The Centers for Disease Control and Prevention's Vessel Sanitation Program is proud to bring to you the following session:

Outbreak Investigations

While this presentation is primarily intended for cruise vessels under the jurisdiction of the Vessel Sanitation Program it may also be used by anyone who is interested in this topic.

This session should not be used as a replacement for existing interactive training but should be used as an adjunct to a comprehensive training program.

Outbreak Investigations

Vessel Sanitation Program
2007

Learning Objectives

- To understand the Vessel Sanitation Program (VSP) Gastrointestinal Illness Surveillance System (GISS)
- To describe what is involved in Gastrointestinal Illness (GI) outbreak investigations
- To explain roles and responsibilities for case reporting and outbreak investigations

Case tracking and management

Case Tracking: Gastrointestinal Illness Log ("GI Log")

- The foundation document of the VSP surveillance system:
  - A line-listing of cases of GI illness reported to the ship's medical staff
  - Used to gather information to manage and report cases GI illness
  - Used in all outbreak investigations
- Required for each cruise/voyage

Contents of the GI Log

- First date of clinic visit/report to staff of illness
- Name, age, gender of case-patient
- Designation of passenger or crew
- Crew position
- Cabin number
- Dining room meal seating (e.g., 1st or 2nd)

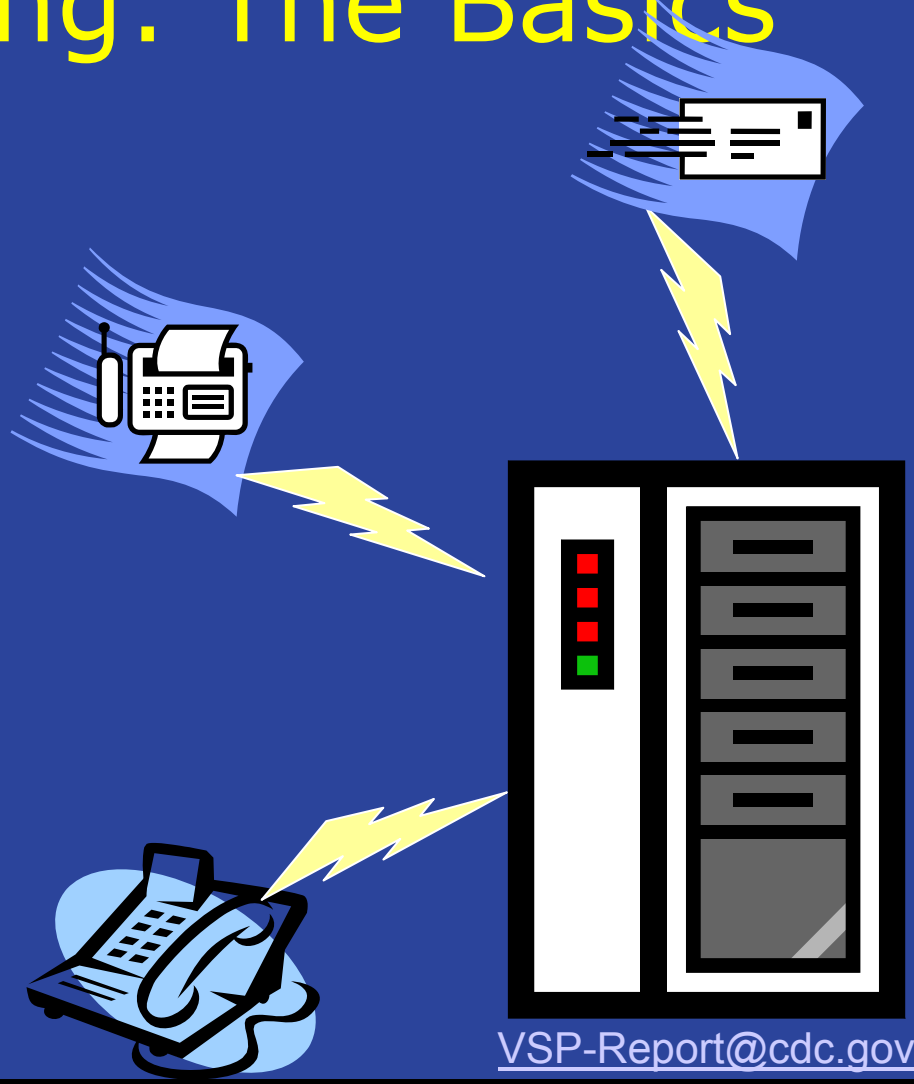
Contents of the GI Log

- Date/time of illness onset
- Illness symptoms
- Stool specimen requested/received
- Anti-diarrheal medication dispensed
- Underlying medical conditions

Gastrointestinal Illness Reporting System

Case Reporting: The Basics

- Web or E-mail-based system of reporting
- Back-up reporting methods:
  - Fax
  - Telephone
  - General e-mail
- Standard set of fields
- Required for all ships under VSP jurisdiction



VSP-Report@cdc.gov

Case Reporting: Reporting Requirements

- **Routine reporting**
  - 24-36 hours prior to arrival
  - 4-hours prior to arrival
- **Special reporting**
  - Notification: ≥ 2% pax/crew
  - Outbreak: ≥ 3%
  - Anytime during a cruise
- **Based on symptoms**
- **Data from the GI log**

Ship Name	ADONIA Change Password
Report Type	24HR
Cruise Length	0
Next US Port	Alaska
Next US Port Arrival Date	04/26/2004 12 : 00 (24 Hour)
Embarkation Port	Alaska
Embarkation Date	04/23/2004
Disembarkation Port	Alaska
Disembarkation Date	04/30/2004
Total Passengers	3241
Total Crew	777
Passenger GI Illness Cases	77
Crew GI Illness Cases	10
Suspected Passenger SARS Cases	0
Suspected Crew SARS Cases	0
Emergency Contact Name	Dr. I.M Afloat
Emergency Contact Number	(770) 555-1212
Email address to send receipt to	imafloat@someship.com
Total GI Illness Rate	2.1%
Passenger GI Illness Rate	2.3%
Crew GI Illness Rate	1.2%

Successful report!

You have successfully submitted a GI Illness Report. For future reference your receipt ID is 20040423150849207

Clear | Submit Report

2% Outbreak Apr 23, 2004 Ship: ADONIA Next Port: Alaska Pax: 77/3241 (2.38%) Crew: 10/777 (1.29%) - Message (Plain Text)

File Edit View Insert Format Tools Actions Help

Reply | Reply to All | Forward

From: Vsptest
Sent: Fri 4/23/2004 3:09 PM
To: Vaughan; George; Vaughan, George, Jr.
Cc:
Subject: 2% Outbreak Apr 23, 2004 Ship: ADONIA Next Port: Alaska Pax: 77/3241 (2.38%) Crew: 10/777 (1.29%)

The Automated Gastrointestinal Illness Surveillance System, Vessel Sanitation Program, Centers for Disease Control and Prevention confirms receipt of the following information:

Report Receipt = 20040423150849207

Ship Name = ADONIA

Report Type = 24HR

Next US Port = Alaska

Next US Port Arrival Datetime = Apr 26 2004 12:00PM

Embarkation Port = Alaska

Embarkation Date = Apr 23, 2004

Disembarkation Port = Alaska

Disembarkation Date = Apr 30, 2004

Total crew on board = 777

Crew gastroenteritis case = 10

Percentage of crew gastroenteritis cases (%): 1.29

Total passengers on board = 3241

Passenger gastroenteritis case = 77

Confirmation Report

via

electronic mail

Start | Inbox - Microso... | GISS-CommonD... | Microsoft Powe... | 2% Outbreak... | 3:12 PM

What is a Reportable Case?

A reportable case of GI illness is defined as…

Diarrhea (3 or more loose stools in a 24-hr period)

- or -

Vomiting + one other symptom (24-hr period):

- One or more loose stool
- Abdominal/stomach cramps
- Headache
- Muscle aches (myalgia)
- Fever (≥ 38°C or 100.4°F)

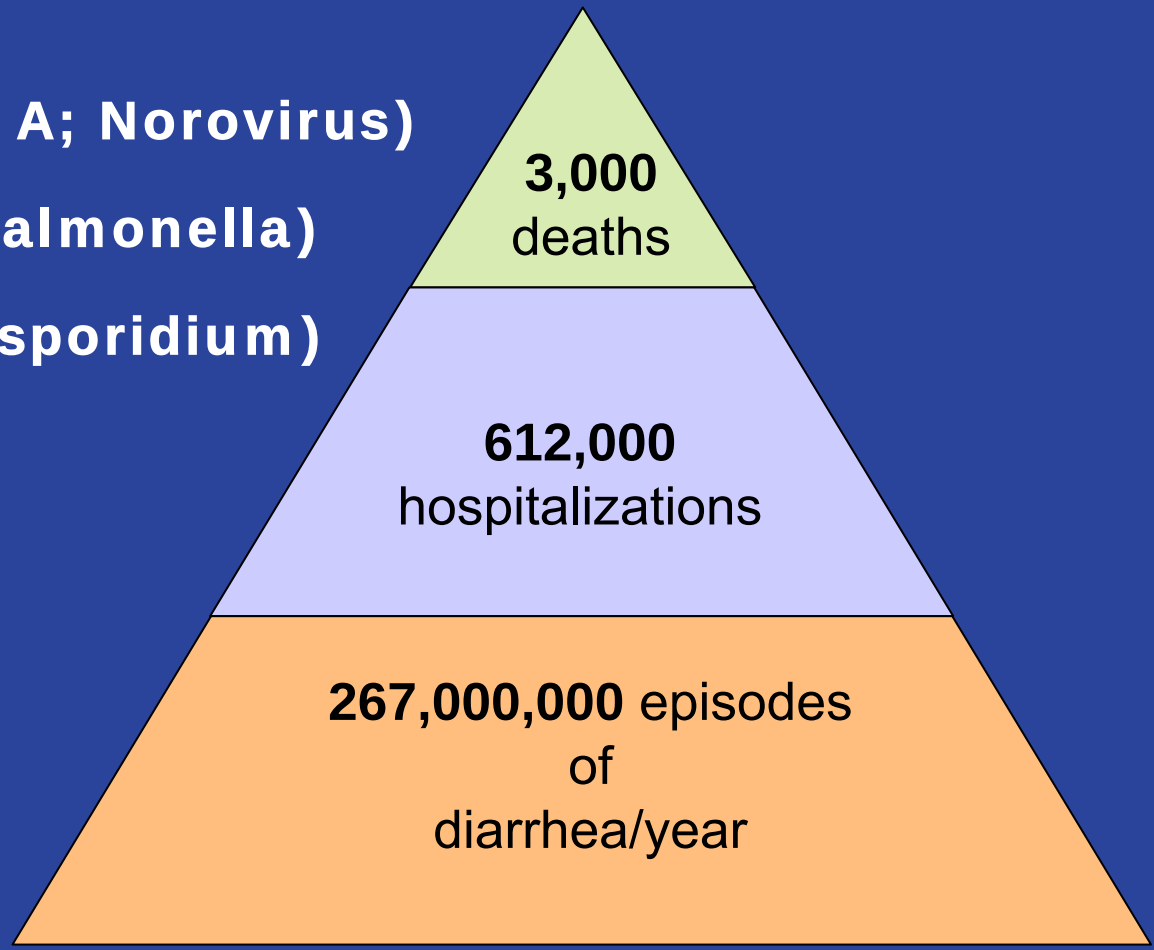
Why Investigate Gastrointestinal Illness?

GI Illness in the United States

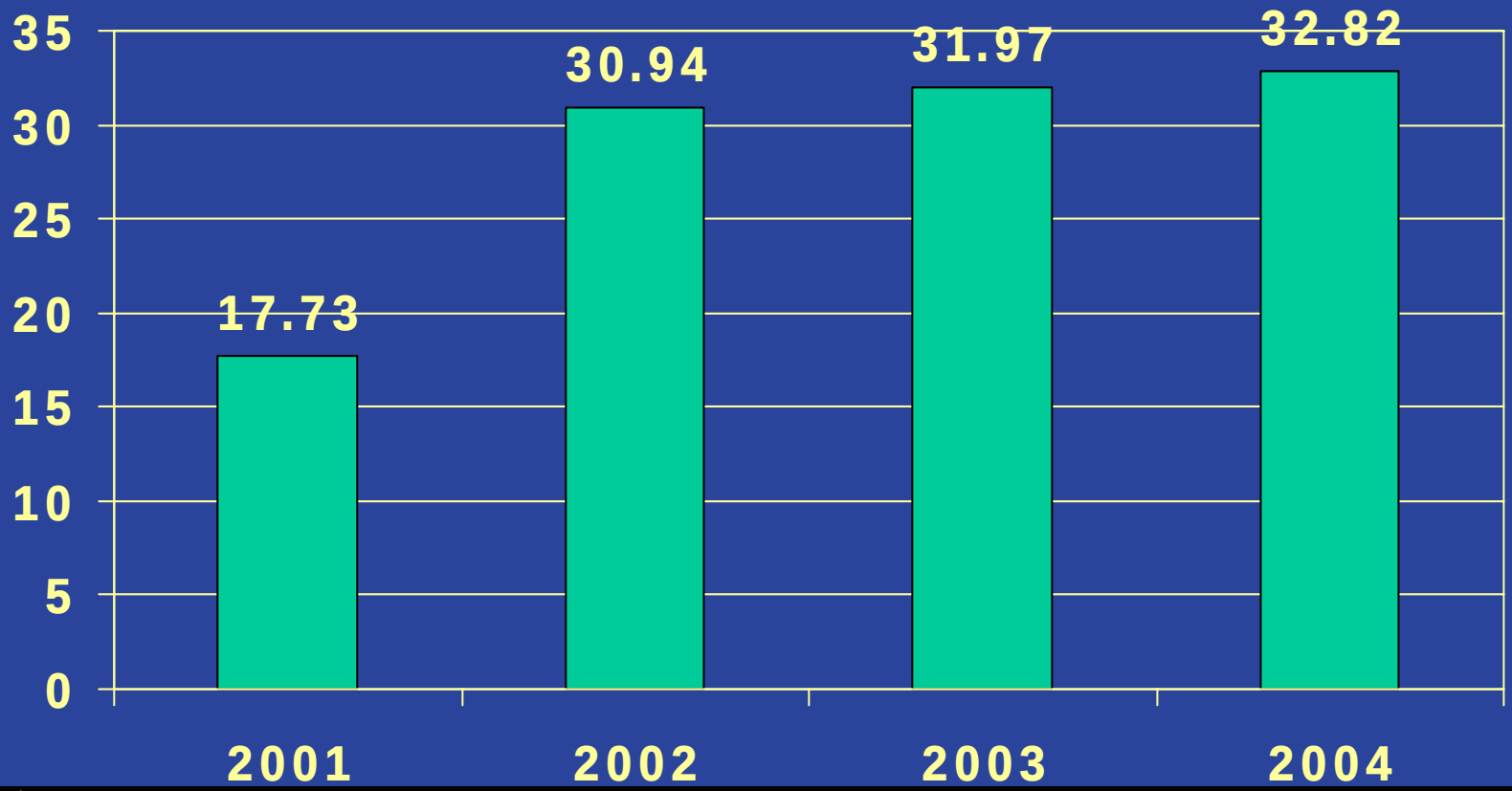
Viruses (Hepatitis A; Norovirus)

Bacteria (E coli; Salmonella)

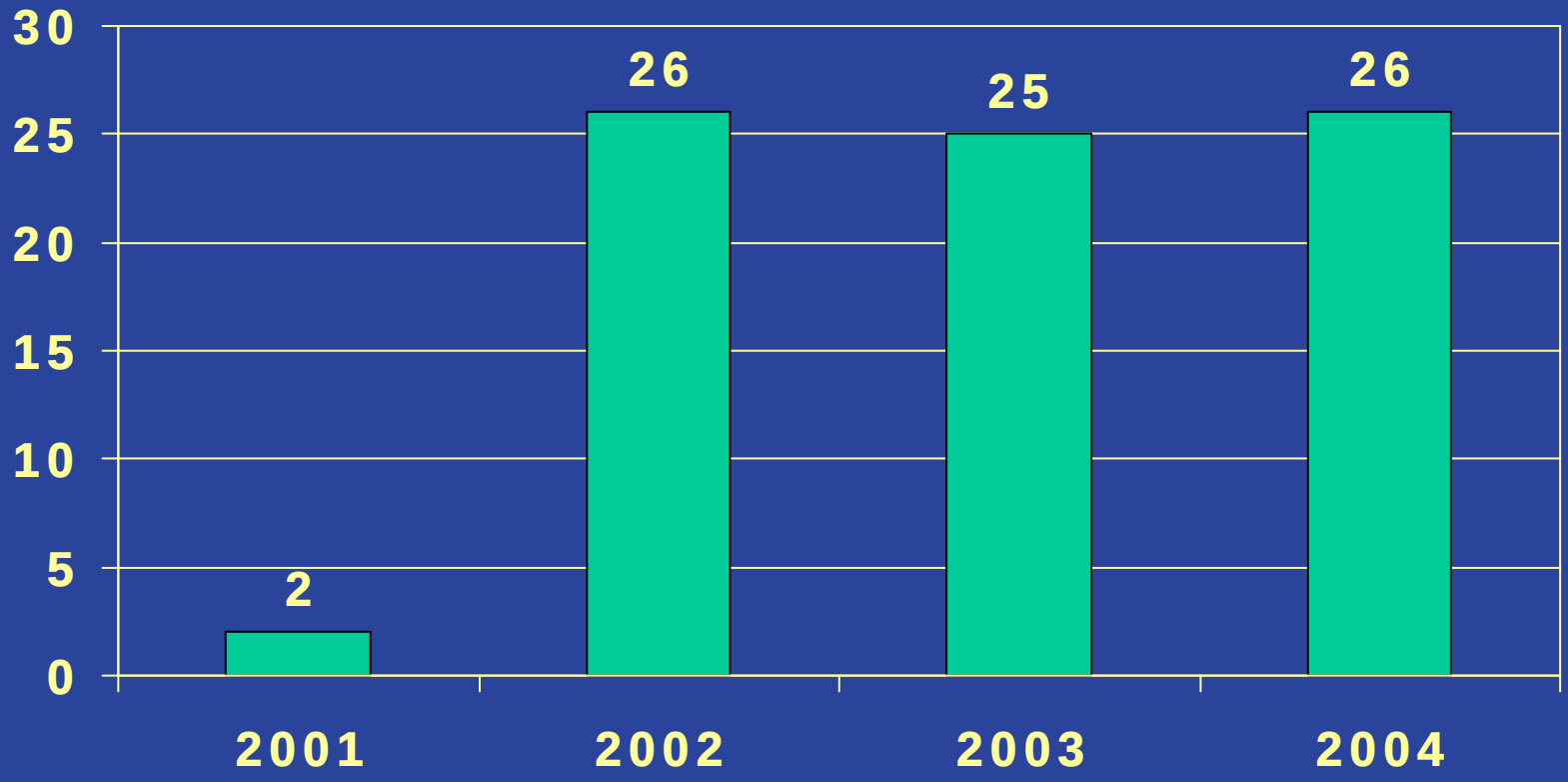
Parasites (Cryptosporidium)



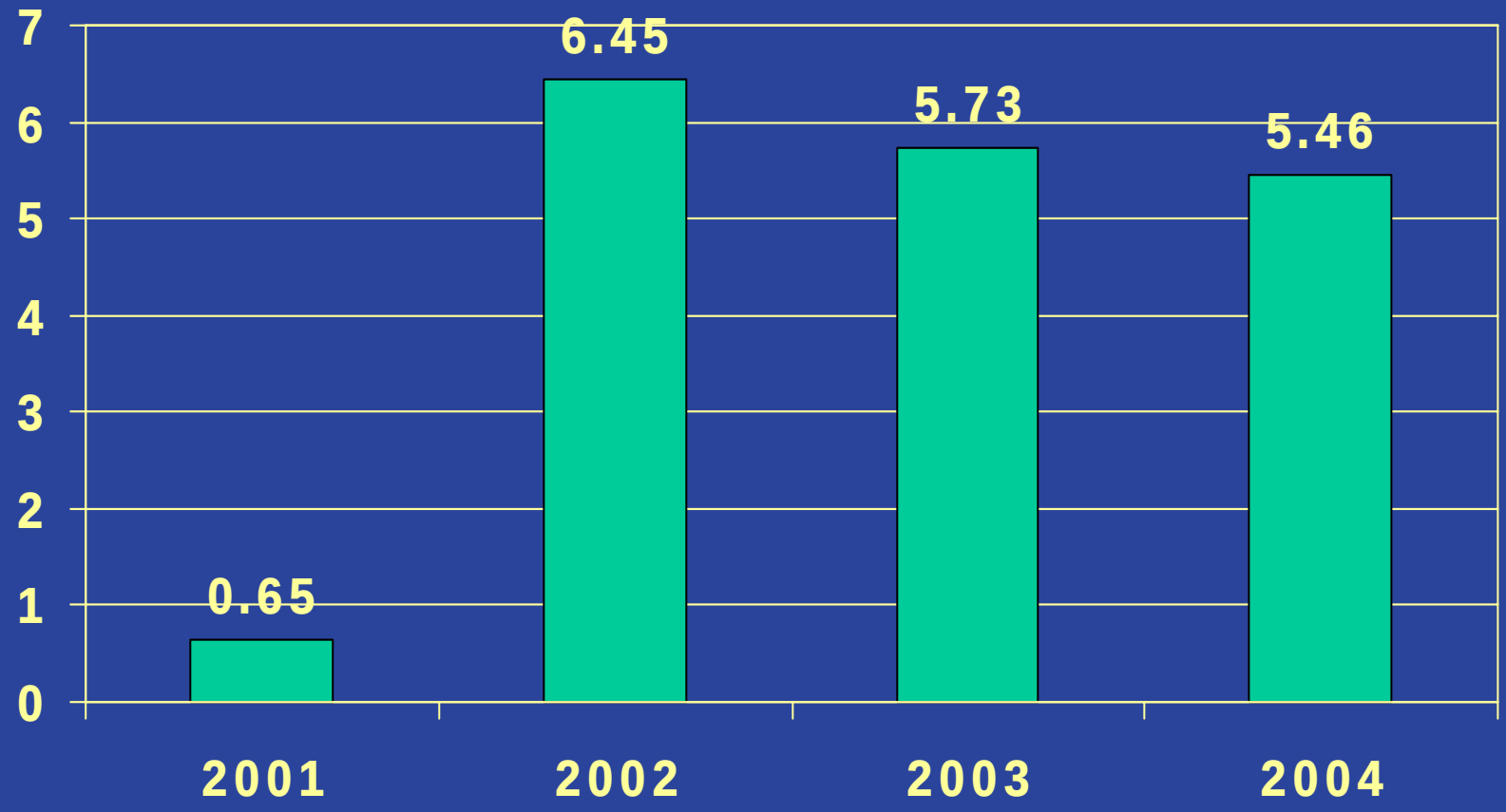
Cases of GI illness per 100,000 passenger-days on cruise ships, 2001-2004



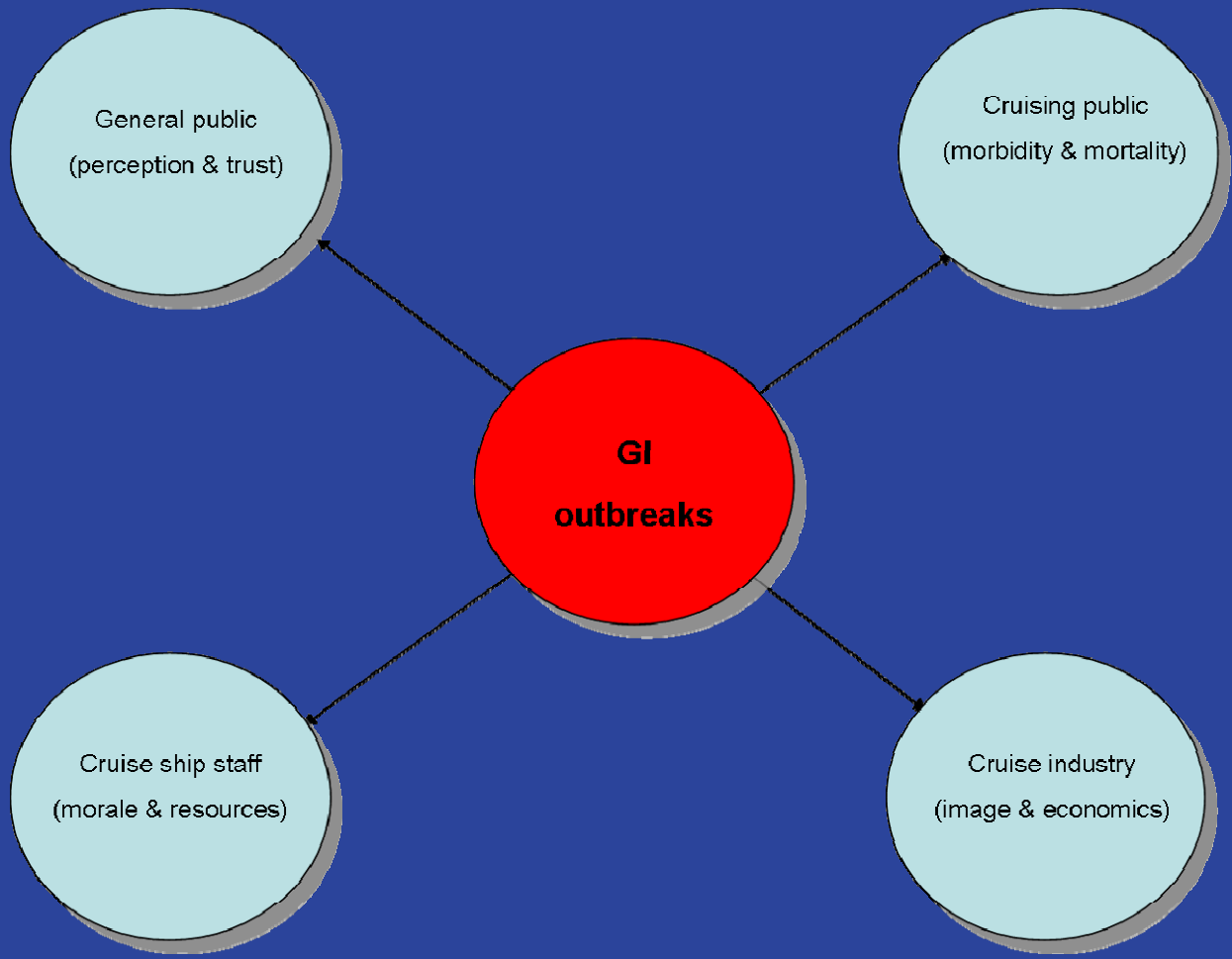
Outbreaks of acute gastroenteritis (AGE) on cruise ships, 2001-2004



Outbreaks of acute gastroenteritis (AGE) per 1,000 cruises, 2001-2004



Who is impacted by outbreaks?



What is the economic cost of outbreaks?

$1,313,337 to cruise line
$408 each ill passenger

Cruise ship outbreaks by etiologic agent – CY 2006

Pathogen	Number	Percent
Norovirus	32	86.5
Enterotoxigenic E. coli.	1	2.7
Unknown	4	10.8
Total	37	100

Epidemiologic Reasons for Investigating Outbreaks

- Primary
  - Eliminate exposure to sources of infection (Stop spread!)
  - Develop strategies for control (Recommendation)

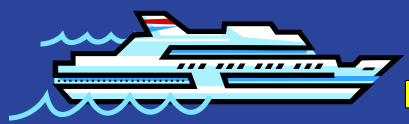
Epidemiologic Reasons for Investigating Outbreaks

- Secondary
  - Describe new diseases/learn more about existing diseases
  - Evaluate existing prevention strategies
  - Teach/learn epidemiology
  - Address public concern about the outbreak

Three Main Activities of an Outbreak Investigation

Agent → Laboratory Assessment →

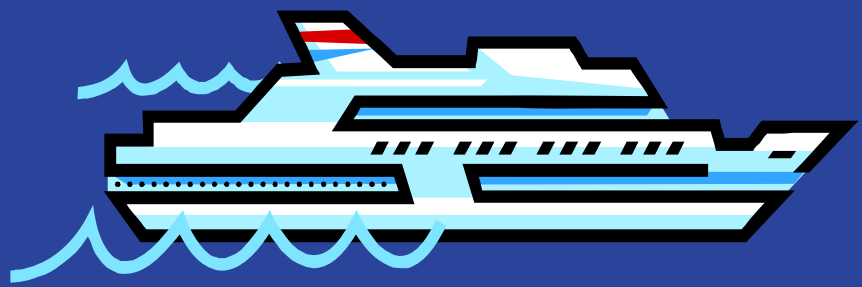
Host → Epidemiological Assessment →



Environment → Environmental Assessment →

Targeted Environmental Health Assessment

- Evaluates the same areas covered in an operational inspection
- Identifies deficiencies specific to the cause of the outbreak
- No scores/no cost
- Purpose: "fact-finding" vs "fault-finding"



Laboratory Assessment

- Clinical specimens
  - Whole stool/swab (preferred)
  - Emesis (vomit)
  - Blood (some cases)
- Environmental specimens
  - Water
  - Food
  - Surface swabs

Example 1: Lab Results
(Clinical specimens only)

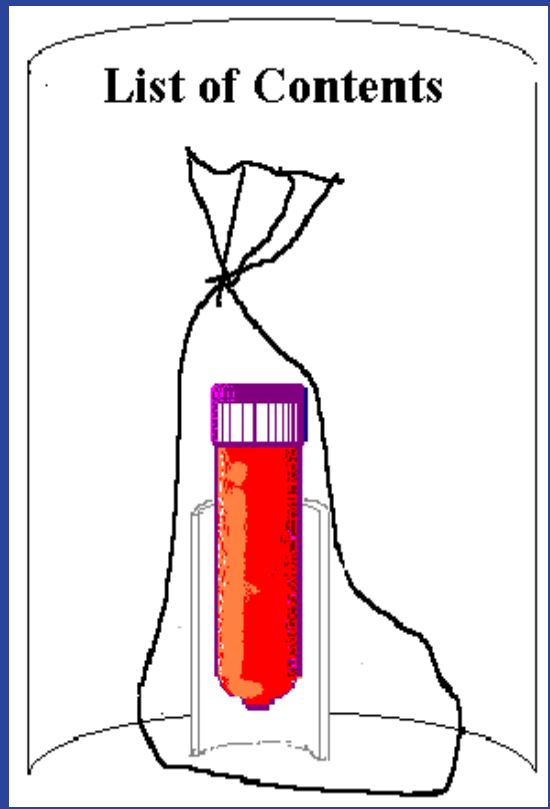
No. of isolates	Serotype	Toxin Type
5	E. coli O27:H7	ST
2	E. coli O148:H28	ST
1	E. coli O25:NM	ST
1	E. coli O6:H16	LT/ST
1	E. coli O78:H und	LT/ST
1	Shigella sonnei	NA

Example 2: Lab Results
(Clinical and environmental specimens)

- Whole stool specimens (10 pax, 4 crew)
  - ETEC
  - Salmonella

- 83 food samples obtained
  - Salmonella in cooked/raw shrimp

New Requirements for Shipping Specimens



Required Clinical Specimen Containers (N=10)

- Bacteria
  - Cary-Blair
  - Para-Pak C&S
- Viral
  - Sterile specimen container

Required Specimen Shipper
(Diagnostic Specimens)

- Triple packaging
- Insulated package (leakproof)
- Outer container (e.g., cardboard)
- Ice packs/coolant packs
- Shipper's address/phone
- Lab address/phone
- Proper shipping name on package
- Proper shipping labels/markings

Epidemiological Investigation

- **Descriptive Epidemiology**
  - Investigates…
    - who,
    - what,
    - when,
    - where of the outbreak
- **Analytical Epidemiology**
  - Investigates…
    - why,
    - how of the outbreak

Descriptive Epidemiology
(Person – Place – Time)

Who became a case:

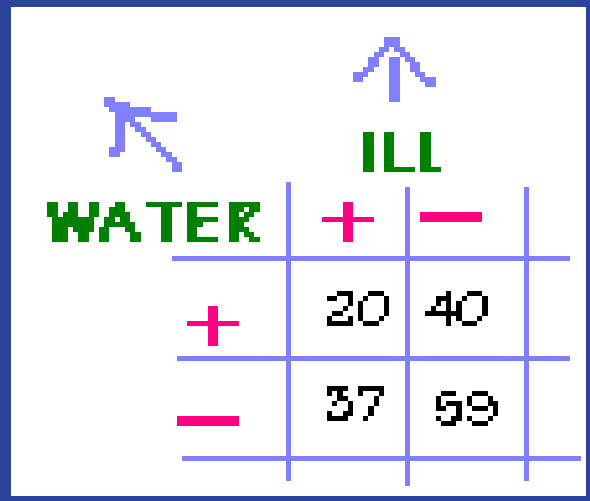
- Pax and/or Crew
- Symptom characteristics
- Age distⁿ (young vs old)
- M/F ratio (gender ratios)
- Job categories/positions
- Index/secondary cases

ILL	Freq	%
+	20	35%
—	37	65%
Total	57	100%

Descriptive Epidemiology
(Person – Place – Time)

Where cases were exposed:

- Cabin location
- Dining seating
- Table number
- Shore excursion



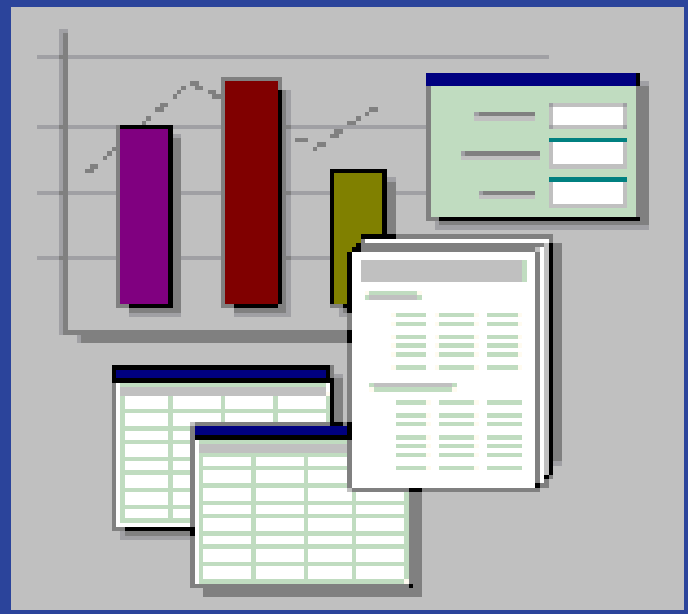
Descriptive Epidemiology
(Person – Place – Time)

When did the case become ill?

- Date of onset of illness
- Time of onset of illness
- Within what time period?

Tools for Gathering Data

- Personal Interviews
  - Ill pax/crew
  - Key management personnel
  - Selected workers
- Questionnaire(s)
  - Crew
  - Pax
- Key documents



Key Documents in Outbreak Investigations

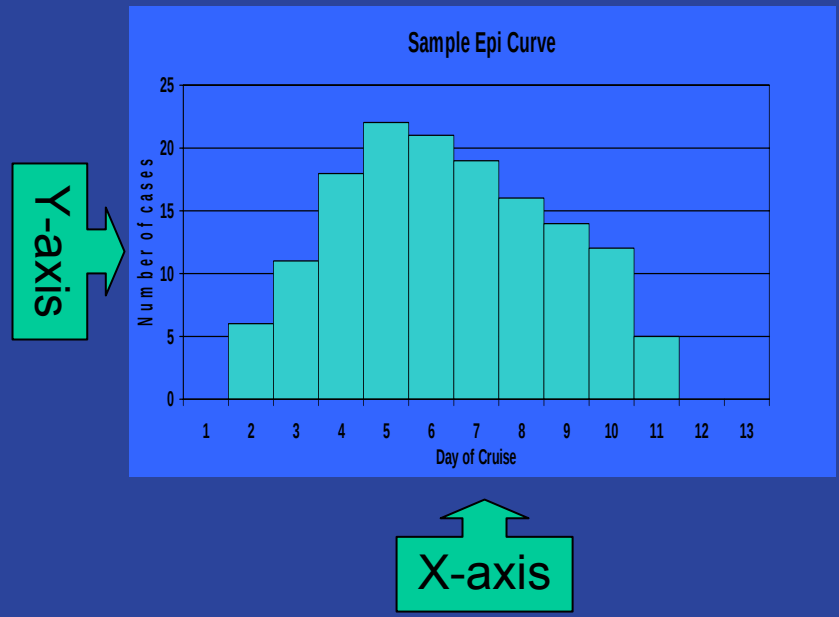
- GI logs
- Ship itinerary
- Activity history
- Food history (72-hr)
- Potable water logs
- Pool/Spa logs
- Provisions logs
- Crew transfer records
- Housekeeping procedures
- SOPs

Outbreak Investigation: GI Logs

- Plot epidemic curve
- Passenger to crew case ratio
- Diarrhea to vomiting ratio
- Symptom type and duration
- Estimate percentage onboard truly ill
- Identify additional cases not reported

The Epidemic ("Epi") Curve

- What is it?
  - Bar chart without spaces (histogram):
    - Time (x-axis)
    - Number of cases (y-axis)
  - Bar heights = case counts
- Why plot it?
  - Size of outbreak
  - Mode of transmission
  - Duration of disease
  - Possible cause(s)
  - Possible vehicle(s)



Note: All data elements should be included on the GI Logs!

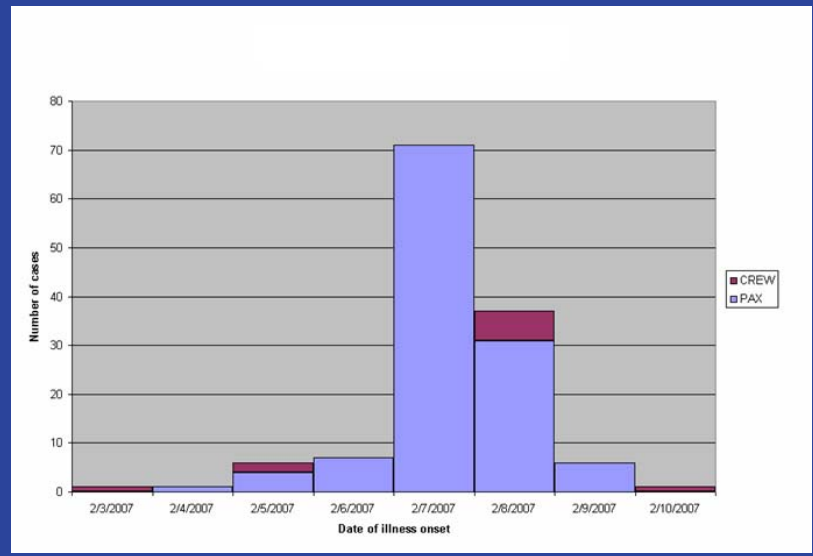
Types of Epidemic Curves

- Common source
  - Point source
  - Continuing common source
- Propagated
- Mixed

Type of curve: Clues to the mode of transmission

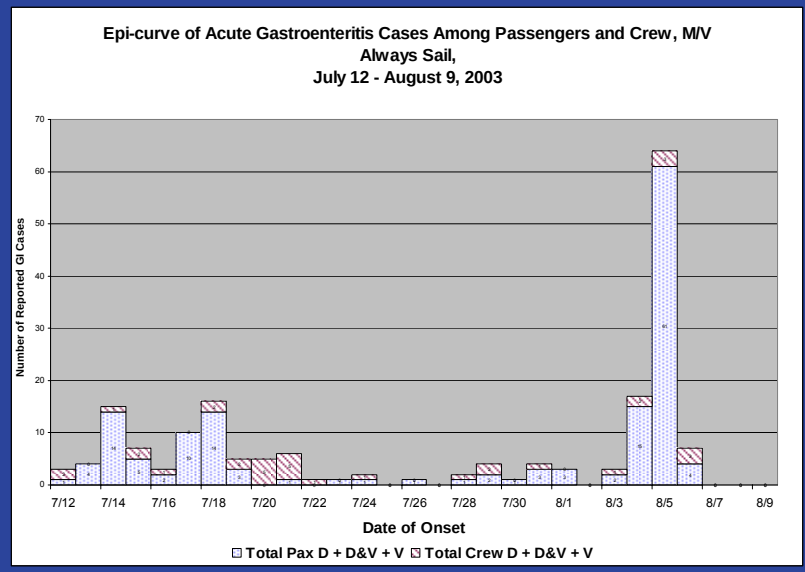
Epi Curve: Common Source Outbreak

- Rapid rise in cases
- Slower decline
- Single peak
- Shorter outbreak duration
- Associated with food and waterborne outbreaks



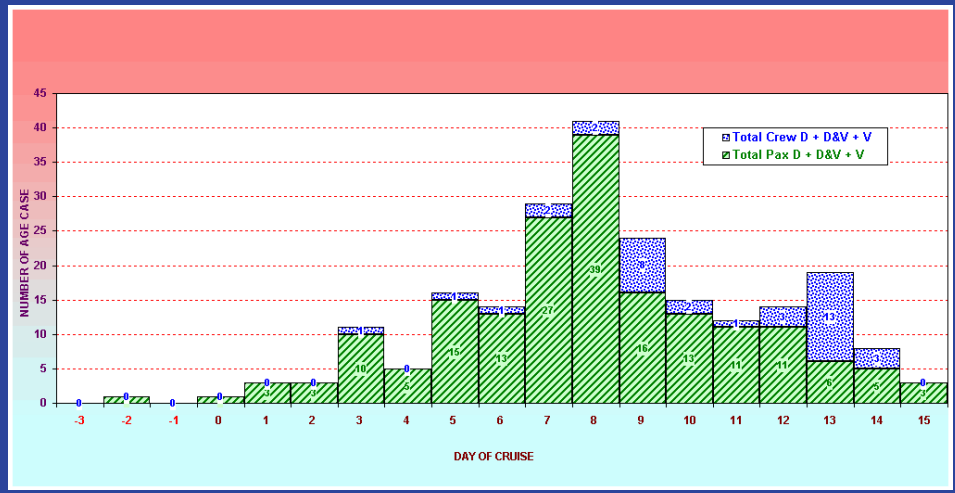
Epi Curve: Propagated Outbreak

- Slow rise in cases
- Slow decline
- Multiple peaks
- Outbreak spread out over longer time period
- Associated with person-to-person and environmental spread



Epi Curve: Mixed Outbreak

- Elements of both common source and propagated
- Extended outbreak
- Associated with secondary spread



Analytical Epidemiology
(Questionnaires)

Purpose: To test hypotheses/theories about the cause of the outbreak

Method: Compares exposure experience of ill vs well with regards to:

- Food/beverages eaten (on land or on the ship)
- Shipboard activities (large gatherings)
- Shore-side activities (shore excursions)

How: Questionnaire is the key tool

Example 1: Symptom Profile

Symptom	Ill Pax / No. responding (%)	Ill Crew / No. responding (%)
Abdominal Cramps	**148 / 195 (76)**	**15 / 20 (75)**
Nausea	132/187 (71)	12/19 (63)
Diarrhea	**220 / 221 (99.5)**	**23 / 23 (100)**
Headache	82/168 (49)	8/17 (47)
Vomiting	70/171 (41)	9/9 (50)
Muscle Aches	55/163 (34)	3/16 (19)
Fever	**41 / 162 (25)**	**4 / 13 (31)**
Sore Throat	37/160 (23)	1/16 (6)
Bloody Stools	5/156 (3)	0/16 (0)

Example1: Outbreak survey results

Attack Rate Table								
	Exposed Persons (Ate suspect food)				Unexposed Persons (Did not eat suspect foods)			
Suspect Food	Ill	Well	Total	AR (%)	Ill	Well	Total	AR (%)
Ham	36	5	41	87.8	2	11	13	15.4
Potato Salad	40	4	44	90.9	9	6	15	60.0
Peas	16	15	31	51.6	10	13	26	43.5

$RR_{(Ham)} = 5.7$ $X^2 = 24.8$ $p < 0.001$

Example 2: Symptom Profile

Symptom	Ill Passengers (%) No. Responding
Abdominal Cramps	166/188 (88)
Nausea	78/178 (44)
Diarrhea	198/205 (97)
Headache	72/180 (40)
Vomiting	70/148 (47)
Muscle Aches	50/143 (35)
Fever	41/198 (21)
Sore Throat	12/103 (12)
Bloody Stools	5/156 (3)

Example 2: Outbreak survey results

Exposure	No Ill/Exposed	No Ill/Unexposed	RR	CI (95%)
Consumed ice	185/317 (58)	17/51 (33)	1.75	1.17 – 2.61
Unbottled H_2O	190/344 (55)	12/24 (50)	1.10	0.73 – 1.67
Bottled H_2O	103/176 (59)	99/192 (52)	1.13	0.94 – 1.37
Ashore in Guatemala	159/292 (55)	36/58 (62)	0.88	0.70 – 1.10
Ashore Costa Rica	172/314 (55)	23/36 (64)	0.86	0.66 – 1.12

Example 2: Attack rate table

Risk factor	No. Ill/No. Exposed (%)	No. Ill/No Not Exposed (%)	Risk Ratio (CI)	P-value
Unbottled water	34/58 (59)	43/76 (57)	1.04 (0.77, 1.39)	0.9517
Embarkation lunch	196/331 (59)	12/40 (30)	1.97 (1.22, 3.20)	0.0008
Embarkation dinner	125/224 (56)	69/133 (52)	1.08 (0.88, 1.32)	0.5420
Shrimp	100/131 (76)	93/134 (48)	1.59 (1.34, 1.90)	0.0000
Hamburger	17/32 (53)	176/293 (60)	0.88 (0.63, 1.24)	0.5688

Outbreak Management and Prevention

Crew roles and responsibilities

1. Report GI illness promptly to medical
2. Follow isolation procedures
3. Participate in interviews/questionnaires during outbreak investigations
4. Practice good personal hygiene (handwashing is key!)
5. Understand your role in outbreak investigations

Outbreak Management and Prevention

Ship roles and responsibilities

1. Written Outbreak Prevention & Response Protocols (OPRPs)
2. Strict implementation of OPRPs procedures

Summary

- Case reporting requirements
- Outbreak investigation procedures
- Roles and responsibilities

Resources and References

- www.cdc.gov
  - www.cdc.gov/nceh/vsp
- www.dot.gov
- www.iata.org