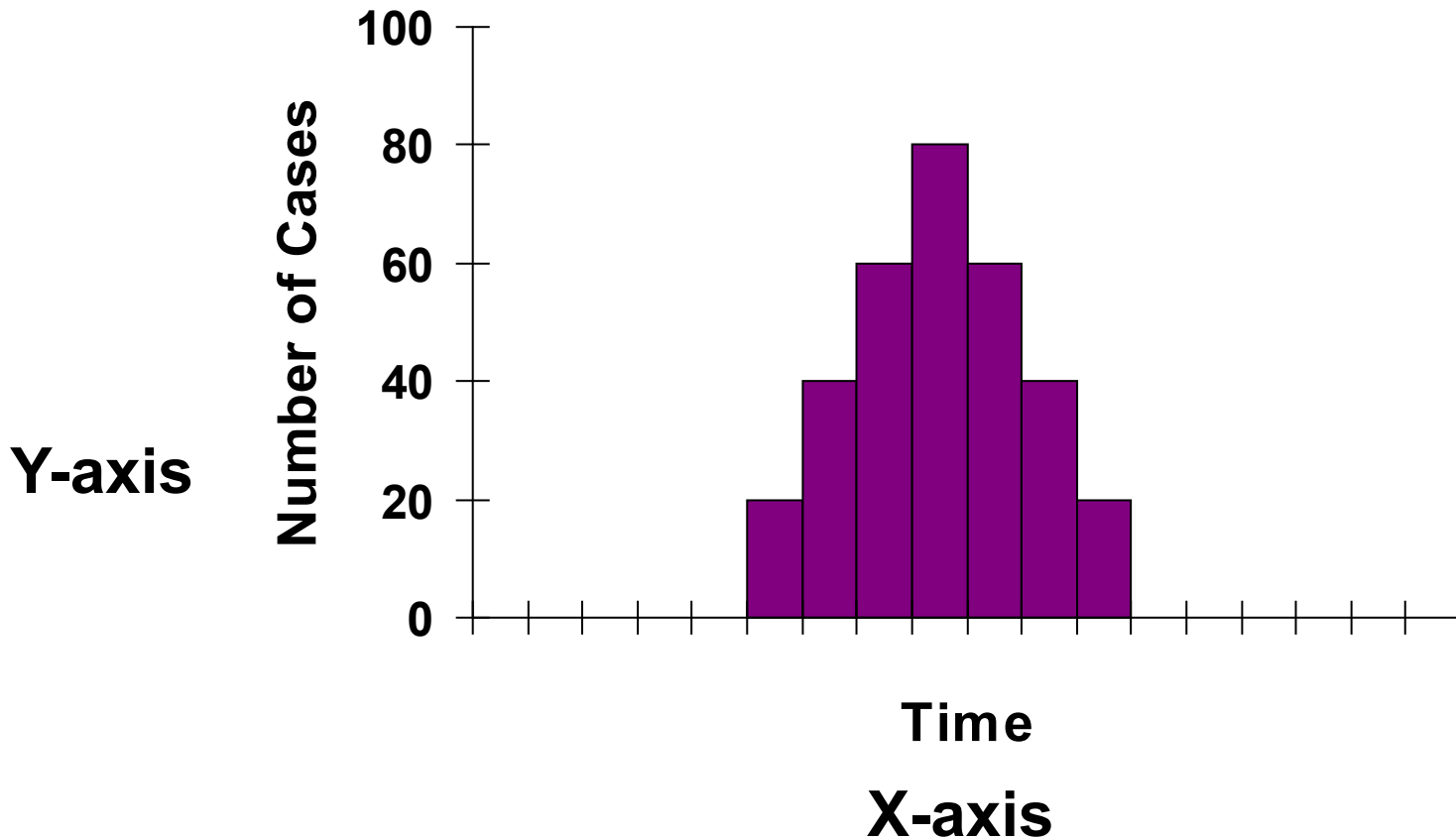
Example – Line List

| Line Number | First-Name | Middle-Name | Last-Name | Date of Birth | Gender | SSN | Street1 | Street2 | City | State | Zip-Code | County | Country | Home Phone |
|-------------|------------|-------------|-----------|---------------|--------|-----|--------------------|---------|------------|-------|----------|----------|---------|------------|
| 1 | Ally | | Alligator | 1/2/1986 | Female | | 100 Swamp Lane | | Cedar Park | NC | 27514 | Escambia | | 302-591 |
| 2 | Benjamin | | Bear | 12/1/1988 | Male | | 506 Forest Road | | Cedar Park | NC | 27514 | Escambia | | 336-28 |
| 3 | Carie | | Cat | 5/7/1992 | Female | | 52 House Circle | | Cedar Park | NC | 27514 | Escambia | | 678-98 |
| 4 | Donald | | Duck | 4/4/1973 | Male | | 200 Disney Way | | Cedar Park | NC | 27514 | Escambia | | 301-66 |
| 5 | Emily | | Elephant | 6/18/1979 | Female | | 64 Safari Ave | | Cedar Park | NC | 27514 | Escambia | | 838-65 |
| 6 | Farrah | | Fox | 8/24/1982 | Female | | 182 Tree Farm Road | | Cedar Park | NC | 27514 | Escambia | | 276-96 |
| 7 | Gary | | Gorilla | 11/25/1981 | Male | | 70 Jungle Drive | | Cedar Park | NC | 27514 | Escambia | | 704-33 |
| 8 | Henry | | Horse | 9/11/2001 | Male | | 300 Farm Court | | Cedar Park | NC | 27514 | Escambia | | 225-92 |
| 9 | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | |
| 13 | | | | | | | | | | | | | | |
| 14 | | | | | | | | | | | | | | |
| 15 | | | | | | | | | | | | | | |
| 16 | | | | | | | | | | | | | | |
| 17 | | | | | | | | | | | | | | |
| 18 | | | | | | | | | | | | | | |
| 19 | | | | | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| 21 | | | | | | | | | | | | | | |
| 22 | | | | | | | | | | | | | | |
| 23 | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | | |

Epidemic 'Epi' Curve

- Visual representation of
 - Ill persons (cases) over time
 - Magnitude of outbreak
 - Number of cases on the vertical (y) axis
 - Time period (or date of illness onset) on the horizontal (x) axis

Example Epi Curve



Oswego – An Outbreak of Gastrointestinal Illness following a Church Supper



Case Study No. 401-303

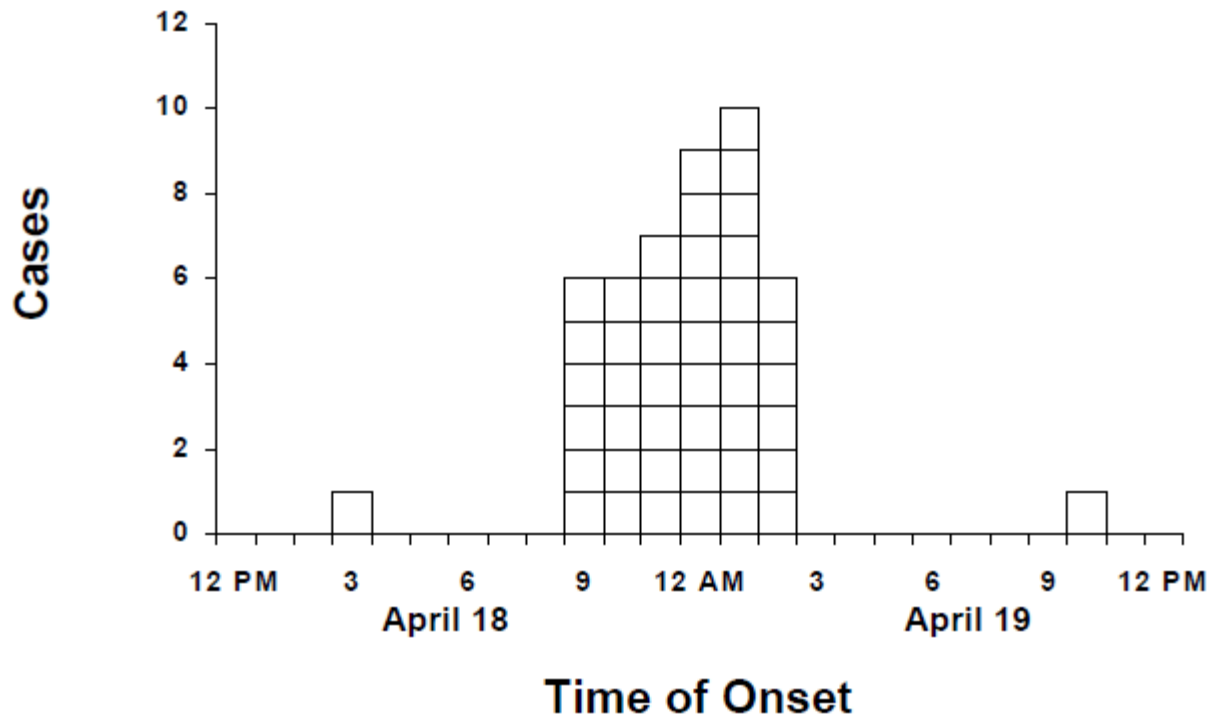
Centers for Disease Control and Prevention
Epidemiology Program Office

- Part I – Entire Group
- Part II – Small Groups
- Part III
 - Q 12-14: Small Groups
 - Q 15-18: Entire Group
- Part IV – Entire Group

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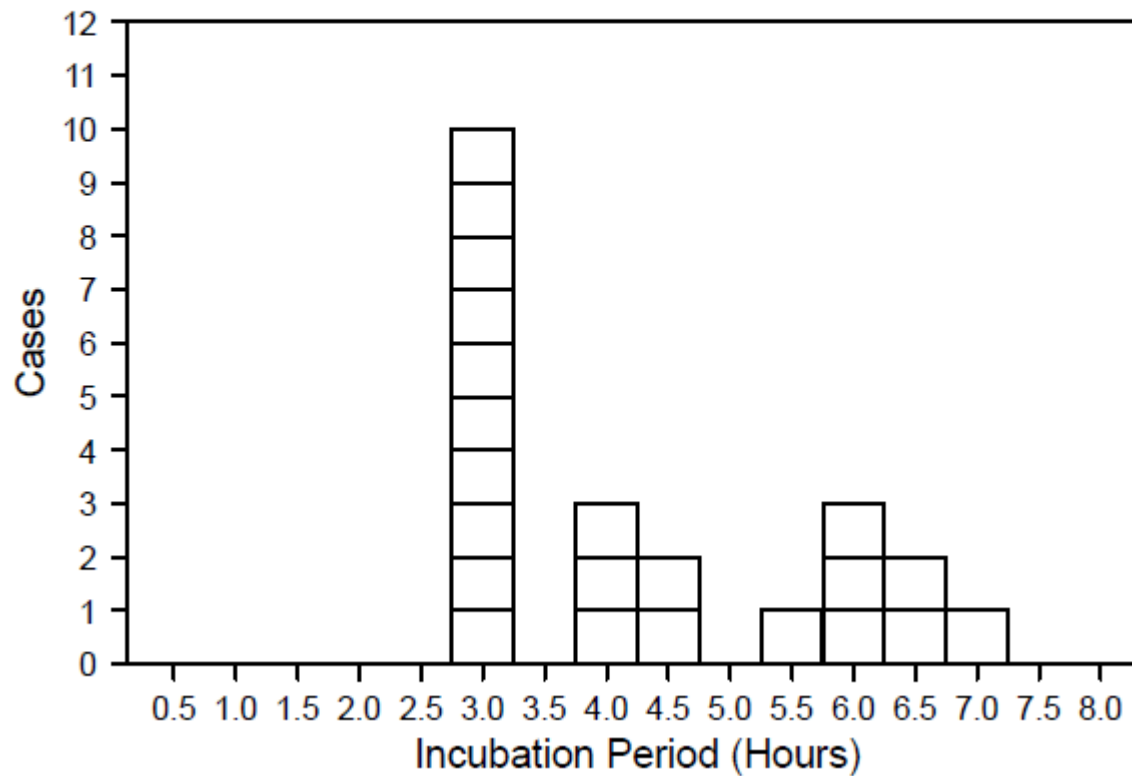
Cases of Gastrointestinal Illness by Time of Onset of Symptoms (Hour Categories) Oswego County, New York, April 18-19, 1940



Incubation Period

| ID | AGE | SEX | TIME OF MEAL | ILL | DATE OF ONSET | TIME OF ONSET | INCUBATION PERIOD |
|----|-----|-----|--------------|-----|---------------|---------------|-------------------|
| 6 | 63 | F | 7:30pm | Y | 4/18 | 10:30pm | 3 |
| 7 | 70 | M | 7:30pm | Y | 4/18 | 10:30pm | 3 |
| 9 | 15 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 21 | 13 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 27 | 15 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 32 | 15 | M | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 33 | 50 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 39 | 16 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 58 | 12 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 65 | 17 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 10 | 33 | F | 7:00pm | Y | 4/18 | 11:00pm | 4 |
| 52 | 8 | M | 11:00am | Y | 4/18 | 3:00pm | 4 |
| 60 | 53 | F | 7:30pm | Y | 4/18 | 11:30pm | 4 |
| 2 | 52 | F | 8:00pm | Y | 4/19 | 12:30am | 4.5 |
| 72 | 18 | F | 7:30pm | Y | 4/19 | 12:00am | 4.5 |
| 71 | 60 | M | 7:30pm | Y | 4/19 | 1:00am | 5.5 |
| 3 | 65 | M | 6:30pm | Y | 4/19 | 12:30am | 6 |
| 4 | 59 | F | 6:30pm | Y | 4/19 | 12:30am | 6 |
| 48 | 20 | F | 7:00pm | Y | 4/19 | 1:00am | 6 |
| 8 | 40 | F | 7:30pm | Y | 4/19 | 2:00am | 6.5 |
| 14 | 10 | M | 7:30pm | Y | 4/19 | 2:00am | 6.5 |
| 59 | 44 | F | 7:30pm | Y | 4/19 | 2:30am | 7 |

Cases of Gastrointestinal Illness
by Incubation Period in Hours
Oswego County, New York; April 18-19, 1940



Incubation Period – Median

| ID | AGE | SEX | TIME OF MEAL | ILL | DATE OF ONSET | TIME OF ONSET | INCUBATION PERIOD |
|----|-----|-----|--------------|-----|---------------|---------------|-------------------|
| 6 | 63 | F | 7:30pm | Y | 4/18 | 10:30pm | 3 |
| 7 | 70 | M | 7:30pm | Y | 4/18 | 10:30pm | 3 |
| 9 | 15 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 21 | 13 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
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| 32 | 15 | M | 10:00pm | Y | 4/19 | 1:00am | 3 |
| 33 | 50 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
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| 58 | 12 | F | 10:00pm | Y | 4/19 | 1:00am | 3 |
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| 10 | 33 | F | 7:00pm | Y | 4/18 | 11:00pm | 4 |
| 52 | 8 | M | 11:00am | Y | 4/18 | 3:00pm | 4 |
| 60 | 53 | F | 7:30pm | Y | 4/18 | 11:30pm | 4 |
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| 72 | 18 | F | 7:30pm | Y | 4/19 | 12:00am | 4.5 |
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| 3 | 65 | M | 6:30pm | Y | 4/19 | 12:30am | 6 |
| 4 | 59 | F | 6:30pm | Y | 4/19 | 12:30am | 6 |
| 48 | 20 | F | 7:00pm | Y | 4/19 | 1:00am | 6 |
| 8 | 40 | F | 7:30pm | Y | 4/19 | 2:00am | 6.5 |
| 14 | 10 | M | 7:30pm | Y | 4/19 | 2:00am | 6.5 |
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| Food Items Served | Number of persons who ATE specified food | | | | Number of persons 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 | 29 | 17 | 46 | 63% | 17 | 12 | 29 | 59% | 1.1 |
| Spinach | 26 | 17 | 43 | 60% | 20 | 12 | 32 | 62% | 1.0 |
| Mashed potato* | 23 | 14 | 37 | 62% | 23 | 14 | 37 | 62% | 1.0 |
| Cabbage salad | 18 | 10 | 28 | 64% | 28 | 19 | 47 | 60% | 1.1 |
| Jello | 16 | 7 | 23 | 70% | 30 | 22 | 52 | 58% | 1.2 |
| Rolls | 21 | 16 | 37 | 57% | 25 | 13 | 38 | 66% | 0.8 |
| Brown bread | 18 | 9 | 27 | 67% | 28 | 20 | 48 | 58% | 1.0 |
| Milk | 2 | 2 | 4 | 50% | 44 | 27 | 71 | 62% | 0.8 |
| Coffee | 19 | 12 | 31 | 61% | 27 | 17 | 44 | 61% | 1.0 |
| Water | 13 | 11 | 24 | 54% | 33 | 18 | 51 | 65% | 0.8 |
| Cakes | 27 | 13 | 40 | 67% | 19 | 16 | 35 | 54% | 1.3 |
| Ice cream, vanilla | 43 | 11 | 54 | 80% | 3 | 18 | 21 | 14% | 5.7 |
| Ice cream, chocolate* | 25 | 22 | 47 | 53% | 20 | 7 | 27 | 74% | 0.7 |
| Fruit salad | 4 | 2 | 6 | 67% | 42 | 27 | 69 | 61% | 1.1 |

* Excludes 1 person with indefinite history of consumption of that food.

1. Food with highest attack rate among consumers: vanilla ice cream (80%)
2. Food with lowest attack rate among non-consumers: vanilla ice cream (14%)
3. Proportion of cases exposed to vanilla ice cream: $43/46 = 93\%$.

| Food Items Served | Number of persons who ATE specified food | | | | Number of persons did NOT eat specified food | | | | Attack Rate Ratio |
|-----------------------|--|---------|-------|---------------------------|--|---------|-------|---------------------------|-------------------|
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