

Case study: An outbreak of gastro-enteritis in Kalyanapuram, Chennai

Classroom version – 11 February 2005

Case study developed by the Master of Applied Epidemiology (MAE) - Field Epidemiology Training Programme (FETP) from the National Institute of Epidemiology (NIE), Indian Council of Medical Research (ICMR), Chennai, Tamil Nadu, India. It is inspired by an investigation conducted by Dr Parvathi, 2002 scholar of the MAE assigned to the state of Tamil Nadu, India.

Learning objectives

At the end of the case study, the scholar will be able to:

1. Identify the steps of the investigation of an outbreak;
2. Construct an epidemic curve;
3. Describe the characteristics of an outbreak in terms of time, place and person;
4. Use descriptive epidemiological data to generate hypotheses;
5. Use analytical epidemiological data to test hypotheses;
6. Calculate odds ratio and test for significance;
7. Formulate recommendations for the control of an outbreak.

Using this case study in a class

This case study is designed as a stand-alone and does not come with a facilitator's guide. The answers to all the questions for each section are provided as an introduction to the following section. To run this case study in a class, it is proposed to distribute it one page at a time. Scholars take turn to read it paragraph by paragraph aloud. Reading all paragraphs aloud and in turns has two advantages. First, everyone can quickly participate and go beyond the inhibition of having her/his voice heard in a large room. Second, time is given to the whole class to understand the issue and think about the answers. The scholar reading the question may try to answer it if s/he can propose an answer. Otherwise, the matter is discussed as a group. The next scholar reads the next question and so on until the end of the page. After the next part/ page is distributed, the next scholar continues with the first paragraph of the next part and so on until the case study is over. Once the epilogue has been read, it is proposed to go back to the first page to read the objectives again. This re-iterates the acquisitions and provides additional opportunity to clarify what may have been misunderstood or not fully acquired.

Part 1. A cluster of gastro-enteritis in Kalyanapuram, Chennai

On 17 May 2002, the press reported a cluster of gastro-enteritis in an area of Chennai, Tamil Nadu, India called Kalyanapuram. According to the report, 17 children presented with vomiting and diarrhoea. The anganwadi worker (community health worker) from the nearby ICDS centre had alerted the local health post regarding the episode. Several patients were admitted for treatment at the local Government hospital, but no deaths and no severe dehydration episodes were reported. Quickly, the local health authorities visited the place with a FETP India scholar. Their first observation was that the cluster affected adults as well as children.

Kalyanapuram is a slum located near to the Central Railway Station in Chennai. According to the local health facility, it had a population of 3,507 in 2002. It is a neighbourhood densely populated with people of lower socio-economic status (mostly agricultural labourers). With the exception of few buildings, housing consists in “kutcha” (made with mud walls and thatched roofs) that do not have a separate kitchen area. The residents use a common lavatory located near the entrance of the slum. The source of water is a common hand pump located near the lavatory. Buying foods from vendors is a common practice here, especially in the morning hours, as most people leave for work at dawn.

Question 1. A.

What are the key steps of the investigation of an outbreak?

Question 1. B.

Can the team determine whether or not they are dealing with an outbreak in this case? What additional information would they need?

Part 2. Confirming the diagnosis

The steps of an outbreak investigation include (1) determining the existence of the outbreak, (2) confirming the diagnosis, (3) defining a case, (4) searching for cases, (5) using descriptive epidemiological data to generate hypotheses, (6) testing hypotheses using an analytical epidemiological study, (7) drawing conclusions, (8) comparing the findings with established facts, (9) communicating the findings and (10) executing prevention measures.

The investigators contacted the office of the corporation of Chennai to find out if reports of similar illnesses had been made in the previous days, months and years. This was not the case for this area. The presence of gastrointestinal illness in 17 individuals in the resident population of Kalyanapuram in one day was an unusual event. Further investigations ruled out recent population influx or any change in any reporting system. Thus, this episode was considered an outbreak.

Once the local health authorities had confirmed the reality of outbreak, they decided to investigate further and to form a rapid response team. The team interviewed 10 of the case-patients that they could find. They gathered that nine presented with vomiting, seven with diarrhea and two with fever. All cases had occurred on 16 May 2002 within few hours of each other.

Question 2. A.

What kind of diseases could you be dealing with in this situation?

Question 2. B.

What should the team do at this stage and how should they go about it?

Part 3. Defining cases

The potential agents of gastroenteritis to be considered include bacteria (e.g., staphylococcus aureus, cholera, salmonella and shigella), virus (e.g., noravirus and rotavirus) and parasites (e.g., giardia and cryptosporidia).

To obtain a microbiological confirmation of the outbreak, the stool specimens of the 18 adults admitted were examined but no pathogens could be identified. The clinical picture and the clustering of the cases within few hours of each other suggest that staphylococcus could be the causal agent. No confirmation was available and another pathogen could also have been involved. However, the laboratory investigations conducted allowed excluding the diagnosis of cholera.

The team now wants to search for cases to describe the time, place and person characteristics of the outbreak.

Question 3A.

What would you propose as a case definition?

Question 3B.

How would you look for cases?

Question 3C.

What basic information would you collect regarding cases?

Part 4. Searching for cases

The investigators defined a case as the occurrence of vomiting or diarrhea in any person residing in the Kalyanapuram slum area between 10 and 19 May 2002. Faced with a number of options, the team decided to go for a complete a door-to-door search and identified 24 cases for which they collected the basic information presented on Table 1. In the meantime, information regarding population size was collected from the health centre (Table 2).

Table 1: Line listing of the 24 cases of gastro-enteritis, Kalyanapuram, Chennai, Tamil Nadu, India, 2002.

ID	Age	Sex	Vomiting	Diarrhea	Fever	Date of onset	Time of onset
1	18 m.	M	+	+	+	16-May-02	10.30
2	40 m.	F	+	+		16-May-02	12.30
3	24 m.	F	+	+		16-May-02	11.30
4	40 m.	F		+		16-May-02	11.00
5	24 m.	M	+	+	+	16-May-02	10.30
6	8 yrs	F	+			16-May-02	11.00
7	48 m.	F	+			16-May-02	11.00
8	35 m.	M	+			16-May-02	11.00
9	10 yrs.	F	+	+		16-May-02	11.00
10	30 m.	F		+		16-May-02	11.00
11	27 m.	F	+			16-May-02	11.00
12	42 m.	M	+	+		16-May-02	12.00
13	49 m.	M	+	+	+	16-May-02	11.00
14	20 yrs.	F	+	+	+	16-May-02	11.30
15	21 yrs.	F	+			16-May-02	11.30
16	50 yrs.	F	+	+		15-May-02	19.00
17	43 m.	M	+	+		16-May-02	11.30
18	19 m.	F	+			16-May-02	10.30
19	25 m.	F	+	+		16-May-02	10.30
20	26 m.	F	+	+		16-May-02	11.30
21	38 m.	F	+	+		16-May-02	13.00
22	54 m.	M	+	+		16-May-02	8.30
23	48 m.	M	+	+		16-May-02	12.30
24	7 yrs.	F	+	+		16-May-02	8.30

Table 2: Distribution of population by age and sex, Kalyanapuram slum area, Chennai, Tamil Nadu, India, 2002

Age group	Population		Total
	Male	Female	
1-3	91	55	146
3-5	75	66	141
5-6	32	39	71
6-10	141	131	272
10-14	121	130	251
>14	1,467	1,159	2,626
Total	1,927	1,580	3,507

Question 4.A.

What will the team do with this information? Can you help the tem in that task?

Question 4.B.

What other elements are they missing to generate hypotheses?

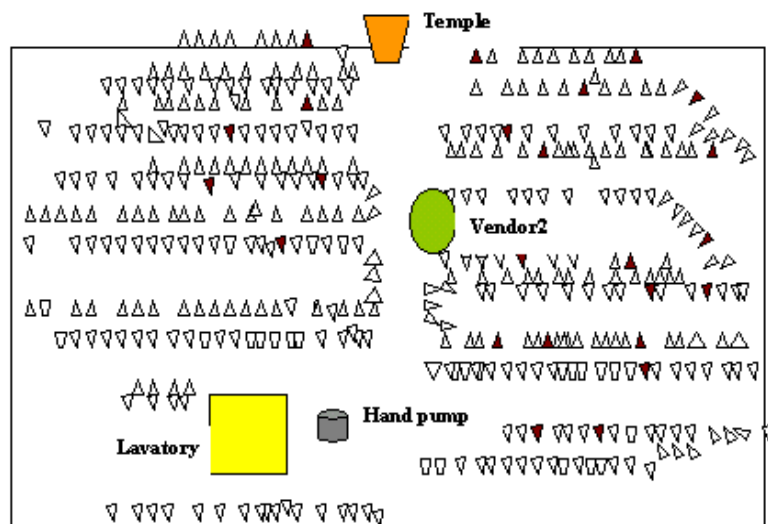
Part 5. Using descriptive epidemiological findings to formulate hypotheses

Using the data collected, the team calculated attack rates by age and sex (Table 3) and an epidemic curve (Figure 2). In addition, they also drew a spot map to examine the distribution of cases within the community.

Table 3: Attack rates of gastro-enteritis by age and sex, Kalyanapuram, Chennai, Tamil Nadu, India, 2002

		Number of cases	Population	Attack rate per 1000 population
Age group (In years)	1-3	9	146	62
	3-5	10	141	71
	5-6	0	71	0
	6-10	2	272	28
	10-14	0	251	0
	>14	3	2,626	11
Sex	Male	8	1,927	4
	Female	16	1,580	10
Total		24	3,507	6.8

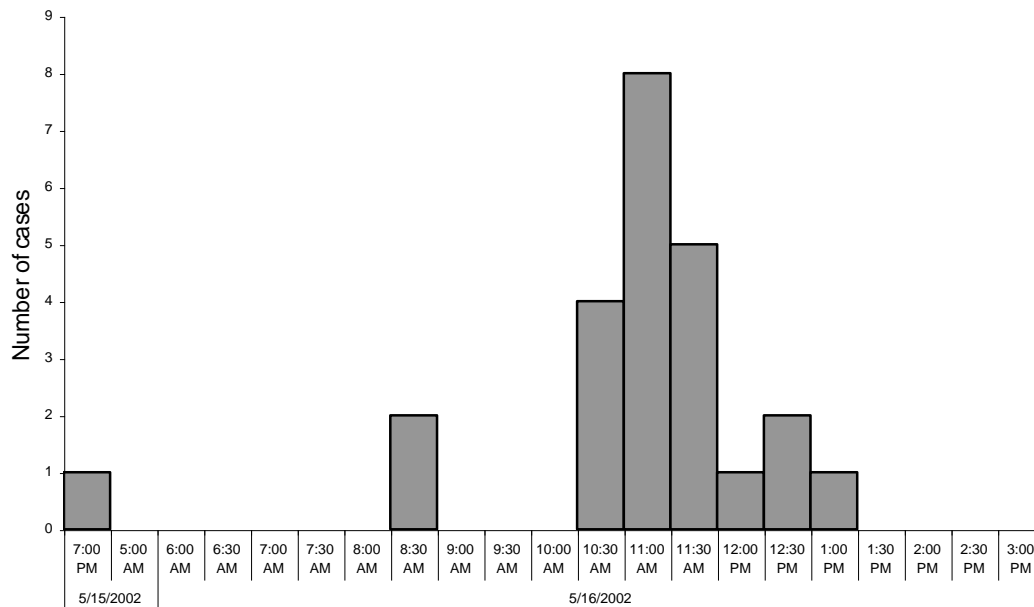
Figure 1: Spot map of the cases of gastro-enteritis, Kalyanapuram, Chennai, Tamil Nadu, India, 2002¹



Aside from the descriptive epidemiology, the team conducted a number of hypotheses – generating interviews with various people. They also looked into outliers.

¹ Vendor 1 did not have a fixed spot and was walking around selling his food items.

Figure 2: Cases of gastro-enteritis by time of onset, Kalyanapuram, Chennai, Tamil Nadu, India, 2002.



The investigators contacted community leaders, including self-group members and youth association president to collect any information about any factors or common event like local festivals that might have triggered the outbreak. No such occurrence was reported. However, talking to the case-patients, they learned that most of them had consumed idiyappam from an outside vendor who regularly supplies food to that area (vendor 1). This outside vendor was walking around selling his products and was not sitting in a specific spot. There was also a second one selling breakfast foods items like “idli, vadai and bajji”(vendor 2) who was a local resident who made these items at home and sold them in front of her houses. Many members of the community purchased foods from these two vendors to eat it, even during the course of the investigation.

The distribution of cases over time pointed to one outlying case-patient who developed symptoms on 15 May 2002 in the evening (19:00). Upon interview, this person reported consuming idiyappam from vendor number 1 at 15:00 that she had bought in the morning.

Question 5.A.

Can you summarize the descriptive findings of this outbreak at this stage?

Question 5.B.

What main hypothesis can you now formulate about the source of the outbreak?

Question 5.C.

How can you test this hypothesis?

Part 6. A case control study to test the main hypothesis

The distribution of cases over time indicates a cluster around a few hours on 16 May 2002, suggesting a point source outbreak of a disease with a short incubation caused by an exposure that occurred in the morning, possibly during breakfast.

The spot map indicates that cases are scattered cases in the community, thus the point source of the outbreak had to be an exposure that could have affected the whole community (e.g., water source, street vendor). It may actually be more in favour of vendor 1 who did not have a fixed selling spot (an outbreak caused by vendor 2 could have been localized around the outlet).

The incidence by age and sex indicates that there were cases among all age groups, but that children were more affected, suggesting that the exposure could have been more common in children (e.g., food item popular among children) or that the pathogen would lead to symptoms more commonly among children.

Finally, the reports of idiyappam among case-patients together with the history reported by the outlier points towards idiyappam sold by street vendor 1 as the possible source of the outbreak. However, other hypotheses should be examined too.

Given the low attack rate (under one percent) and in the interest of time, the team decides to conduct a case-control study.

Question 6.A.

What could be a good case definition?

Question 6.B.

How could be a good way to recruit controls?

Question 6.C.

What information should be collected among cases and controls?

Question 6.D.

How should the data be analyzed?

Part 7. Identifying the source of the outbreak

The investigators used the case definition they had formulated at the case search stage for the case control study.

Ideally, a control group should include subjects who are recruited from the population from which cases were identified, have a theoretical possibility of being exposed that is equivalent to cases, have a probability of exposure comparable to the general population, are capable of acquiring the disease of interest and would be included as cases if they were to become sick. To meet these requirements, investigators selected controls from among persons residing in the Kalyanapuram area and who did not have gastrointestinal illness during the period 10-19 May 2002. The questionnaire was designed to collect information about background characteristics and potential exposures to the outbreak (i.e., food items consumed during breakfast on 16 May 2004) to calculate odds ratio for these exposures and population attributable fractions.

The fieldwork has now been completed. The FETP scholar administered the questionnaire to respondents that included mothers (n=42), grandmothers (n=4) and aunts (n=2). The data has been summarized on Table 4 and Table 5.

Table 4: Consumption of breakfast items by case control study subjects (Controls), Kalyanapuram, Chennai, Tamil Nadu, India, 2002.

Status	ID	Age	Sex	Idiyappam	Idli	Pongal	Rice
Control	1	20 m.	M	+			
Control	2	48 m.	F		+		
Control	3	24 m.	F			+	
Control	4	45 m.	F			+	
Control	5	28 m.	M		+		
Control	6	9 yrs.	F		+		
Control	7	48 m.	F				+
Control	8	30 m.	M	+			
Control	9	12 yrs.	F		+		
Control	10	30 m.	F	+			
Control	11	29 m.	F		+		
Control	12	44 m.	M			+	
Control	13	55 m.	M			+	
Control	14	25 yrs.	F		+		
Control	15	30 yrs.	F	+	+		
Control	16	45 yrs.	F			+	
Control	17	40 m.	M				+
Control	18	24 m.	F	+			+
Control	19	25 m.	F				
Control	20	28 m.	F				+
Control	21	36 m.	F				+
Control	22	58 m.	M				
Control	23	40 m.	M				+
Control	24	8 yrs.	F	+			

Table 5: Consumption of breakfast items by case control study subjects (Cases), Kalyanapuram, Chennai, Tamil Nadu, India, 2002.

Status	ID	Age	Sex	Idiyappam	Idli	Pongal	Rice
Case	1	18 m.	M	+			
Case	2	40 m.	F		+		
Case	3	24 m.	F	+			
Case	4	40 m.	F	+			
Case	5	24 m.	M		+		
Case	6	8 yrs	F				
Case	7	48 m.	F				+
Case	8	35 m.	M	+			
Case	9	10 yrs.	F	+			
Case	10	30 m.	F	+			
Case	11	27 m.	F				
Case	12	42 m.	M	+			
Case	13	49 m.	M	+			
Case	14	20 yrs.	F		+		
Case	15	21 yrs.	F	+			
Case	16	50 yrs.	F				+
Case	17	43 m.	M	+			
Case	18	19 m.	F	+			
Case	19	25 m.	F	+			
Case	20	26 m.	F			+	
Case	21	38 m.	F	+			
Case	22	54 m.	M	+			
Case	23	48 m.	M		+		
Case	24	7 yrs.	F	+			

Question 7.A.

Analyze the data presented.

Question 7.B.

Construct a summary table to present the results.

Question 7.C.

What is the conclusion?

Part 8. Examining this outbreak in the context of what is known of gastro-enteritis

Having constructed the 2 x 2 tables, calculated the odds ratio and tested for significance, the results are now summarized on Table 6.

Table 6: Consumption of breakfast food items among cases and controls, gastrointestinal illness outbreak, Kalyanapuram, Chennai, May 2002.

Food item	Number of study subjects reporting consuming the breakfast food item		Odds ratio	95% confidence interval
	Cases (n=24)	Controls (n=24)		
Idiyappam	15	6	5.0	1.2-21
Idli	4	7	0.49	0.1-2.3
Pongal	1	5	0.17	0.1-1.7
Rice	2	6	0.27	0.01-1.8

Question 8.A.

What is the population attributable fraction for Idiyappam?

Question 8.B.

What additional investigations are necessary?

Part 9. Formulating recommendations

The population attributable fraction for Idiyappam is calculated as follow:

$$\text{PAF}^2 = \text{Proportion of cases exposed} \times \frac{\text{OR}-1}{\text{OR}}$$

$$\text{PAF} = (15/24) \times \frac{5-1}{5}$$

This relatively low proportion could suggest that other food items may have been involved in the outbreak (e.g., other breakfast items prepared by vendor 1)

The environmental investigation revealed that this slum is a highly congested area with 550 households and with a population of 3,507. Members of the community cook in front of their houses where an open drainage is running along. The Idiyappam came from vendor 1, the idly from vendor 2. Rice and pongal were prepared in homes. Unfortunately, the health status of the food vendor and the inspection of the place of preparation of the food could not be done, as the food vendor could not be traced. Food samples could not be collected from the households nor from the vendors who supplied food as remains were thrown away by the time the investigators could reach the site.

Question 9. A

What should be the short term, medium term and long-term recommendations following this outbreak?

² PAF: Population attributable fraction.

Part 10. Epilogue: Executing prevention measures

On the basis of the finding of the outbreak investigation, health education was given to the residents of the slum regarding good sanitary measures to prepare food at home and avoidance of consumption of food from outside vendors.

Unfortunately, this investigation was incomplete. A precise identification of the pathogen and an effective trace back of the food vendor were missing. This prevented the investigators from identifying specific unsafe food handling practices that could have been pin pointed to base the formulation of precise recommendations. In any outbreak investigations, these two activities should be given a high priority.

This outbreak illustrated the problem of unsanitary practices among food handlers who sell food on the street. More investigations such as this one generating more precise information (with proper microbiological investigations and proper trace back) could ultimately help framing generic, practical recommendations that could allow protecting the public since it is unlikely that street vendors will ever disappear from the streets of Chennai.