

Outbreak Investigations: The 10-Step Approach

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Objectives

- 1. Understand why outbreak investigations to are important to public health**
- 2. Know the steps of an outbreak investigation**
- 3. Learn to approach outbreak investigations systematically**

Reasons to Investigate an Outbreak

- Identify the source (and eliminate it)
- Develop strategies to prevent future outbreaks
- Evaluate existing prevention strategies
- Describe new diseases and learn more about known diseases
- Address public concern
- It's your job!

When to Investigate

- Consider the following factors:
 - Severity of illness
 - Transmissibility
 - Unanswered questions
 - Ongoing illness/exposure
 - Public concern

Environmental Investigation

- Vital part of investigation
- Should be done *with* (not instead of) epidemiologic investigation

Collecting and Testing Environmental Samples

- Ideally, epidemiologic results guide sample collection
 - Often collected at the same time
- Can support epidemiologic findings
 - Positive or negative results can be misleading

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 epi curve provide valuable information; many investigations never go past this point
- **Coordinate with partners (e.g., environmental and epidemiology)**

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. Find cases systematically and develop line listing
6. Perform descriptive epidemiology/develop hypotheses
7. Evaluate hypotheses/perform additional studies as necessary
8. Implement control measures
9. Communicate findings
10. Maintain surveillance

10 Steps of an Outbreak Investigation

1. Identify investigation team and resources

Investigation Resources

- **Local**
 - Epi teams
- **State**
 - CD Branch epidemiologists / subject matter experts
 - Nurse Consultants
 - PHRST teams
- **Other**
 - Team Epi-Aid (UNC)
 - CDC

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2. Establish existence of an outbreak

What is an Outbreak?

- Increase in cases above what is expected in that population in that area
 - *Four kids with cough and runny nose in a child care center in January?*
 - *Woman vomiting after eating at Restaurant A?*
 - *10 members of the swim team vomiting after eating at Restaurant A?*
 - *One case of smallpox?*

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- 2. Establish existence of an outbreak**
- 3. Verify the diagnosis**

Verify the Diagnosis

- Obtain medical records and lab reports**
- Conduct clinical testing if needed**
 - Consult with CDB, State Lab**

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Components of Case Definition

- Person..... Type of illness
(e.g., “a person with...”)
- Place..... Location of suspected
exposure
- Time..... Based on incubation
(if known)

Start broad!!!

Sample Outbreak Case Definition

Hepatitis A outbreak:

- *Person:* An acute illness involving jaundice or elevated liver function tests
- *Place:* Occurring after visiting or residing on Property A
- *Time:* During May–August 2006

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Example of line listing for an outbreak of hepatitis A

Line Listing of reported suspect cases, page 1

Case #	Initials	Date of Report	Date of Onset	MD Dx	Diagnostic							Lab		Age	Sex
					Signs and Symptoms							HA IgM	Other		
					N	V	A	F	DU	J					
1	JG	10/12	10/6	Hep A	+	+	+	+	+	+	+	+	scot†	37	M
2	BC	10/12	10/5	Hep A	+	-	+	+	+	+	+	+	ALT†	62	F
3	HP	10/13	10/4	Hep A	±	-	+	+	+	S*	+	+	scot†	30	F
4	MC	10/15	10/4	Hep A	-	-	+	+	?	-	+	+	Hbs Ag†	17	F
5	NG	10/15	10/9	NA	-	-	+	-	+	+	NA	NA	NA	32	F
6	RD	10/15	10/8	Hep A	+	+	+	+	+	+	+	+	+	38	M
7	KR	10/16	10/13	Hep A	±	-	+	+	+	+	+	+	scot-240	43	M
8	DM	10/16	10/12	Hep A	-	-	+	+	+	-	+	+	+	57	M
9	PA	10/18	10/7	Hep A	±	-	+	±	+	+	+	+	+	52	F
10	SS	10/11	10/11	r/o Hep A Hep	+	+	+	+	+	+	+	+	+		

S* = scleral F = fever
 N = nausea DU = dark urine
 V = vomiting J = jaundice
 A = anorexia HA IgM = hepatitis A IgM antibody test

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Descriptive Epidemiology

- **Person, place and time**
- **Use line list to summarize information**
 - **Symptoms (type, duration)**
 - **Onset dates: Epidemic Curve**
 - **Demographics**
 - **Exposures**
- **Line lists and epi curves useful in developing hypotheses**

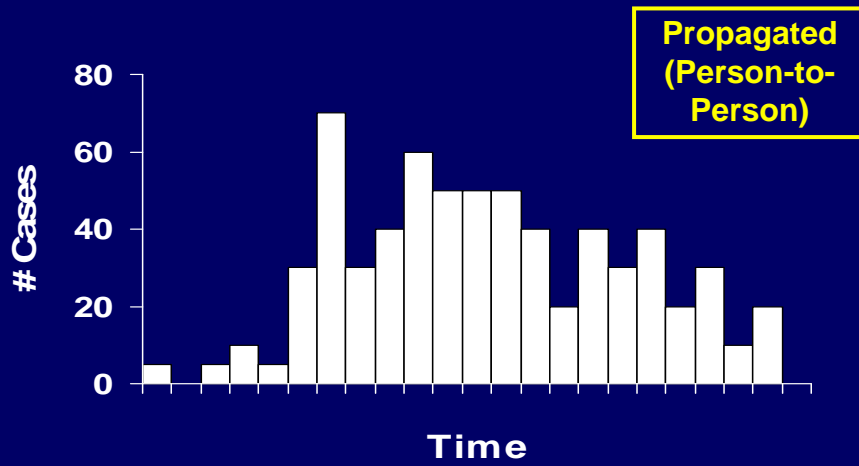
Epi Curves

- **Can suggest type of exposure**
 - **Point-source, person-to-person, etc.**

Epi Curve A



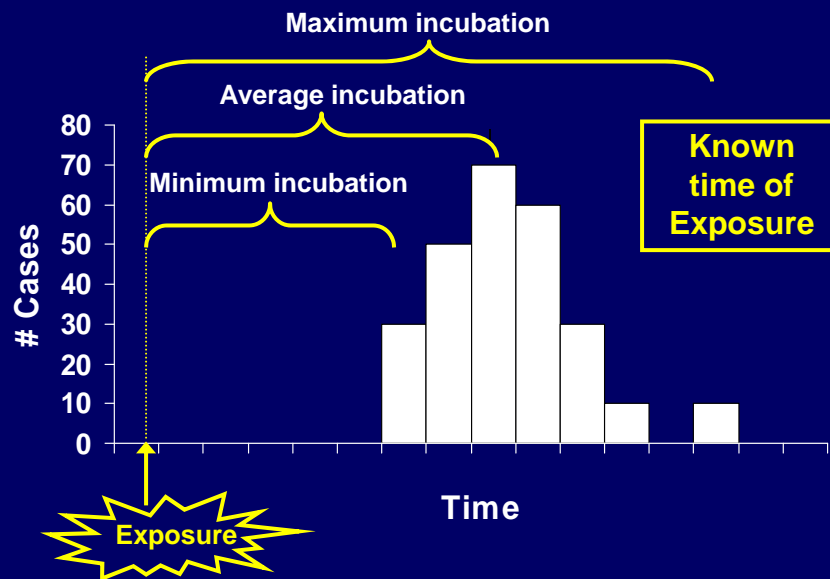
Epi Curve B



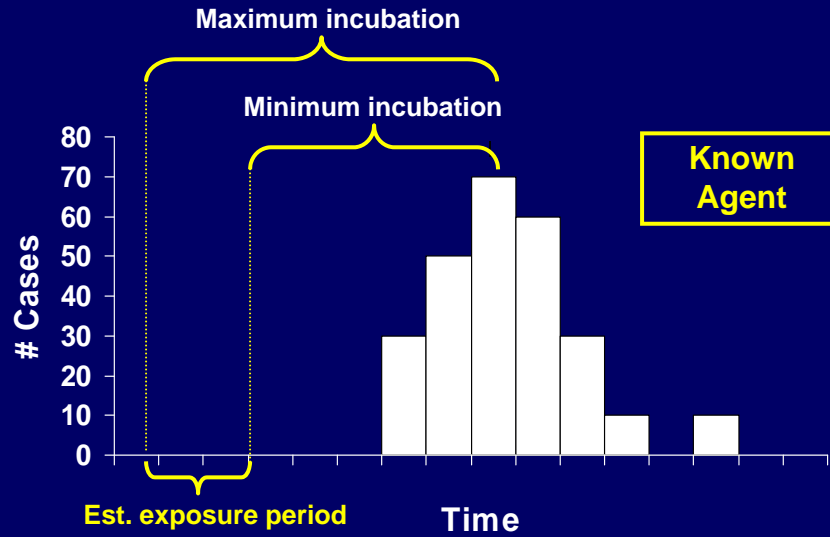
Epi Curves

- Can suggest type of exposure
 - Point-source, person-to-person, etc.
- Can suggest time of exposure (if agent known)
OR
- Can suggest possible agents (if time of exposure known)

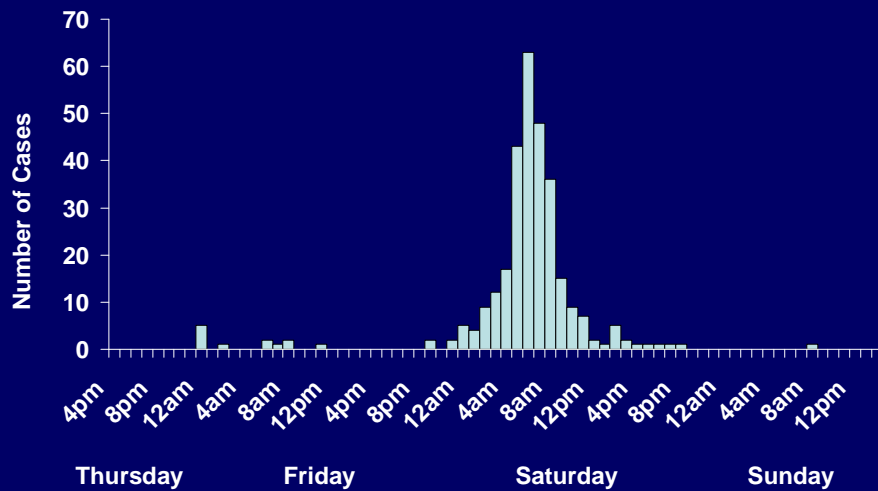
Epidemic Curve & Exposure Period



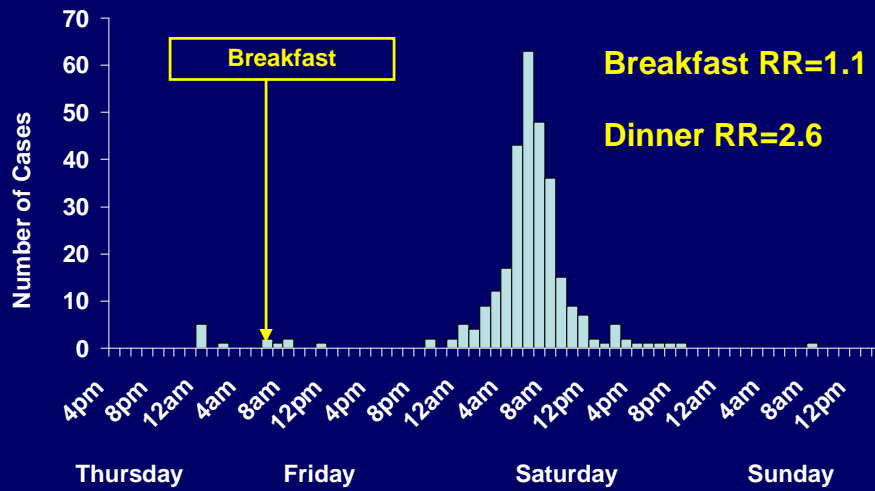
Epidemic Curve & Exposure Period



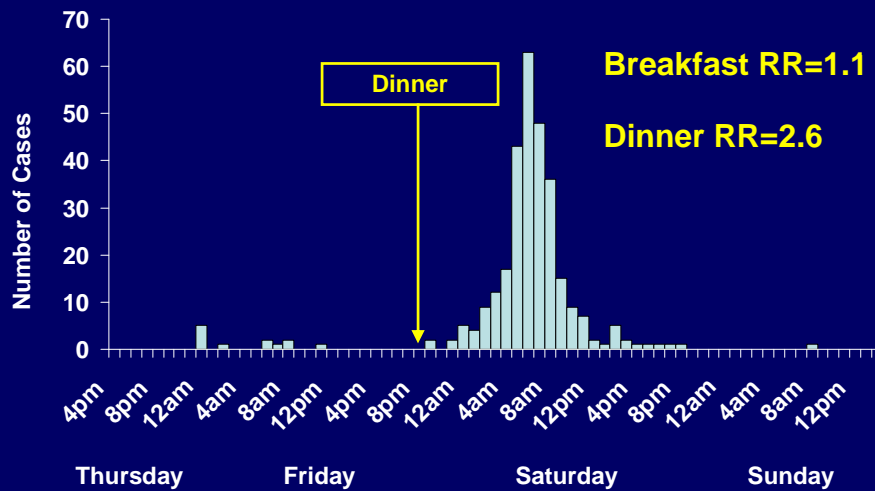
Cases of Gastroenteritis by Time of Symptom Onset (n=307)



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Additional Studies

- Two usually types:
 - Cohort
 - Case-control
- Designed to assess exposures equally among ill and non-ill

Cohort Studies

- Include *EVERYONE* who could have been exposed
 - Only use if a complete list is available
 - Meeting attendees, students, LTCF residents, etc.
- Measure of association = Relative Risk

Relative Risk (RR)

- = 1.0
Risk same among exposed and unexposed
- > 1.0
Risk is HIGHER among exposed
- < 1.0
Risk is LOWER among exposed

Relative Risk: Example

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

“Those who ate Jello were 20% more likely to become ill than those who did not”

Interpretation

If exposure is truly associated with disease

- Relative risk should be high +/- statistically significant
- Most cases should have been exposed - i.e., exposure could “explain” most, if not all, of the cases

Case-Control Studies

- Compare exposures among ill persons (case-patients) and non-ill persons (controls)
- Used when a complete list is not available or too large
 - Restaurant outbreaks, national outbreaks, etc.
- Measure of association = Odds Ratio

Interpretation of OR

- $OR = 1.0$
Same odds of exposure among ill and non-ill
 - $OR > 1.0$
HIGHER odds of exposure among ill
 - $OR < 1.0$
LOWER odds of exposure among ill
- “Ill persons were 20% more likely to have eaten the Jello than non-ill persons”

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Control Measures

- Can occur at any point during outbreak
- Isolation, cohorting, product recall, etc
- Balance between preventing further disease and protecting credibility and reputation of institution
- Should be guided by epidemiologic results in conjunction with environmental investigation

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Inform Public (and Media)

- Public and press are not aware of most outbreak investigations
- Media attention desirable if public action needed
- Response to media attention important to address public concerns about outbreak
 - Single overriding communication objective (SOCO)
- Results of investigations public information

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Maintain Surveillance

- Important for:
 - Deciding if outbreak is over
 - Documenting effectiveness of control measures

Conclusions

- **Epidemiologic investigations are essential to determine source of outbreaks**
- **Be systematic: Follow the steps!**