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# Electronic network for monitoring travellers' diarrhoea and detection of an outbreak caused by *Salmonella enteritidis* among overseas travellers

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## SUMMARY

The Traveller's Diarrhoea Network, by which the Infectious Disease Surveillance Center is electronically connected with two major airport quarantine stations and three infectious disease hospitals, was launched in February 1988 in Japan. The data on travellers' diarrhoea detected is reported weekly by e-mail. Two clusters of infection among travellers returning from Italy were reported by two airport quarantine stations at the end of September 1998. A total of 12 salmonella isolates from 2 clusters were examined. All were identified as *Salmonella enteritidis*, phage type 4 and showed identical banding patterns on pulsed-field gel electrophoresis. A case-control study showed that the scrambled eggs served at the hotel restaurant in Rome were the likely source of this outbreak. This outbreak could not have been detected promptly and investigated easily without the e-mail network. International exchange of data on travellers' diarrhoea is important for preventing and controlling food-borne illnesses infected abroad.

## INTRODUCTION

Many European and north American countries have been struggling against food-borne illnesses caused by salmonella strains and Shiga toxin-producing *Escherichia coli* (STEC) 0157 infections [1–9]. Salmonella has been a leading causative agent of food-borne illnesses in Japan and the serotype Enteritidis has been the predominant strain in recent years. More than 100 outbreaks involving 10 or more cases of salmonella poisoning were reported in 1996 [10]. With the globalization, recent increases in some diarrhoea diseases infected abroad were reported in Japan [11].

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An e-mail network system that connects the Infectious Disease Surveillance Center (IDSC), two major airport quarantine stations (Tokyo and Osaka), and three infectious disease hospitals was launched in February 1998 to monitor prevailing pathogens and suspected places of infection in travellers' diarrhoea and to detect outbreaks promptly. Data sent to the IDSC by e-mail are analysed weekly as to the pathogens isolated from travellers, suspected places of infection, date of onset and so on. The reporting format is shown in Figure 1.

We report that this unique e-mail network could detect an outbreak of *S. enteritidis* food poisoning among Japanese overseas tourists. At the end of September 1998, two clusters of salmonella infections were reported from the two airport quarantine

**Kansai Airport Quarantine Station (1999/4/25〜5/2)**

| Serial No. | No. | Pathogen | subtype | age | sex | patient address | onset | place of infection | institute of isolation | institute of reporting | miscellous |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1334 | 1 | 5 | 1 | 30 | 2 | 2 | 99/4/25 | Indonesia(Bali) | 2 | 2 | 2.indonesia:4/15–4/26 |
| 1372 | 2 | 5 | 1 | 14 | 1 | 4 | 99/4/26 | Vietnam(HCMC) | 2 | 2 | 2:Vietnam:4/26–4/27 |
| 1380 | 3 | 4 | 1 | 50 | 2 | 2 | 99/4/27 | Thailand(Bankok) | 2 | 2 | 3:H2 blocker for G.Ulcer |
| 1402 | 4 | 0 | 4 | 46 | 1 | 6 | 99/4/29 | Nepal | 2 | 2 | 2:Nepal 4/25/4/30 |
| 1408 | 5 | 3 | 3 | 19 | 1 | 9 | 99/4/29 | India | 2 | 2 | 2.india 3/20–4/30 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.Shigella | 1:dysenteriae–1,2,3,4,5,6,7,8,9,10,11,12, z=unkown | 1:man | prefecture | Y/M/D | City | institution/organization | 1:Narita Airport QS | 1:susptected source |
| | | 2:Flexneri–1a,1b,1c,2a,2b,3a,3b,4a,5,5a,5b,6,x,y,z=unknown | 2:woman | 1:Hokkaido | | | 1:Narita Airport QS | 2:Kansai Airport QS | 2:shedule of travel |
| | | 3:Boydii–1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,z=unknown | | 2:Aomori | | | 2:Kansai Airport QS | 3:yokohama city hospital | 3:past history of host (operation of GI tract, use of H2 blocker) |
| | | 4:Sonnei | | 3:Iwate | | | 3:others ( ) | 4:Osaka city hospital | 4:clinical symptoms |
| | | 5:unknown serotype | | 4:Miyagi | | | | 5:Tokyo Met. Gov.Hospital (Ebara) | 5:others |
| 1 | 1.Salmonella | 1:Typhi, 2:Paratyphi A, | | 5:Akita | | | | 6:Tokyo Met. Gov.Hospital (Komagome) | |
| 2 | 2.Salmonella | 1:O4, 2:O7, 3:O8, 4:O9, 5:O3,10, 6:O1,3,19, 7:O13, 8:O18, 9:others, | | 6:Yamagata | | | | 7:Tokyo Met. Gov.Hospital (Bokuto) | |
| 3 | 3.V. cholerae O1(CT+) | 1:C.Ogawa, 2:C.Inaba, 3:E.Ogawa, 4:E.Inaba, | | 7:Fukushima | | | | | |
| 4 | 4.V. cholerae | 1:non O1(non–O139), 2:O139 | | 8:Ibaragi | | | | | |
| 5 | 5.Vibrio | 1:parahaem, 2:fluvialis, 3:mimicus, | | 9:Tochigi | | | | | |
| 6 | 6.E.coli* | 1:toxigenic, 2: invasive, 3: serotype, 4: VTEC(O157), 5: VTEC(non–O157), 6: unknown | | 10:Gunma | | | | | |
| 7 | 7.Yersinia | 1:enterocolitica, 2: pseudotuberculosis | | 11:Saitama | | | | | |
| 8 | 8.Campylobacter | 1:jejuni, 2: coli, | | 12:Chiba | | | | | |
| 9 | 9.Aeromonas | 1:hydrophila, 2: sobria, 3: unknown | | 13:Tokyo | | | | | |
| 10 | 10.Plesiomonas shigelloides | | | 14:Kanagawa | | | | | |

**Fig. 1.** An example of reporting form in electronic network for monitoring travellers diarrhoea. The fulfilled form is sent as attached file of e-mail (Microsoft Excel version 5·0 format).

stations through this e-mail network. All the travellers affected had just returned from Italy. We made bacteriological and epidemiological investigations on these cases.

## METHODS

### Tour group at the Kansai Airport Quarantine Station (Osaka)

Twelve of 14 tourists who had travelled to Italy together developed severe diarrhoea on the airplane returning from Rome to Osaka on 29 September 1998. Stool specimens obtained from seven of them at the bacteriology laboratory of the airport yielded salmonella. All the tourists with diarrhoea were hospitalized. Salmonella was isolated from two more of the patients during hospitalization (totally nine cases of salmonella isolated). This cluster of salmonella was reported to IDSC by mail on 5 October 1998.

### Tour group at the Narita Airport Quarantine Station (Tokyo)

Four of 30 tourists who travelled to Italy developed severe diarrhoea in Rome during the evening of 28 September 1998 and were admitted to a local hospital. Another 16 of the tourists developed diarrhoea on the airplane bound from Rome to Tokyo on 29 September 1998. They consulted a physician at the Narita Quarantine Station. Stool specimens (or rectal swabs) were examined, five of which yielded salmonella. This cluster of salmonella was reported to IDSC by mail on 7 October 1998.

### Laboratory investigation

The IDSC detected the two clusters of salmonella infections. All of infected travellers were returning from Italy. All the salmonella isolates from the two quarantine stations were collected and analysed at the Department of Bacteriology, National Institute of Infectious Diseases. Twelve isolates were tested for serovar typing, phage typing, and pulsed-field gel electrophoresis (PFGE) of DNA fragments digested by the *B1n*I restriction enzyme.

### Epidemiological investigation

The IDSC conducted telephone interviews with the tour members who returned through Osaka; 12 of the 14 tourists could be interviewed. Mail questionnaires were sent to the 29 tour members returning through Tokyo. Twenty-five (86%) tourists responded. The odds ratio, 95% confidence interval and *P* value were calculated using EPI INFO version 6.04.

## RESULTS

### Laboratory investigation

The 12 salmonella isolates obtained from the tourists at the two quarantine stations were identified as serotype Enteritidis and phage type 4. All had identical banding patterns in *B1n*I-digested PFGE (Fig. 2). These findings are strong indication that all these persons were exposed to a common infection source.

### Epidemiological investigation

Because laboratory investigation findings strongly suggested a common causative pathogen, the meals both tour groups took in common were reviewed. The breakfast buffet at a Rome hotel on 28 September was the only common meal. Figure 3 shows the onset of diarrhoeal symptoms between 6 and 48 h after eating breakfast at the hotel (median 18 h). These findings are consistent with a common source of infection. Analysis then focused on the breakfast of 28 September. Scrambled eggs, bacon, cheese, orange juice, grapefruit juice, fresh fruit, bread, corn flakes, tea, coffee, cream and fresh milk were served at the breakfast buffet. Among the total 37 tourists who responded to our questionnaire, some of them were not confident whether they had eaten specific foods. These cases were excluded from the statistical analysis.

Case control analyses for the tour members on the breakfast items are shown in Table 1. Tour members without diarrhoea or infection-related symptoms were classified as the control group. Results showed that only scrambled eggs were the possible causative food in this outbreak (odds ratio, 31; 95% confidence interval, 3·5–277·2 and *P* value, 0·0014).

## DISCUSSION

Because of the newly established e-mail network system for monitoring travellers' diarrhoea, this

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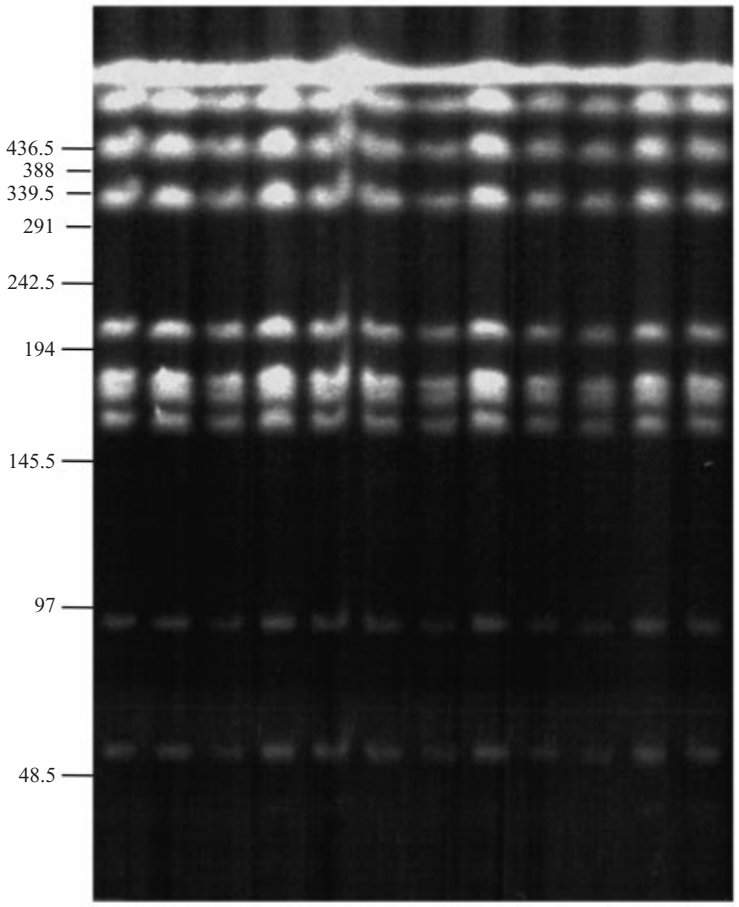


**Fig. 2.** *B1n*I restriction patterns of 12 strains of *Salmonella enteritidis* isolated from tourists at two airport quarantine stations (left: 7 from Osaka and the other 5 from Tokyo) by pulsed-field gel electrophoresis. The values on the left side the size of marker in kb.

outbreak was detected promptly, and the causative food was easily identified. *S. enteritidis* has been the predominant serotype over the past 3 years in Japan accounting for more than 70% of salmonellosis cases associated with food-borne outbreaks. Phage type 4 is the second leading phage type of *S. enteritidis* isolated in Japan and it accounted for 36% of the cases in 1996. It would have been more difficult to detect an outbreak and to identify the causative food without e-mail if only one cluster of cases had been reported after a long period. We were able to focus on the breakfast served at the hotel restaurant, because the only meal common to the two clusters was that breakfast.

Concerning salmonella outbreaks, a Swiss study showed that results of multivariate risk factor analysis confirmed a positive association between travel abroad and salmonellosis [12]. A Swedish study also showed that the annual number of *S. enteritidis* infections in humans has increased from about 200 to 2000 over the past 10 years. Of these 90% were acquired abroad even when extensive control measures were implemented. The majority of domestic cases of *S. enteritidis* probably are the results of secondary infections from imported human cases and from imported meat [13].

In our investigations, the tour conductor remembered seeing other groups of tourists at breakfast in the hotel on 28 September 1998, some of whom seemed to be Chinese speaking tourists, and other members of a group from the United States. Closer international collaboration therefore would be helpful in investigating and effectively controlling salmonella food-borne illnesses. It is most important to exchange information on travellers' diarrhoea, including the pathogens (serotype, phage type and, if possible, PFGE pattern) and the probable source and place of infection.

The United States has established the Sentinel Network of Travel Medicine Clinics (*GeoSentinel*); 22 travel clinics located in the United States and other countries [14]. An international surveillance network

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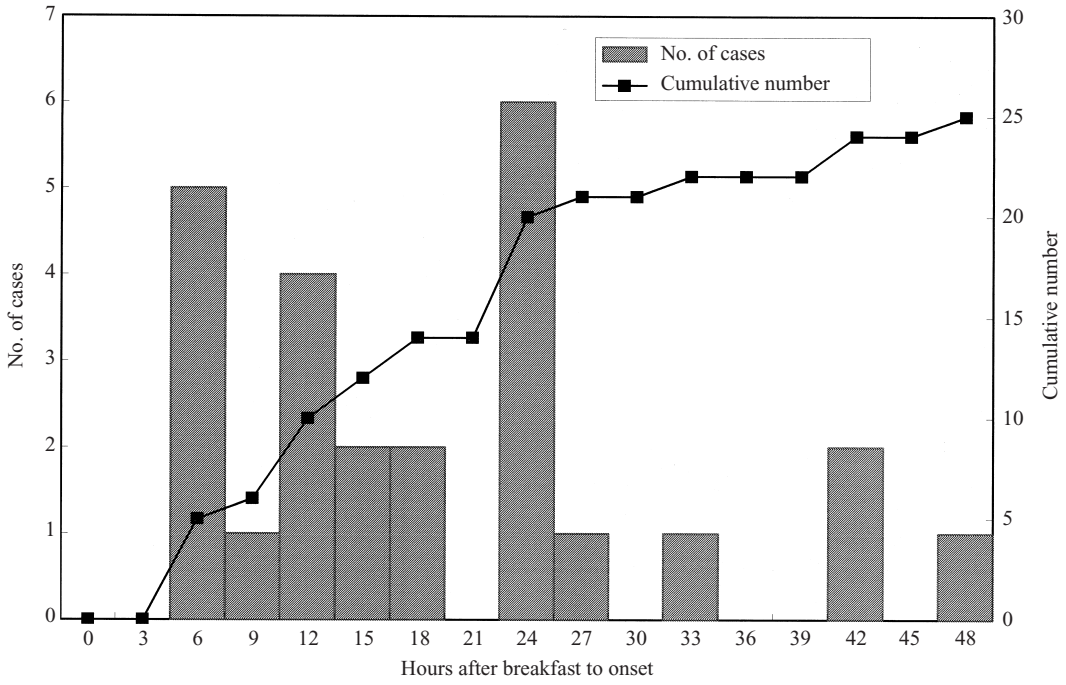


**Fig. 3.** Period to onset of diarrhoea symptoms after eating breakfast. The diarrhoea symptoms started from 6 h after until 48 h (median 18 h).

Table 1. *Specific odds ratio for foods served at the breakfast on 28 September 1998*

| | Case (salmonella confirmed and diarrhoeal cases) | | Control (persons without diarrhoea or infection related symptoms) | | | | |
|---|---|---|---|---|---|---|---|
| Food items | Ate | Did not eat | Ate | Did not eat | Odds ratio | 95% Confidence interval | *P* value* |
| Scrambled eggs | 25 | 2 | 2 | 5 | 31·25 | 3·52–277·16 | 0·0014 |
| Bacon/ham | 22 | 5 | 4 | 2 | 2·20 | 0·31–15·55 | 0·5843 |
| Cheese | 7 | 18 | 2 | 4 | 0·78 | 0·12–5·25 | 1·0000 |
| Orange juice | 15 | 10 | 3 | 4 | 2·00 | 0·37–10·92 | 0·6691 |
| Grapefruit juice | 5 | 20 | 0 | 7 | 4·02 | 0·20–81·93 | 0·5603 |
| Cut fruit | 12 | 9 | 1 | 5 | 6·67 | 0·66–67·47 | 0·1647 |
| Bread | 25 | 1 | 7 | 0 | 1·13 | 0·04–30·81 | 1·0000 |
| Cornflakes | 4 | 20 | 1 | 6 | 1·20 | 0·11–12·88 | 1·0000 |
| Black tea | 4 | 23 | 0 | 7 | 2·87 | 0·14–59·76 | 0·5585 |
| Coffee | 18 | 7 | 7 | 0 | 0·16 | 0·01–3·26 | 0·3002 |
| Milk | 6 | 19 | 1 | 5 | 1·58 | 0·15–16·31 | 1·0000 |
| Cream | 10 | 16 | 3 | 4 | 0·89 | 0·16–4·85 | 1·0000 |
| Yogurt | 11 | 15 | 3 | 3 | 0·73 | 0·12–4·35 | 1·0000 |

* *P* value calculated using Fisher's exact test.

called *Enter-net* (formerly *Salm-net*) set up to monitor enteric infections caused by salmonella and STEC 0157 also includes 15 countries in the European Union, plus Switzerland and Norway, and this network has detected some outbreaks in the past [15–17]. Japan also participates in this network (*Enter-net*). Such networks are expected to have an important role in detecting 'diffuse' outbreaks and in helping to investigate the causative foods and effectively control food-borne illnesses.

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