This is a sample of the instructor resources for Steven T. Fleming, *Managerial Epidemiology: Cases & Concepts*, third edition. The complete instructor resources consist of the following:

- PowerPoint slides for each case study and chapter
- 69-page instructor's manual

The instructor's manual contains answers to the questions posed in the Capstone Cases at the end of the book. This sample includes the PowerPoint slides and the answers to the questions for Capstone Case A.

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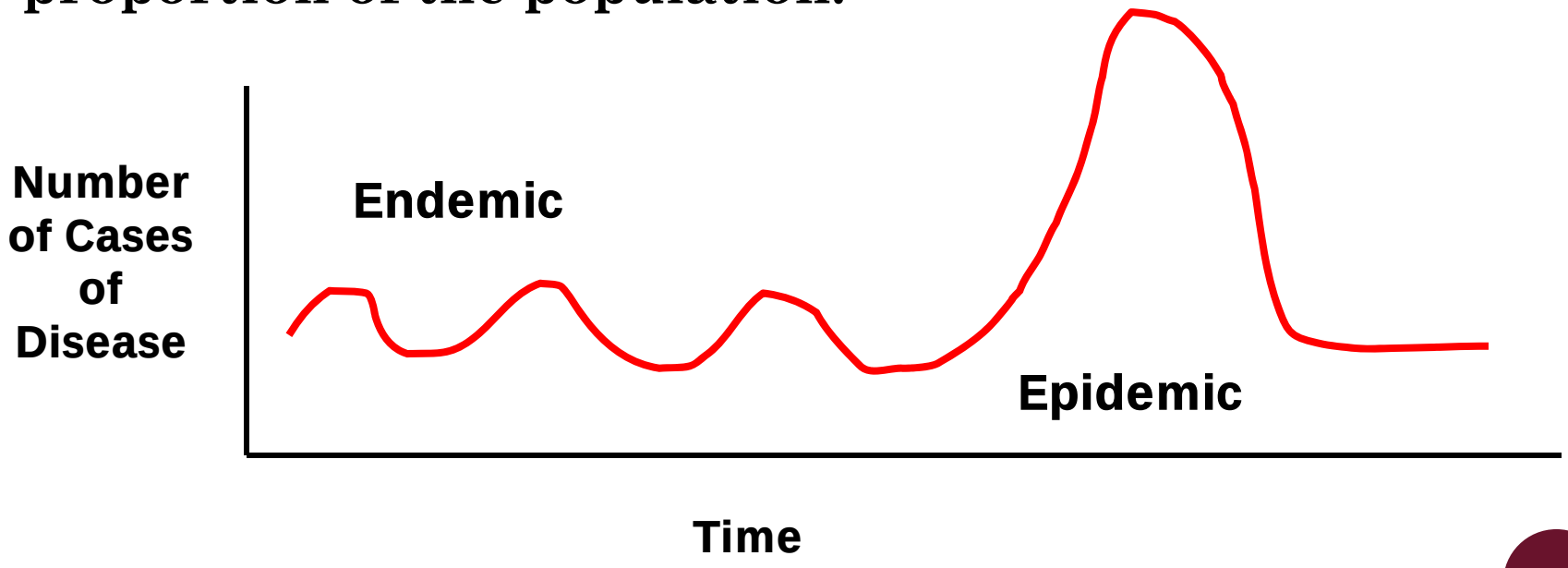
CAPSTONE CASE A

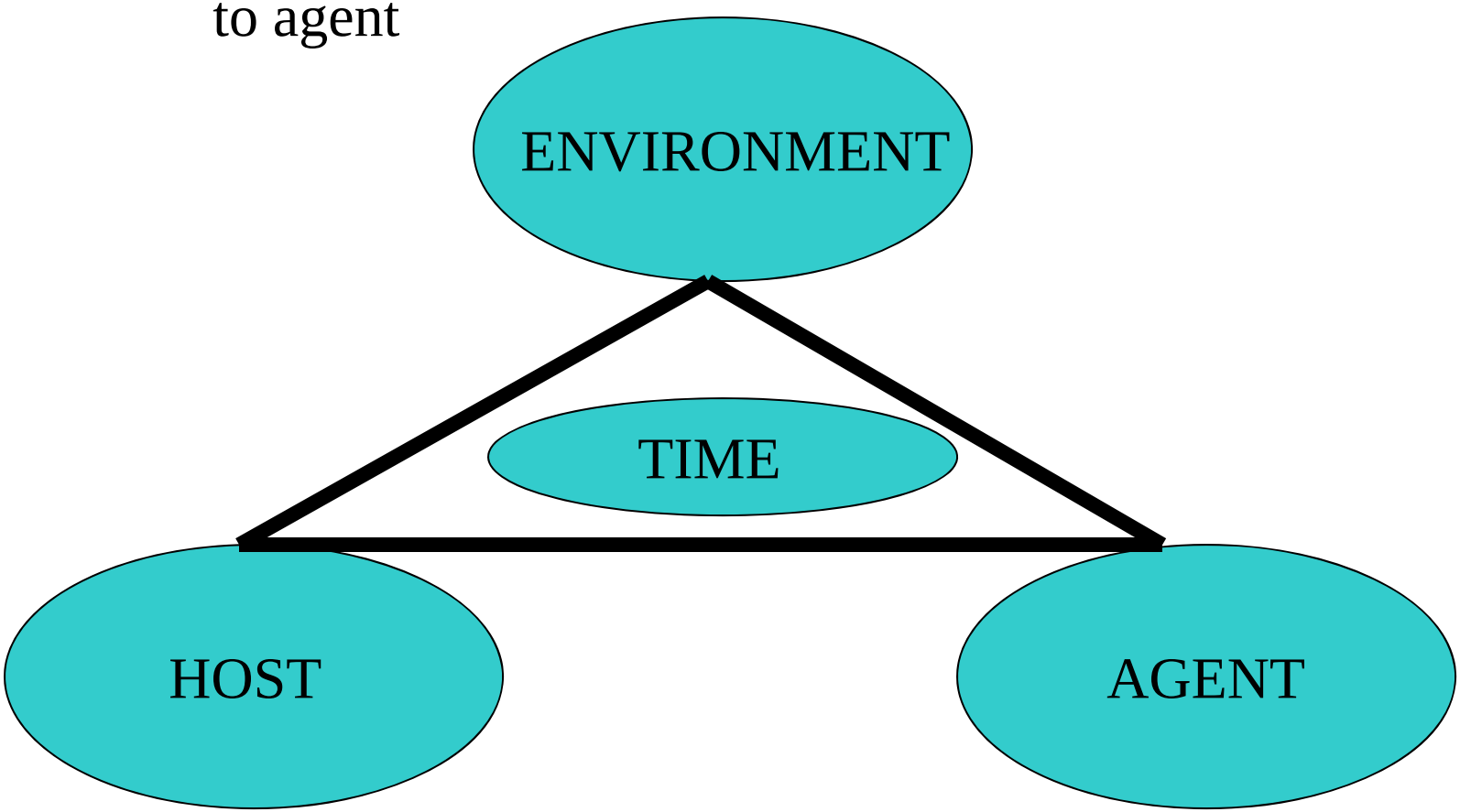
Hepatitis A Outbreak in the Midwest

Endemic, Epidemic, and Pandemic

- Endemic is the "normal" level of disease.
- Epidemic is an above-normal level of disease.
- Pandemic is an epidemic occurring globally or over a very wide area and usually affecting a large proportion of the population.



External conditions in which host exposed to agent



The organism harboring the disease

Disease-causing factor

AGENT–HOST–ENVIRONMENT TRIANGLE

Types of Disease transmission

- **Direct (contact, droplet, transplacental, animal bite, environmental)**
- **Indirect (animate, inanimate, vector borne, fomites)**
  - **Vector: a living carrier of disease**
  - **Fomite: inanimate objects that facilitate disease transmission**

RESERVOIR

- The "place" where infectious agents normally live and multiply
- The reservoir may or may not be the source from which an agent is transferred to a host.
  - Clostridium botulinum spore — Reservoir is soil, but the agent of transmission is most often contaminated food.
  - Aspergillosis (fungus) – Reservoir is decaying vegetation in the soil, but the agent could be flowers, raw vegetables, and pepper.

TYPES OF CARRIERS

- **Carrier** – spreads infectious agent
  - **Active/healthy/passive carrier** – exposed to agent, can spread disease, no symptoms
  - **Convalescent carrier** – infectious but recovering
  - **Incubatory carrier** – infectious, beginning phase of disease
  - **Intermittent carrier** – spreads disease intermittently

TYPES OF CASES

- Case – person diagnosed with disease
- Primary case – first case in population in epidemic with disease
- Index case – first case recognized in epidemic
- Secondary cases – got disease from primary case
- Recurring case – person gets disease again
- New case – part of incidence calculations
- Suspect case – signs/symptoms but undiagnosed

Table 1. Line Listing 40 Cases. Hepatitis A Outbreak in Midwest State

	Sex	Age	Symptoms	Date Symp	Date Ate	IP	O	T	T+	T-	C	C+	C-	M	M +	M-	R	G	L	K	P	S	Ci	P g
1	F	34	A,N,V,F,J	13-Nov	11-Oct		√				√	√					√			√		√		√
2	F	66	N,V,J	17-Nov	20-Oct		√																	
3	M	45	N,V,J	18-Nov	4-Nov		√																	
4	F	25	A,N,V,F,J	20-Nov	23-Oct		√	√	√		√	√												
5	M	56	A,N,V,F,J	21-Nov	26-Oct		√				√	√		√	√		?	√	√					
6	F	52	A,N,V,F,J	22-Nov	19-Oct		√	√		√														
7	F	41	N,V,J	22-Nov	25-Oct		√											√				√		
8	M	23	N,V,J	22-Nov	23-Oct		√											√		√				
9	M	31	N,V,J	22-Nov	30-Oct		√	√	√		√	√					√							
10	F	16	N,V,J	22-Nov	2-Nov		√	√		√	√										?			
11	M	45	N,V,J	23-Nov	30-Oct		√				√			√		√	√	√						√
12	F	28	N,V,J	23-Nov	21-Oct		√				√	√					√		√					
13	F	27	A,N,V,F,J	23-Nov	26-Oct		√	√	√		√													
14	M	35	A,N,V,F,J	23-Nov	17-Oct		√	√		√	√			√	√		√			√				
15	M	56	N,V,J	24-Nov	28-Oct		√	√		√	√	√									?		√	
16	M	5	N,V,J	24-Nov	3-Nov		√										√			√				
17	F	13	N,V,J	24-Nov	31-Oct		√				√	√							√				√	√
18	F	12	N,V,J	24-Nov	24-Oct		√				√	√		?										
19	M	55	A,N,V,F,J	24-Nov	15-Oct		√				√													
20	F	43	A,N,V,F,J	24-Nov	29-Oct		√	√	√		√							√	√			√		

Table 1. Line Listing 40 Cases. Hepatitis A Outbreak in Midwest State

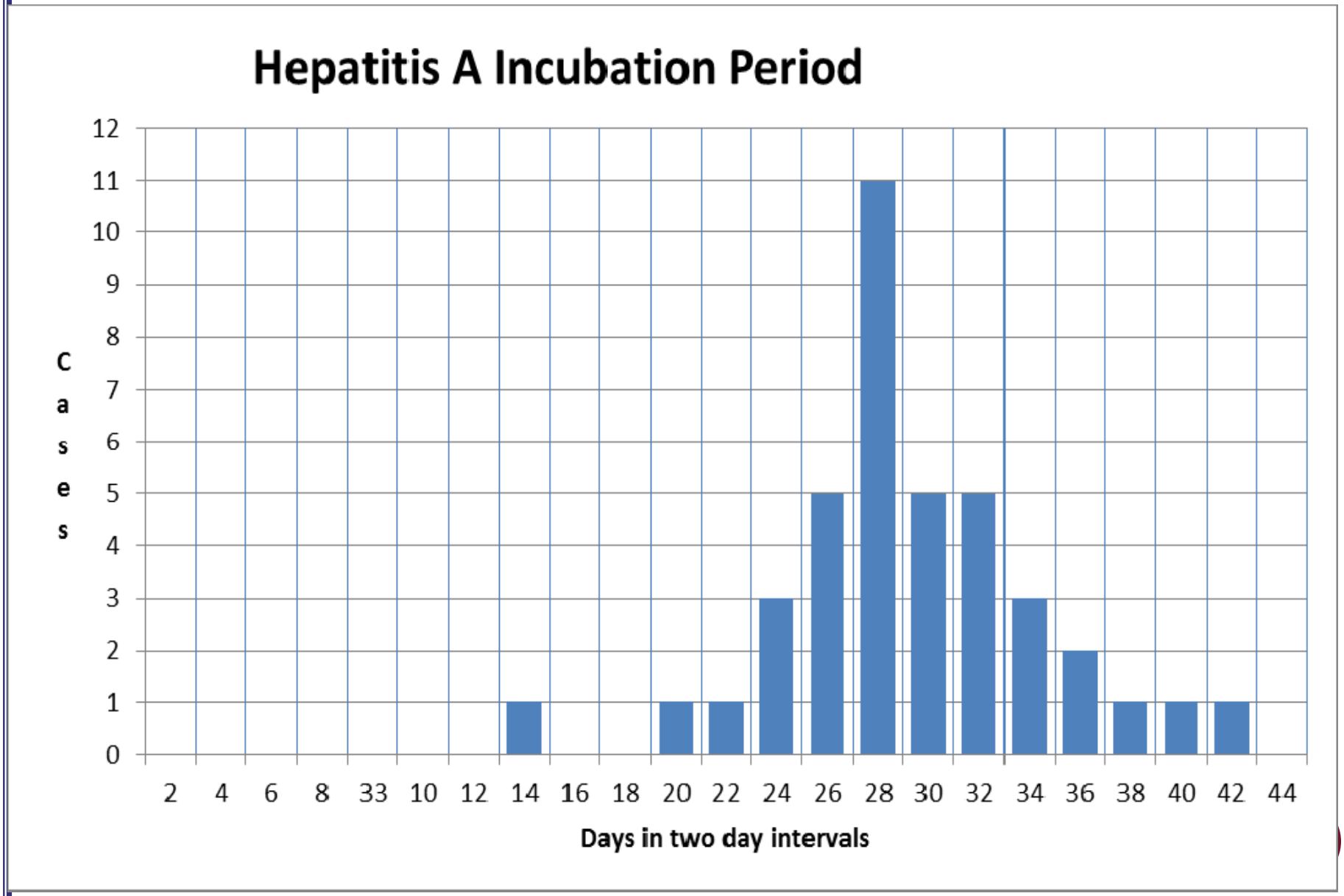
	Sex	Age	Symptoms	Date Symp	Date Ate	IP	O	T	T+	T-	C	C+	C-	M	M+	M-	R	G	L	K	P	S	Ci	Pg
21	M	35	A,N,V,F,J	25-Nov	24-Oct		√									?	√							
22	F	21	A,N,V,F,J	25-Nov	26-Oct		√	√		√	√	√									√			
23	M	14	A,N,V,F,J	25-Nov	25-Oct		√															√		
24	M	62	N,V,J	25-Nov	31-Oct		√				√	√						?					√	
25	M	64	N,V,J	27-Nov	1-Nov		√							√	√						√		√	√
26	F	14	N,V,J	27-Nov	30-Oct		√	√	√		√	√				?	√			√		√		
27	F	15	N,V,J	27-Nov	31-Oct		√											?						
28	M	10	N,V,J	27-Nov	22-Oct		√	?		?	√	√							√	√				
29	F	41	N,V,J	27-Nov	28-Oct		√							√	√			√				√		
30	F	30	A,N,V,F,J	27-Nov	27-Oct		√							√		√			√			√		
31	M	34	A,N,V,F,J	27-Nov	30-Oct		√										?			√				
32	M	46	N,V,J	28-Nov	23-Oct		√	?	√		√									√			√	
33	F	42	N,V,J	28-Nov	29-Oct		√										√							√
34	F	32	N,V,J	28-Nov	1-Nov			√	√		√						√					√	√	
35	M	27	A,N,V,F,J	28-Nov	2-Nov		√				√	√		√		√								
36	F	25	A,N,V,F,J	28-Nov	18-Oct		√				√	√						√						
37	M	18	A,N,V,F,J	28-Nov	1-Nov		√	√	√									√						
38	F	17	A,N,V,F,J	30-Nov	2-Nov						√												√	
39	M	10	A,N,V,F,J	1-Dec	1-Nov		√																	
40	M	12	A,N,V,F,J	3-Dec	2-Nov		√				√						√		√					√

Incubation Period

- Interval between exposure to agent and onset of illness
  - Difference between disease and illness
  - A statistical distribution
  - Varies considerably by agent

Incubation Periods

- Botulism 12-36 hours
- Common cold 12-72 hours (usually 24)
- Conjunctivitis 1-3 days
- Influenza 1-3 days
- Bacterial/viral pneumonia 1-3 days
- Gonorrhea 2-5 days
- Meningitis 2-10 days
- Herpes simplex virus up to 2 weeks
- Measles 12-26 days
- Dysentery 2-4 weeks
- Epstein-Barr (mononucleosis) 4-7 weeks
- Serum hepatitis 45-160 days



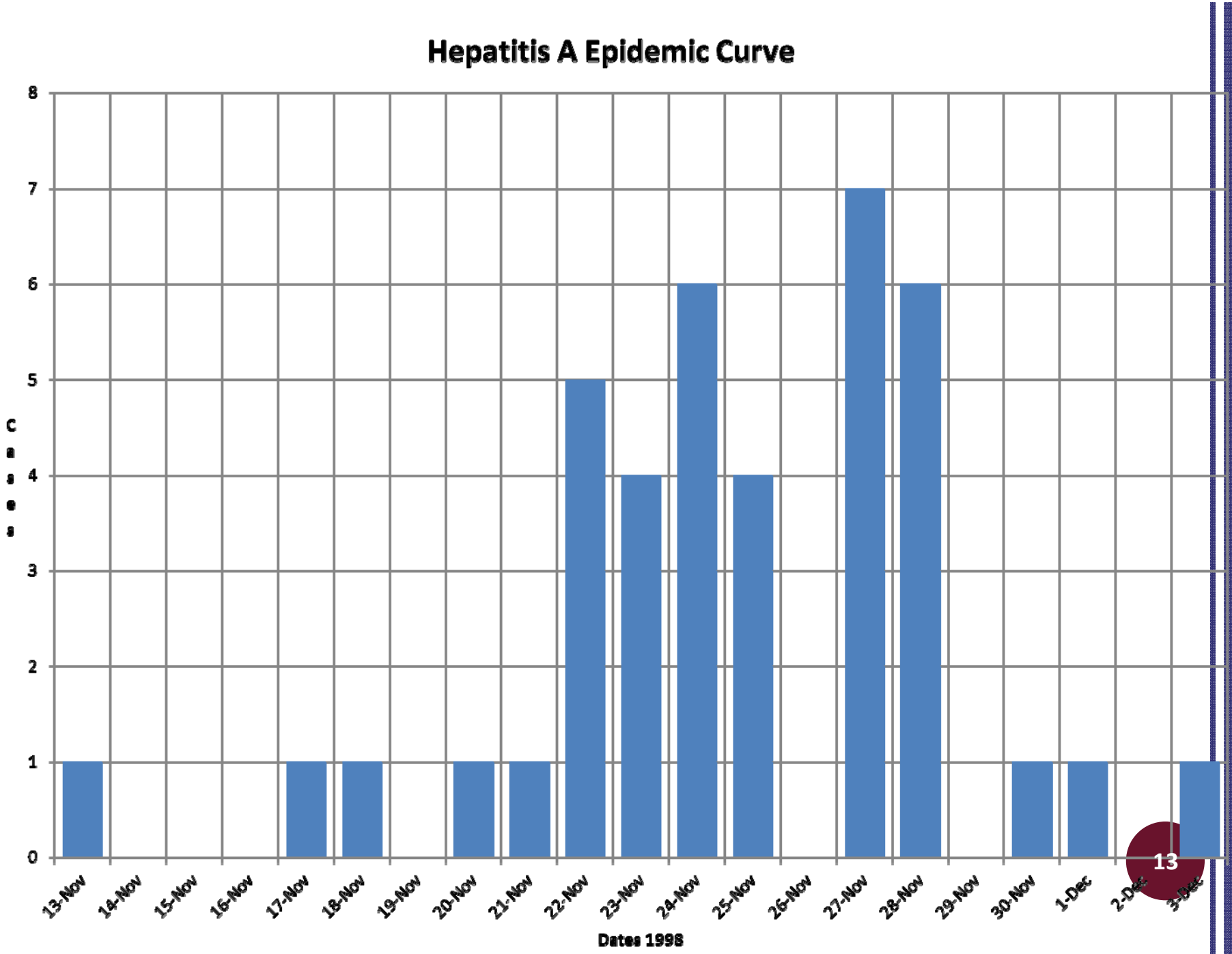


Table 1. Consumption of Food by Case Patients and Control Subjects Who Ate at Restaurant A Between October 17 and November 4, 1998, County R (City Two)

	Case Patients (n = 40)	Control Subjects (n = 64)	
Menu Items Containing:	# who ate/#total (%)*	# who ate/#total (%)*	Odd's Ratio (95% CI)
Romaine Lettuce			
Mixed greens			
Shredded lettuce (packaged)			
Kale			
Green pepper			
Diced tomatoes			
Green onions			
Spanish onion			
Cilantro			
Pico de Gallo			
Grated cheddar or jack cheese			
Honey-mustard sauce			

* The total number of study participants varied depending on whether they recalled eating the food item.

Kinds of Prevention

- Primary prevention – stop disease before it starts
- Secondary prevention – detect disease early (screening)
- Tertiary prevention – limit degree of disability

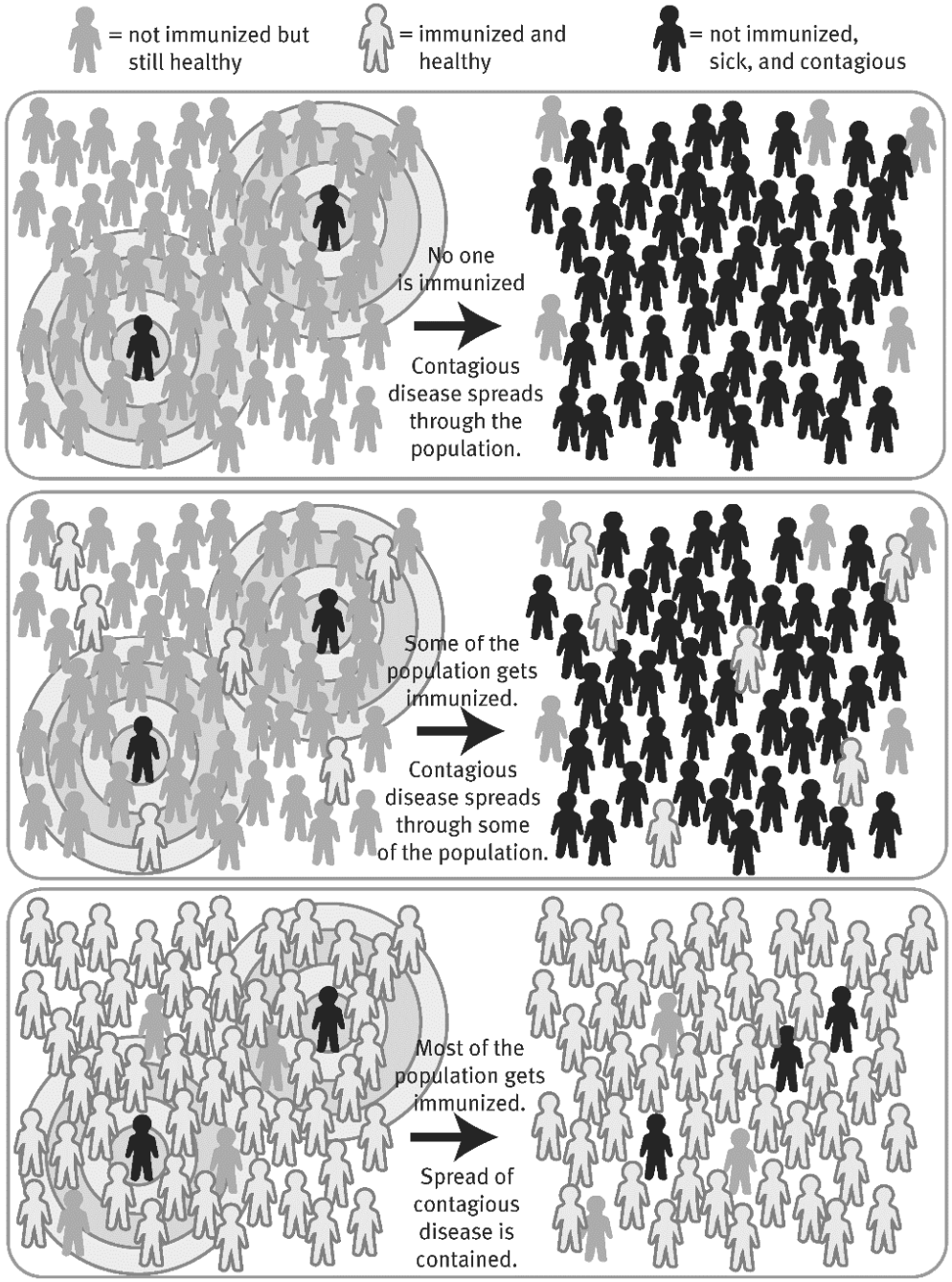
How To Prevent and control disease

- Destroy agent
  - Pasteurization, chlorination, radiation of meat, heat
- Break cycle of transmission
  - Eliminate means of transmission (e.g., drain swamp, sewage treatment)
  - Reduce direct contact (e.g., wear condoms)
- Increase immunization/resistance
  - Immunization programs, good health habits
- Reduce risk factors
  - Behaviors, diet etc.
  - Good hygiene, food handling, protective clothing, repellants
- Isolate infectious cases
  - Isolation – separate infectious cases during communicability
  - Quarantine – limit freedom/movement of exposed well people

GENERAL PRINCIPLES IN EPIDEMIOLOGY

- **Herd immunity - The immunity of a group or community. The resistance of a group to invasion and spread of an infectious agent, based upon the resistance to infection of a high proportion of individual members of the group. The resistance is a product of the number of susceptibles and the probability that those who are susceptible will come into contact with an infected person.**

EXHIBIT 2.6
How Herd Immunity Prevents an Epidemic



Note to the Instructor: Please use your discretion about distributing these answers to your students. Some instructors may use these Capstone Cases as gradable assessments.

Capstone Cases Answers

CASE A: HEPATITIS A OUTBREAK IN THE MIDWEST

ANSWERS

1. *Epidemic* and *outbreak* are equivalent: more cases of disease than expected. *Outbreak* may be used to refer to more localized or shorter episodes than *epidemic*. The 48 cases of disease in Country R and County L put the rate of disease well above the expected or background level.
2. Steps of an outbreak investigation:
    a. Verify the diagnosis.
    b. Establish the existence of an epidemic.
    c. Identify potential investigation team and resources and prepare for field work (e.g., administration, clearance, travel, contacts, designation of lead investigator).
    d. Construct a working case definition.
    e. Find cases systematically, develop line listing.
    f. Perform descriptive epidemiology.
    g. Develop hypotheses.
    h. Evaluate hypotheses.
    i. Reconsider and refine hypotheses and execute additional studies as necessary.
    j. Implement control and prevention measures as early as possible.
    k. Communicate findings: summarize investigation for requesting authority and prepare written report(s).
    l. Maintain surveillance to monitor trends and evaluate control and prevention measures.
3. Bacteria (e.g., *Salmonella sp.*, *Shigella sp.*, *Vibrio cholerae*), viruses (e.g., norovirus, rotavirus), parasites (e.g., *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium sp.),* toxins (e.g., Scombroid fish poisoning, *Staphylococcus aureus* enterotoxin), and noninfectious etiologies (e.g., heavy metals, drugs, radiation).
4. Characteristics of infectious agents
    a. Infectivity is the ability of an agent to colonize and/or invade a host.
    b. Pathogenicity is the ability of the agent to produce disease, which depends on the rapidity and extent of agent multiplication, extent of disease damage, and whether agent produces toxin. In food-borne illness, disease can be produced either by a toxin already present in the food (e.g., *Staphylococcus aureus*) or by invasion of the infectious agent (e.g., *Salmonella sp*.). The incubation period varies by characteristics of the organism, including associated toxins.
    c. Virulence is a quantitative measure of the likelihood of a pathogen to cause disease. It is also used to describe the severity of disease caused by an organism.
5. Measures of morbidity

a. Infectivity is measured either by the primary attack rate (number who meet the case definition divided by the number exposed) or by the secondary attack rate (number exposed to a primary case with disease divided by the number exposed to a primary case).

b. Pathogenicity can be measured by the pathogenicity rate (number infected with clinical disease divided by the total number infected).

c. Virulence is measured by the case fatality rate (number of cases who died divided by the total number of cases).

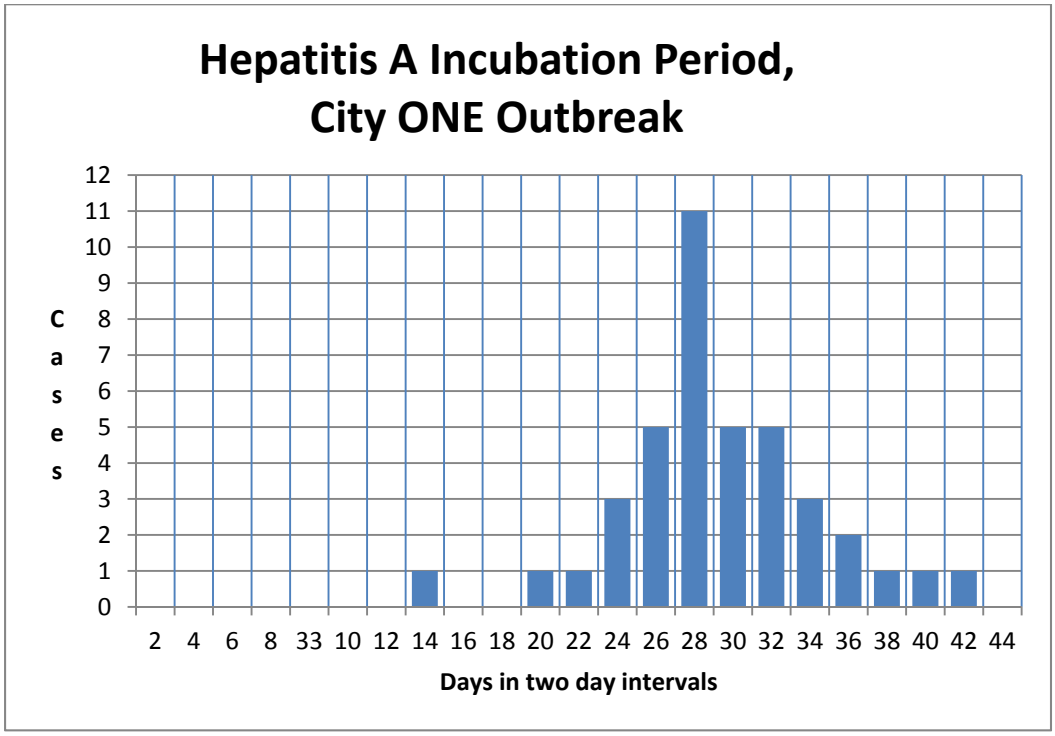
6. With direct transmission, the organism is transferred from the habitat in which it lives, grows, and multiplies (reservoir) to the host by either direct contact (kissing, sex, shaking hands) or by droplet spread (sneezing, coughing). Indirect transmission occurs when nonhuman carriers of the pathogen (e.g., vectors such as mosquitoes) transmit the organism, or it is transmitted via a vehicle (water, food, dust) or by the air (e.g., Tuberculosis). Individuals infected with hepatitis A may have asymptomatic or subclinical infections but be shedding virus in the stool.
7. Hepatitis A virus (HAV) causes hepatitis A. It is transmitted via the fecal–oral route. In susceptible older children and adults (those who have never had HAV infection and have not been immunized) it causes an illness characterized by a flu-like prodrome followed by symptoms including fatigue, abdominal discomfort, anorexia, light stools, and jaundice. Young children are often asymptomatic. Contaminated food or water are common vehicles for HAV transmission, and travel to endemic countries is currently (2014) the biggest risk factor for infection in US residents.
8. A "carrier" is a source of infectious agents and may transmit them to others. Carriers can be symptomatic or asymptomatic. In this investigation both patrons and food handlers are potential sources of HAV. Patrons could spread the disease to friends and family via close personal contact or by contaminating food or water. Food handlers could spread the disease to friends, family, and patrons by contaminating foods that are served raw, such as salads and garnishes, or by contamination of pastries that are handled after baking. HAV is inactivated by heating to 85°C; however, freezing does not inactivate the virus.
9. The incubation period is the time interval between contact with the agent (eating at the restaurant) and the onset of illness. A frequency distribution of the incubation period of the cases provides some information regarding the possible pathogen. Initial contact is not always easy to ascertain, which may introduce a bias in the determination of incubation periods.

Incubation periods for cases						
	Sex	Age	Symptoms	Date Symp	Date Ate	IP
1	F	34	A,N,V,F,J	13-Nov	11-Oct	33
2	F	66	N,V,J	17-Nov	20-Oct	28
3	M	45	N,V,J	18-Nov	4-Nov	14
4	F	25	A,N,V,F,J	20-Nov	23-Oct	28
5	M	56	A,N,V,F,J	21-Nov	26-Oct	26
6	F	52	A,N,V,F,J	22-Nov	19-Oct	34
7	F	41	N,V,J	22-Nov	25-Oct	28

8	M	23	N,V,J	22-Nov	23-Oct	30
9	M	31	N,V,J	22-Nov	30-Oct	23
10	F	16	N,V,J	22-Nov	2-Nov	20
11	M	45	N,V,J	23-Nov	30-Oct	24
12	F	28	N,V,J	23-Nov	21-Oct	33
13	F	27	A,N,V,F,J	23-Nov	26-Oct	28
14	M	35	A,N,V,F,J	23-Nov	17-Oct	37
15	M	56	N,V,J	24-Nov	28-Oct	27
16	M	5	N,V,J	24-Nov	3-Nov	21
17	F	13	N,V,J	24-Nov	31-Oct	24
18	F	12	N,V,J	24-Nov	24-Oct	31
19	M	55	A,N,V,F,J	24-Nov	15-Oct	40
20	F	43	A,N,V,F,J	24-Nov	29-Oct	26
21	M	35	A,N,V,F,J	25-Nov	24-Oct	32
22	F	21	A,N,V,F,J	25-Nov	26-Oct	30
23	M	14	A,N,V,F,J	25-Nov	25-Oct	31
24	M	62	N,V,J	25-Nov	31-Oct	25
25	M	64	N,V,J	27-Nov	1-Nov	26
26	F	14	N,V,J	27-Nov	30-Oct	28
27	F	15	N,V,J	27-Nov	31-Oct	27
28	M	10	N,V,J	27-Nov	22-Oct	36
29	F	41	N,V,J	27-Nov	28-Oct	30
30	F	30	A,N,V,F,J	27-Nov	27-Oct	31
31	M	34	A,N,V,F,J	27-Nov	30-Oct	28
32	M	46	N,V,J	28-Nov	23-Oct	36
33	F	42	N,V,J	28-Nov	29-Oct	30
34	F	32	N,V,J	28-Nov	1-Nov	27
35	M	27	A,N,V,F,J	28-Nov	2-Nov	26
36	F	25	A,N,V,F,J	28-Nov	18-Oct	41
37	M	18	A,N,V,F,J	28-Nov	1-Nov	27
38	F	17	A,N,V,F,J	30-Nov	2-Nov	28
39	M	10	A,N,V,F,J	1-Dec	1-Nov	30
40	M	12	A,N,V,F,J	3-Dec	2-Nov	31
*Data are modified from the original investigation for teaching purposes						

10. 13–14 days (1); 19–20 days (1); 21–22 days (1); 23–24 days (3); 25–26 days (5); 27–28 days (11); 29–30 days (5); 31–32 days (5); 33–34 days (3); 35–36 days (2); 37–38 days (1); 39–40 days (1); 41–42 days (1)
11. The modal incubation period is 28 days. The incubation period can be used to determine which agent might be the cause of the outbreak. The incubation period for these cases was consistent with the agent, HAV (mean = 28 days, range 14–42 days). The serology results (i.e., presence of IgM antibody to hepatitis A virus indicating recent infection) and the symptomology of the cases (i.e., jaundice) confirms that the infecting agent was HAV. The hepatitis A case definition published by the Council of State and Territorial Epidemiologists [CSTE] follows:

Table 1. Incubation Period Hepatitis A Outbreak



Clinical Description

An acute illness with a discrete onset of any sign or symptom consistent with acute viral hepatitis (e.g., fever, headache, malaise, anorexia, nausea, vomiting, diarrhea, and abdominal pain), and either a) jaundice, or b) elevated serum alanine aminotransferase (ALT) or aspartate aminotransferase (AST) levels.

Laboratory Criteria for Diagnosis

Immunoglobulin M (IgM) antibody to hepatitis A virus (anti-HAV) positive

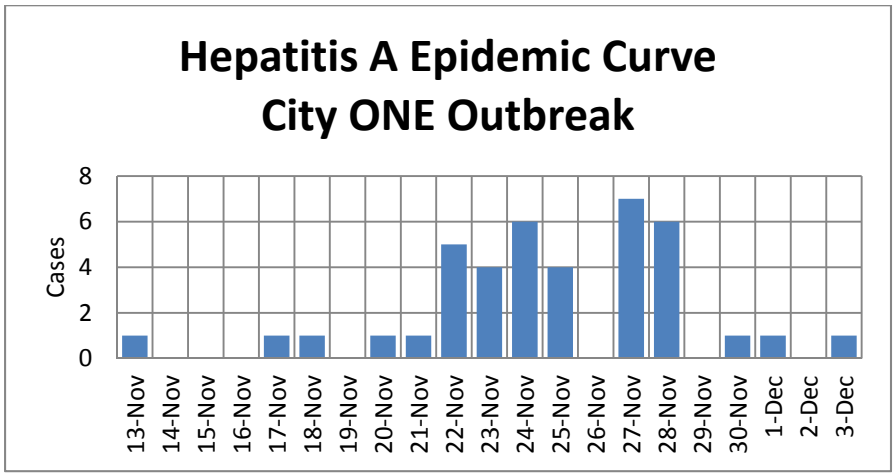
Case Classification

Confirmed

- A case that meets the clinical case definition and is laboratory confirmed, OR
- A case that meets the clinical case definition and occurs in a person who has an epidemiologic link with a person who has laboratory-confirmed hepatitis A (i.e., household or sexual contact with an infected person during the 15–50 days before the onset of symptoms)

12. An epidemic curve is a graph with number of confirmed cases on the Y-axis and time along the X-axis. The graph illustrates the magnitude and duration of the epidemic and provides clues as to the pattern of spread, whether there are any outliers, and whether the epidemic is on the upswing or nearly ended. See Table 2.

Table 2. Hepatitis A Epidemic Curve, City ONE Outbreak



13. See Table 3.

Table 3. Consumption of Food By Case Patients and Control Subjects Who Ate At Restaurant A Between October 17 and November 4, 1998, County R (City ONE)

	Case Patients (n = 40)	Control Subjects (n = 64)	
Menu Items Containing:	# who ate/#total (%)*	# who ate/#total (%)*	Odds Ratio (95% CI)
Romaine Lettuce	11/38 (29)	13/59 (22)	1.44 (0.57–3.66)
Mixed greens	8/38 (21)	14/60 (23)	0.88 (0.33–2.34)
Shredded lettuce (packaged)	7/40 (18)	14/63 (22)	0.74 (0.27–2.03)
Kale	8/40 (20)	6/64 (9)	2.42 (0.77–7.58)
Green pepper	2/38 (5)	2/64 (3)	1.72 (0.23–12.76)
Diced tomatoes	12/38 (32)	8/64 (13)	3.23 (1.18–8.85)
Green onions	38/40** (95)	30/60 (50)	19.0 (4.2–85.95)
Spanish onion	8/40 (20)	10/64 (16)	1.35 (0.48–3.77)
Cilantro	7/40 (17)	7/64 (11)	1.73 (0.56–5.36)
Pico de gallo	6/40 (15)	3/64 (5)	3.59 (0.84–15.27)
Grated cheddar or jack cheese	24/40 (60)	20/60 (33)	3.00 (1.31–6.88)
Honey-mustard sauce	7/39 (18)	3/64 (5)	4.45 (1.08–18.37)

* The total number of study participants (denominator) varied depending on whether they recalled eating the food item.

**Of the two case-patients who did not report eating a menu item which contained green onions both had a dinner partner who had a menu item which contained green onions.

14. All but mixed greens, shredded lettuce, and green pepper.

15. Green onions.

16. Most foods contain a combination of ingredients.
17. When stratified by whether the menu item also contained green onions, menu items that did not contain green onions were not associated with illness (i.e. the confidence interval of the odds ratio contained 1.0).

18. Only Restaurant Y was associated with an increased risk of disease. Hepatitis A cases had an estimated 46 times the odds of having eaten at Restaurant Y compared with controls, and we are 95 percent confident that the true odds were between 11 and 226 times that of controls.

19. Serologic testing was obtained for 15 (94 percent) employees working in Restaurant Y during the three months prior to the outbreak. One employee had ceased working at Restaurant Y by the time of the investigation and was unavailable for follow-up. Of the 15 workers, one was IgM anti-HAV positive. This person was employed 20 hours per week as a grill cook and was responsible for preparation of hot and cold foods at breakfast and lunch. He denied any symptoms in the previous three months; his alanine aminotransferase (ALT) level was 2.5 times the upper limit of normal. He lived with his wife and four small children. No potential source of his infection could be identified.

20. The results of the City One/County R investigation indicate that a common source outbreak of hepatitis A occurred in Restaurant A. All 42 cases reported eating at Restaurant A and 40 of 42 (95 percent) reported eating a menu item that contained green onions. Eating green onions was strongly associated with illness in the case–control study. In contrast, in City Two, no food item could be clearly associated with illness; however, there was a food handler with serologic evidence of recent HAV infection who could have been the source of the outbreak. Persons who reported eating foods that were less likely to be handled appeared to have less risk for infection, suggesting the chef may have contaminated food items that were not subsequently cooked and thus became vehicles for infection.

The findings and conclusions in this case are those of the authors and do not necessarily represent the official position of the Centers for Disease Control or the National Institutes of Health.