

Epidemiological Investigation of A Bacillary Dysentery Outbreak at A Juvenile Correction Institution

Abstract

An incident of group diarrhea occurred at a juvenile correction institution on 6 May 1997. The institution had 106 children at the time, 62 of them had developed symptoms of fever, vomiting, serious diarrhea and bloody stools. Laboratory testings on 8 May confirmed that the incident was caused by *Shigella flexneri* 2a. By the epidemic curve and the findings of the epidemiological investigation, it was speculated that inter-personal contact was the major route of transmission. The index case was a 13-year old juvenile offender. He had already shown symptoms at the time when he was admitted to the institution on 30 April. The special circumstances of the institution encouraged direct and indirect contact with the source of infection. 60% of the children had been infected in six days. The case was closed in two months on 4 July. During this time, 842 specimens had been collected from 200 some individuals for 96 laboratory testings. The results indicated that 87 shigella strains were isolated and 45 positive cases were identified. Drug susceptibility tests showed that the isolated strains had already developed resistance to nalidixic acid used for treatment. The later-isolated strains even transformed from serotype 2a to y. By plasmid profile and large DNA fragment profile, the source of infection was confirmed to be the index case. The possibility that the strain was originated from Jenai Township of Nantou County was ruled out preliminarily. Cefixime orals were administered on 20 May, and five days later, 10 cases (22%) still discharged the bacterial pathogen. They though were without symptoms, were inapparent carriers. Treatment continued until the last case stopped discharging the pathogen on 4 July. Follow-up continued till 20 August and the investigation was called off when no further cases were reported.

Background

The juvenile correction institution in question, is in the outskirts of a city. The two-story transition-like building in the front has a visitor's lounge, classrooms, a clinic and offices for instructors and staff on the first floor; and dormitories on the second floor. Each dormitory room is shared by 10 persons. The ten rooms on the left are for boys; three of the rooms on the right are for girls, one room is used for night duty, and the rest seven are for boys. The building in the back has classrooms for girls. The kitchen is in the building on the right. The institution had 102 boys and 4 girls under 18 at the time of the outbreak (6 May). The staff of the institution included 47 instructors, guards and other workers. Instructors took turn to stay on duty. The others were on routine working hours.

Operational Procedures in the Handling of the Outbreak

The procedures included: 1) case reporting, 2) diagnosis, 3) confirmation of outbreak, 4) identification of source and route of infection, 5) identification of high- risk groups, and 6) implementation of preventive measures. These procedures are described in detail as follows:

1. Case reporting: The index case was a 13-year old juvenile offender admitted on 30 April. The child had acute vomiting and diarrhea on the day of admittance. Some boys and girls of the institution developed similar symptoms within 3-4 days. The incident was reported as suspected food poisoning to the local health authorities by the resident physician.
2. Diagnosis: To improve isolation rate, both HE (Hektoen Enteric agar) and SS (Salmonella Shigella agar) were used as selective culture media for the isolation of pathogens. 29 rectal swabs from the children and 4 from the cooks, and 8 environmental specimens were collected by the local health bureau on 6 and 7 May for laboratory testings. On 8 May, the Central Branch Laboratory of the National Institute of Preventive Medicine succeeded in isolating *Shigella flexneri 2a* from 11 rectal swabs of the children and one specimen from the wall of a septic tank. The incident was thus confirmed a dysentery outbreak caused by group B shigella. During the time until 4 July, 842 specimens had been examined and isolated 87 shigella strains. Of them, 85 were of serotype 2a, and two were the y variation. 45 individuals were found positive.
3. Confirmation of outbreak: No cases of acute diarrhea, fever and vomiting had been reported by the institution before the admittance of the index case on 30 April. By 6 May, of the 106 children, 62 had developed symptoms of acute diarrhea, fever and vomiting. The attack rate was around 60%, and the incident was then confirmed an outbreak.

4. Identification of source and route of infection: On 8 May, a descriptive epidemiological survey was conducted jointly by the Central Disease Surveillance Center of the National Quarantine Service and the local health bureau.

1) characteristics of cases: children under 18 of deviant behaviors such as stealing, drug abuse, and running away from home and schools were kept in the correctional institution. Most of them came from broken families. A case was defined as one who either worked or was kept in the institution during the period of the outbreak from 30 April to 4 July as well as his/her contacts, and who were detected positive of *S. flexneri* by laboratory testings. 45 individuals met the criteria: 43 children of the institution (40 boys and 3 girls), one male instructor, and one female family contact. Of them, 41 had developed symptoms, and four without symptoms. They aged from 12 to 42. The attack rate for the children was 40.6%; 20 times higher than the 2.1% attack rate for the staff ($RR=40.6/2.1=20$). By sex, the attack rate for girls was 75.0%; 1.9 times higher than the 39.2% for boys. The sensitivity of diagnosis by the demonstration of symptoms was 66% ($41/62=0.66$); the accuracy rate was 96% ($42/44=0.96$) (Table 2).

2) epidemic curve: an epidemic curve for the 45 individuals who met the criteria of a case was drawn from the onset of the index case on 30 April to the onset of the last case on 15 May as Figure 1. The two peaks on 5 and 10 May suggested that there were two infections and that the outbreak was a man-to-man chain infection of an average incubation period of five days. The incubation period corresponded with the clinical incubation period of bacillary dysentery⁽¹⁾.

3) the environment:

(1) food preparation: there was only one kitchen. Food for children and staff was cooked separately by different cooks. Food for children was distributed after cooking in individual stainless lunch boxes and kept outside classroom for about 40 minutes before consumption. Some staff members brought their own boxed lunch; some had the lunch in individual lunch boxes specially prepared for them at the institution. Some of the boys who helped distribute lunch boxes shared the room with the index case and became ill on 5 May; one of the girls who helped distribute lunch boxes also became ill in the first round on 5 May. Mr. Lin, an instructor, who had been with the institution for more than a year, helped distribute lunch for instructors and at the same time supervised the distribution of lunch boxes for the children. He was detected positive though without symptoms. The infected children were removed from the kitchen soon after the outbreak. The staff, after the incident, either brought their own lunch or had their lunch elsewhere.

- (2) source of water: they all had the same source of drinking water from the public water supply system. Water was often in short supply; a water tower about 150-200 meter away from the institution was used to store water. The septic tank, of cement-made sealed type, was in the yard. It was disposed of regularly. On 10 May, the local health bureau threw in some red color No 6 in the tank. The water specimens tested on 12 May did not demonstrate any color reactions.
 - (3) working schedules: children spent most time either in the classrooms or the dormitories. They could have visitors during daytime. The visitor's lounge, equipped with some house phones for communicating with the family, was shared by boys and girls. The staff worked on routine schedule with some staying overnight on duty.
 - (4) sanitary facilities: one dormitory room was shared by ten children. Each room had one washing basin, a non-flushing, unscreened toilet and a waste basket. For short of water, the toilet was flushed with water collected in a pot. Classrooms were assigned one each for children of different offenses and also for boys and girls. Toilet and washing facilities of the same types in the dormitories were installed in the classrooms.
 - (5) space: children slept on the wooden floor. The room was quite crowded. They had meals and toilet in the same room. Classrooms were tightly closed each with a capacity for 120 children.
 - (6) vectors: flies were many. Not all rooms were screened against flies. No facilities were available to control flies.
- 4) route of transmission:
- (1) common exposure: of the 15 cases in the first cycle of infection on 5 May, 8 shared the room with the index case. On 30 April, in an acute diarrhea, the index case contaminated the floor. The roommates helped clean up, and were therefore exposed to the pathogens. If not washed carefully, their fingernails could have been contaminated.
 - (2) indirect personal contact: more children, both boys and girls, were infected. The likely reasons were: 1) children were often in close personal contact under the crowded circumstances; 2) unsanitary use of toilet could contaminate the toilet area; 3) inadequate hand-washing for short of water; 4) sharing of house phones by boys and girls; 5) carriers helping with the distribution of lunch boxes; 6) poor personal hygiene (most were homeless children), hand-washing before meal and after toilet rarely practiced.
 - (3) transmission by vectors: poor sanitary conditions in the rooms allowed flies to transmit the disease.

5) source of infection: the source of infection was the index case. However, the source of infection of the index case was, after investigations, not clear. The same *S. flexneri* serotype 2a found in Jenai Township, Nantou County, was identified from the index case. The index case, however, had never been to Jenai Township. Later laboratory testings confirmed that the two strains were not of the same origin.

5. Identification of high-risk groups:

- 1) examination of all members of the institution for positive cases. Between 6 May and 4 July, 43 children and one instructor (without symptoms) had been found positive. Of the 43 children, 32 (2 without symptoms) were kept in the institution; one transferred to another institution; and 10 sent home.
- 2) visit to and examination of all contacts of the positive cases. One family member of a negative child on house observation was detected positive without symptoms.
- 3) visit to and examination of all contacts of the index case a week prior to onset. None was found positive.
- 4) surveillance for new cases in the counties and cities where the positive cases came from. No new cases had been reported from these areas between 4 July and 20 August.

6. Preventive measures:

For effective disease control, necessary preventive measures had been taken even before the findings of either the laboratory testings or the epidemiological investigations.

- 1) treatment of positive cases: cases in the first cycle of infection were initially identified *S. flexneri* 2a infection on 8 May by the Central Branch Laboratory of the National Institute of Preventive Medicine. They were medicated by the local health bureau with nalidixic acid supplied by the Central Disease Surveillance Center of the National Quarantine Service on 8 May. The second screening was conducted on 16 May to find 7 cases of the same strains (five being new positive cases). On 16 May, six strains, including the one isolated from the index case, were tested for drug susceptibility. They were found no more susceptible to ampicillin, nalidixic acid, streptomycin, tetracycline and chloramphenicol, though were still susceptible to amikacin, gentamicin, tobramycin and cephalothin. Nalidixic acid is the medicine used for the treatment of bacillary dysentery. Drug susceptibility tests have shown that the shigella strains isolated from the central part of Taiwan in the past were significantly susceptible to this medicine. However, the strains isolated from this incident were resistant to this medicine. It was an oversight not to conduct drug susceptibility test soon after the isolation on 8 May. Cefixime orals were administered on 20 May when the strains were found resistant to nalidixic acid. After five days of medication on 27 May, 10 cases still discharged

pathogens. After five more days of medication on 6-10 June, three continued to discharge pathogens (Table 1). On 13 June, upon the order of the Department of Health, amikacin or gentamicin intravenous drips were used. On 24 June, two cases turned into negative, although one still remained positive. This case finally stopped discharging pathogens after discontinuation of medication for some time. He was detected negative on 1-2 July. The ten positive children sent home were placed under isolation treatment by local health bureaus. The one positive family member without symptoms was given nalidixic acid at home for five days, and found negative after two examinations. Surveillance of the 45 positive cases was terminated after two follow-up examinations gave negative findings.

- 2) contacts of positive cases: nalidixic acid was given to all children of the institution for five days as prophylactic medication. Children sent home on observation were followed-up by local health bureaus. Contacts of the positive cases were given as prophylactics nalidixic acid for two days.
- 3) isolation: to prevent the spread of the infection, newly admitted children were excused from class work and were isolated from those children already in the institution.
- 4) environmental sanitation: the environment (the floor, handrails, door knobs, house phones) was disinfected on 6 May with 5% lysol, 30% chlorine compounds and 1% Idophors (500 cc). The septic tank was also disinfected. Measures were taken to control flies. Toilet paper containers were covered.
- 5) personal hygiene: children were urged to wash hands with soaps before meals and after toilet and not to put fingers in the mouth. Soaps and disinfectants were placed in each office room, around the toilet and the entrance for hand washing. For security reason, only soaps were placed in the dormitories and classrooms.

Discussion

“Reporting” is the key to the effective control of communicable diseases. It was not easy for the physician of a “special institution” to report to the local health authorities the incident immediately after the first round of the infection. Jails and correctional institutions are often relatively isolated, unusual incidents are rarely reported. The cooperation of the institution in the investigations and disease control was also appreciated.

The epidemic curve (Figure 1) suggested that the route of infection of the present incident was mainly man-to-man contact. Table 2 shows that the relative risk of children was 20 times higher than that of the instructors. The likely reasons

were: 1) the water source was not contaminated as no color reactions were detected after the application of the red color No 4, the infection was therefore not universal; 2) contact between instructors and the children was less frequent than contact among children; they did not share the same toilet facilities; 3) instructors practiced better personal hygiene; and 4) different cooks and distributors helped with the food for instructors. Table 2 also shows that the relative risk of girls was 1.9 times higher than that of boys. The likely reasons were: only four girls were under correction, they were in close contact 24 hours; one of them was infected, chances of the rest three being infected were high.

The validity of the laboratory testings was questioned. Table 2 shows that 21 cases with clinical symptoms were found negative, while two cases without symptoms were found positive. The inconsistency in the laboratory findings could have been due to: rectal swabs and not stool specimens were collected for testings, and rectal swabs always give lower positive detection rate; for higher isolation rate, both HE (Hektoen Enteric agar) and SS (*Salmonella Shigella* agar) were used as selective culture media⁽²⁾, their sensitivity and accuracy were not 100%; a study by DuPont et al. on shigella infection showed that of volunteers with typical shigella bacillary dysentery symptoms, no pathogens were detected from 19% of the stools, whereas pathogens were detected from 14% of the volunteers who did not demonstrate any symptoms; Munox et al.⁽³⁾ also reported cases of inapparent carriers. The credibility of the testings was also challenged. Specimens collected from the same cases (cases 082 and 237 of Table 1) at different times on the same day showed different findings. Yet, credibility should not be a problem as the two separate specimens collected each from cases 167, 082 and 184 (Table 1) at the same time showed consistent findings. The fact that cases had taken medicines before testings could have affected the findings of the testings. The growth of bacilli could be temporarily inhibited after the use of antibiotics. Growth resumed some time after the discontinuation of drug use. The laboratory findings could have been different. The timing of the follow-up collection was thus considered important. To avoid similar problem, collection of specimens should be made 48 hours after medication.

The 87 positive strains identified were confirmed *S. flexneri*; of them, 85 were of serotype 2a and two of the γ variation. When the two γ variations were compared by plasmid profile analysis and large DNA fragment analysis by pulsed-field gel electrophoresis with the three strains isolated earlier from the same case, it was found that the γ variation strains were not the new source of infection, but rather a serotype transformation as a result of DNA mutation of the earlier strain. Through immunological screening, the γ variation became the major serotype discharged by the case at the later stage. Strains isolated from 10 cases (including the index case) were also analyzed by plasmid profile analysis and large DNA fragment analysis. The fact that the ten strains showed the same plasmid

profiles and large DNA fragment profiles suggested that the outbreak was caused by one single strain.

The isolated strains were tested for drug susceptibility by disk diffusion method. These strains were found to be resistant to the first-line (trimethoprim/sulfamethoxazole, ampicillin) and the second-line medicines (nalidixic acid of the quinolones group); though were still susceptible to tobramycin, gentamicin and amikacin of the aminoglycoside group and cephalothin, cefotaxime and cefixime of the cephalosporin group. *Shigella* strains of Taiwan have been found resistant to ampicillin ⁽⁴⁾, nalidixic acid has been used for the treatment of bacillary dysentery. Testings have also demonstrated that the strains similar to those isolated in the present incident are susceptible to nalidixic acid. Nalidixic acid is safe with few side effects. It is regularly stored at the Central Disease Surveillance Center of the National Quarantine Service for use in disease control. The drug resistance of some strains to nalidixic acid will make the treatment of bacillary dysentery in the future more difficult.

For effective disease control, when the incident was confirmed *S. flexneri 2a* infection on 8 May, nalidixic acid was immediately supplied by the Central Disease Surveillance Center to local health bureaus for treatment and prophylactics. Because of drug resistance, the infection was not brought under control. When other medicines were used, the situation did not improve, and there even appeared some stubborn carriers. Was the ineffectiveness of the treatment associated with the drug abuse of the children? As no relevant literature in this connection has been located, this argument remains to be studied. Cases of bacillary dysentery tend to discharge pathogens for a long period. In the study by DuPont et al. ⁽¹⁾, the unmedicated volunteers continued to discharge pathogens for 27 days; and 30% (5/17) of them even continued to for more than 30 days. Though it is generally believed that medication can shorten the time of discharge ⁽¹⁾, 10 of the 17 cases medicated with cefixime for 5 days in the present incident continued to discharge pathogens; three of them continued for three more weeks even after more intensive medication. Drug susceptibility tests of isolated strains showed no changes in antibiotic profiles for strains isolated at different times. Levine et al. ⁽⁵⁾ reported two long-term carriers of shigella bacillus. Case 1 was infected by *S. sonnei*. Though symptoms disappeared seven days after onset, the case was placed under antibiotic oral and injection treatment for nine months. The case continued to discharge pathogens for 17 months. Case 2 was a volunteer for the *S. flexneri 2a* vaccine efficacy test. Typical bacillary dysentery symptoms appeared on the second day of the test. Though symptoms disappeared five days later, the case continued to discharge pathogens for 16 months. Pathogens discharged by inapparent carriers can still be pathogenic ⁽⁵⁾. Carriers abound in areas of poorer sanitary conditions ^(6,7). While medication is not totally effective in the control of shigella infection, improvement of environmental sanitation and personal hygiene is the key to the prevention and control.

During the outbreak between 30 April and 4 July, some children had been transferred to other institutions, jails and institutions for drug cessation; some children had been sent home on observation. The infection could have been spread to elsewhere. For disease control, health authorities, acting upon the Regulations for the Control of Communicable Diseases, had requested justice authorities to suspend the probation of any persons at risk. Local health bureaus were also told to immediately follow-up the suspects and their contacts. Justice authorities declined the request but agreed to notify local health authorities in advance when a positive case was to be released. The case was then referred to a hospital for isolation treatment. Some positive cases had already been released to make follow-up and control more difficult.

It was regretful that the original source of infection of the index case, after several trials, had not been located and eliminated. During the outbreak, 62 children had been placed under house observation. Each was followed-up. The homeless children on probation were a headache to follow-up. Fortunately, after an intensive surveillance for one and a half months, no new cases had been reported

The major functions of laboratories in the disease control system are: through laboratory testings to confirm the beginning of an outbreak and to help disease control authorities assess the outbreak for necessary actions; through follow-up testings to evaluate control measures; through drug susceptibility tests to provide information on the use of drugs; and through analysis of strains to help epidemiological investigations. However, the sensitivity of testings cannot be 100%, the sensitivity of culture method also has its ceiling, errors may occur. When laboratories succeed in confirming a bacillary dysentery infection, they are no longer the focus of the control program. The focus then should be shifted to epidemiological investigations, disinfection of the environment, health education of the public, isolation and treatment of patients and surveillance of contacts and new cases.

During the outbreak, three general screenings of the children at the institution were conducted. Local health authorities were asked to follow-up the 62 children on probation and their contacts. In total, specimens from 200 some individuals had been collected for 96 laboratory testings. The cooperation of all health agencies concerned in this incident should serve a good example in the future control of communicable diseases.

Recommendations

1. The probation and house observation of offenders at time of disease outbreak at jails and correctional institutions should be clearly regulated. At the beginning of the outbreak, health authorities had requested the justice

authorities to suspend probation or transfer of the children. The request was declined as there was no such law to justify the action. The infection could have spread to elsewhere. It is therefore suggested that the health and the justice authorities reach a consensus as to the suspension of probation or house observation of offenders at time of the outbreak of highly infectious diseases.

2. Strategies for the medication for bacillary dysentery at time of outbreak should be reviewed. Nalidixic acid is often used as prophylactic for likely contacts of bacillary dysentery at time of outbreak. General medication may give selective pressure on micro-organisms, and drug screening will result in more pathogens resistant to drugs, which in turn will make treatment of serious cases more difficult. The practice of general medication should be discontinued. Instead, only cases with symptoms should be medicated.
3. Priorities in the use of medicines should be reviewed. No drug susceptibility tests were conducted soon after the outbreak. After the use of the front-line medicines, the strains were found drug-resistant. Improvement should be made in this regard. When the front-line medicines were found ineffective, the disease control authorities were not certain as to what medicine were to be used next. Medicines for bacillary dysentery and their priorities in use should be decided in advance. Drug susceptibility of these medicines can then be tested by laboratories on routine basis for the reference of health care authorities and epidemiological studies.
4. Fingerprint databases of shigella strains should be established. There had been several outbreaks of bacillary dysentery in Jenai Township of Nantou County since August 1996. It was the concern of many that the strain detected at the correctional institution was originated in Jenai Township. Further investigations, however, ruled out this connection. Outbreaks of bacillary dysentery are likely to occur in Taiwan due to the abuse of natural resources, the contamination of the sources of water supply, the changes in diet with more consumption of raw food, the more frequent visits to mainland China and the south-east Asian countries, and the importation of alien labors. The establishment of a fingerprint database of shigella bacillus will provide valuable reference to future epidemiological investigations.
5. More sensitive testing methods should be developed. The bacterial culture method is not sensitive enough for the testing of bacillary dysentery. More sensitive methods should be developed to upgrade the level of laboratory testings. Highly sensitive methods can support epidemiological investigations in understanding the distribution of carriers of bacillary dysentery in areas of poorer conditions.

Acknowledgement

Thanks are due to the Taichung City, Taichung County, Changhua County and

Nantou County health bureaus and health stations, the Central Branch Laboratory of the National Institute of Preventive Medicine and the Central Disease Surveillance Center of the National Quarantine Service for their support in the collection of specimens, follow-up of cases and contacts and disease surveillance. Support of the officials concerned is also appreciated. Special thanks are due to Dr KJ Wang, Deputy Director of the National Institute of Preventive Medicine, for his comments.

Table 1. Specifications of Positive Cases

No.	Sex	Age	Date of Onset	Specimens Tested and Findings+
005	M	13	4/30/97	5/7 5/8 5/16 5/19 5/20
032	M	12	5/4/97	5/6 5/7 5/16 5/19 5/20 5/31 6/2
083	M	16	5/5/97	5/6 5/8 5/16 5/19 5/27 5/29 6/7 6/10 6/23 6/24
084	M	16	5/5/97	5/6 5/7* 5/7* 5/8 5/16 5/19
121	M	17	5/5/97	5/7 5/16 5/19 5/20 5/30 5/31
103	M	15	5/5/97	5/7 5/16 5/19 5/27
002	M	15	5/5/97	5/6 5/7* 5/7* 5/8 5/16 5/19 5/20 5/27 5/29 6/6 6/7
061	M	16	5/5/97	5/8 5/16 5/19 5/20 5/30 5/31 6/10 6/11 6/23 6/24
W1 ≠	F	18	5/5/97	5/6 5/19 5/21
167	M	15	5/5/97	5/7# 5/8 5/16 5/19 5/20 5/7
174	M	17	5/5/97	5/7 5/16 5/19 5/20 5/27 5/29
175	M	17	5/5/97	5/7 5/16 5/19 5/20
180	M	17	5/5/97	5/7 5/16 5/19
111	M	16	5/5/97	5/7 5/16 5/19 5/20
042	M	16	5/5/97	5/8 5/16 5/19
185	M	17	5/5/97	5/8 5/16 5/19 5/20
015	F	17	5/5/97	5/7 5/16 5/20 6/2 6/3
082	M		5/6/97	5/7 5/9# 5/10# 5/10* hospital care, 5/9 5/10* negative after two tests
184	M	17	5/6/97	5/7# 5/16 5/19 5/20 5/7
033	M	15	5/6/97	5/7 5/16 5/19 5/20
151	M	17	5/6/97	5/7 5/16 5/19
237	M	17	5/6/97	5/7* 5/7* 5/7* 5/16 5/19
076	M	17	5/6/97	5/8 5/16 5/19

058	M	15	5/8/97	5/8	5/24	5/26			
114	M	17	5/10/97	5/8	5/16	5/19	5/20	5/30	5/31
				6/10	6/11				
156	M	17	5/10/97	5/8	5/9	5/19	5/29	5/31	
L1 ≠	M	14	5/10/97	5/10	5/12	5/16	5/19	5/24	5/25
144	M	116	5/10/97	5/7	5/16	5/19	5/27	6/6	6/7
				6/23	6/24	7/1	7/2		
064	M	16	5/10/97	5/8	5/16	5/20	5/27	5/29	6/7 6/10
192	M	17	5/10/97	5/7	5/16	5/20	5/27	5/29	6/7 6/10
096	M	17	5/10/97	5/8	5/20	5/30	5/31	6/10	6/11
149	M	17	5/10/97	5/8	5/20	5/30	5/31		
230	M	17	5/10/97	5/7	5/16	5/20	5/30	5/31	6/10 6/11
123	M	15	5/10/97	5/6	5/8	5/16	5/20	5/30	5/31 6/10
				6/11					
173	M	17	5/10/97	5/7	5/8	5/16	5/19	5/20	
130	M	17	5/10/97	5/8	5/16	5/19	5/20		
136	M	17	5/10/97	5/7	5/16	5/20	5/27	5/29	
155	M	16	5/10/97	5/9	5/16	5/20	5/30	5/31	
007	F	17	5/10/97	5/7	5/8	5/16	5/20	5/30	5/31
094	M	18	5/11/97	5/6	5/8	5/12	5/13	5/16	5/20
				5/28	5/29				
C1 ≠	M	17	5/15/97	5/12	5/22	5/23			
105	M	14	no symptoms	5/7	5/8	5/16	5/19	5/20	
115	M	18	no symptoms	5/8	5/16	5/20	5/30	5/31	
L2 ≠	M	34	no symptoms	5/7	5/13	5/16	5/19		
W1 ≠	F	42	no symptoms	5/9	5/21	5/22			

Notes: + The shadowed parts stand for positive findings of laboratory testings.

≠ No identification number given by the institution; either on probation or not a member of the institution at the time of onset.

*Specimens collected at different times on the same day.

Two specimens collected on the same day.

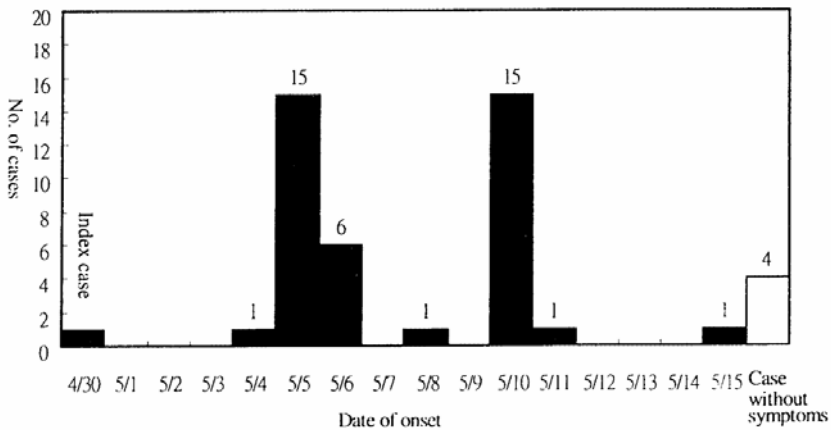
Table 2. Attack Rates and Relative Risks

Items	No.	No. Positive (%)	No. Negative (%)	RR
Occupation*				
(1) children	106	43(40.6)	63(59.4)	20
(2) staff	47	1(2.1)	46(97.9)	
(3) family members	?			
Gender**				
(1) female	4	3(75.0)	1(25.0)	1.9
(2) male	102	40(39.2)	62(60.8)	
Clinical symptoms**				
(1) yes	62	41(66.1)	21(33.9)	14.7
(2) no	44	2(4.5)	42(95.5)	

* Family members are not included in the analysis of relative risks.

**Relative risks are calculated by the children at the institution (N=106).

Figure 1. Epidemic Curve of the Outbreak in One Juvenile Correction Institution, 1997



Participants of Investigation: HC Chen-, SH Chen², CS Chiou³, YM Shen³,
LC Yang³, SL Wei³, TS Hong⁴, TF Lee⁴,
HK Lai⁴, CH Shih⁵

Prepared by: CS Chiou³, TF Lee⁴

1. Taichung City Health Bureau
2. Taichung County Health Bureau
3. Central Branch Laboratory, National Institute of Preventive Medicine, DOH
4. Central Disease Surveillance Center, National Quarantine Service, DOH
5. Adviser, National Quarantine Service, DOH

References:

1. DuPont HL, Hornick RB, Dawkins T, et al. The response of man to virulent *Shigella flexneri* 2a. J Infect Dis 1969; 119: 296-299.
2. Altwegg M, Buser J and von Braevenitz A. Stool cultures for *Shigella* spp: Improved specificity by using MacConkey agar with xylose. Diagn Microbiol Infect Dis 1996; 24: 121-124.
3. Munoz C, Baqar S, van de Verg L, et al. Characteristics of *Shigella sonnei* infection of volunteers: signs, symptoms, immune responses, changes in selected cytokines and acute-phase substances. Am J Trop Med Hyg 1995; 53: 47-54.
4. Lin SR and Chang SF. Drug resistance and plasmid profile of shigellae in Taiwan. Epidemiol Infect 1992; 108: 87-97.
5. Levine MM, DuPont HL, Khodabandelou M, et al. Long-term shigella-carrier state. New Eng J Med 1973; 288: 1169-1171.
6. Sakdisiwasdi O, Achananuparp S, Limsuwan A, et al. *Salmonella* and *Shigella* carrier rates and environmental sanitation in a rural district, central Thailand. Southeast Asian J Trop Med Pub Hlth 1982; 13: 380-384.
7. Achi R, Mata L, Siles X et al. Immunomagnetic separation and PCR detection show shigellae to be common faecal agents in children from urban marginal communities of Costa Rica. J Infect 1996; 32: 211-218.