Surveillance programme for the control of foodborne infections and intoxications in Europe: the first 6 years' experience in Scotland, 1980–85

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In 1979 WHO recommended the establishment of a surveillance programme in Europe for foodborne infections and intoxications that incorporated an early warning system for incidents affecting more than one country as well as a routine reporting system to record details of outbreaks of foodborne disease. The Early Warning System was introduced in Scotland in July 1979 and the Routine Reporting System in January 1980. By the end of 1985, 23 European countries were participating in the programme.

The introduction of the surveillance programme in Scotland permitted the formation of a standard national reporting system for foodborne infections and intoxications. During the 6 years from 1980 to 1985, the major features of the programme in Scotland have been the introduction of compulsory pasteurization of cows’ milk, in 1983, with the consequent eradication of general outbreaks of milkborne salmonellosis; the emergence of poultry meat as the major food vehicle of infections; and the development of techniques for costing foodborne disease outbreaks.

In April 1979, WHO convened a meeting in Geneva, at which 13 countries were represented, to discuss a coordinated surveillance programme for the control of foodborne infections and intoxications in the European Region. The main recommendations were that an early warning system and a routine reporting system should be established and that the FAO/WHO Collaborating Centre for Research and Training in Food Hygiene, Berlin (West), should act as the coordinating centre.

Under the Early Warning System, which was introduced in Scotland in July 1979, details of outbreaks involving more than one country, unusual, rare or severe diseases, or emergencies were relayed immediately to the Collaborating Centre. The Routine Reporting System, whereby regular reports were made about any disease of an infectious or toxic nature that was attributed to the consumption of food or water, became effective in Scotland on 1 January 1980. By the end of 1980, 13 European countries were participating in these schemes, and by December 1985 this had increased to 23.

The results and experience gained in Scotland over the first 6 years of participation in the programme are reviewed here.

MATERIALS AND METHODS

In Scotland, epidemiological information on the occurrence of foodborne diseases is obtained initially by the district environmental health officer or community health nurse, following notification by a family doctor or a medical laboratory. Details are then compiled by the community physician on an outbreak summary form. Subsequently, reports are scrutinized at the Communicable Diseases (Scotland) Unit and forwarded, for national analysis, to the Information and Statistics Division of the Scottish Health Service and to the Collaborating Centre in Berlin (West), for international analysis. A national report is published each year (1).

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Details of etiological agents causing foodborne disease are obtained from medical and veterinary laboratories throughout Scotland, and this is complemented, for example, by the results of serotyping, phage typing, and toxin testing undertaken by specialist reference laboratories in Glasgow and London.

RESULTS

A total of 1380 outbreaks of foodborne disease, comprising 1012 household and 368 general outbreaks, were recorded from 1980 to 1985 in Scotland (Table 1); 2619 persons (26%) were affected in the household outbreaks (average, 2.6 persons per outbreak) and 7508 (74%) in the general outbreaks (20.4 per outbreak). Of the total of 10 127 persons affected, 599 (6%) required admission to hospital and 33 (0.03%) died. Altogether, 207 episodes (15%) that affected 757 persons (7%) originated from outside Scotland and involved holidaymakers and other travellers who had acquired their infection overseas or elsewhere in the United Kingdom. On four occasions, the Early Warning System was implemented because of outbreaks of salmonellosis that involved groups of tourists.

Etiological agents

Salmonella spp. were responsible for 1105 outbreaks (80%) and for 6463 (64%) of the persons affected (Table 1), including 530 (88%) of those admitted to hospital and 30 of the 33 deaths. Campylobacter spp. were associated with 111 outbreaks (8%) and 613 persons (6%), Clostridium perfringens with 42 outbreaks (3%) and 1108 persons (11%), and staphylococcal enterotoxin with 11 outbreaks (0.8%) and 137 persons (1.4%). Viruses (hepatitis A virus and Norwalk agent) were implicated in six episodes (133 persons). Finally, chemical contamination caused four incidents, in one of which 54 persons consumed eggs that contained dieldrin (2). In 86 outbreaks (6%) that affected 1494 persons (15%), no etiological agent was identified.

Food vehicles

Meats. Poultry meat was the most commonly reported food vehicle (3) and was recorded in 19% of outbreaks (involving 26% of persons), mainly of salmonellosis and campylobacteriosis (Table 2). Other meats were involved in 15% of outbreaks (involving 21% of persons), among which salmonellosis and C. perfringens food poisoning predominated.

Milk and dairy products. From 1980 to 1982, milk caused 4% of outbreaks of foodborne infections (4), affecting 26% of persons. In 1983, following legislation requiring the heat treatment of cows’ milk in Scotland, milkborne infection decreased significantly (5), and thereafter accounted for only 2.5% of outbreaks and 3% of infected persons. However, outbreaks of salmonellosis continued in farming communities, where dairy workers received raw milk as a wage-benefit, a practice not prohibited by the legislation since no retail sale was involved (6). Also, an outbreak of campylobacter enteritis in 1985 was associated with an illegal sale of raw milk (7).

In late 1985, heat-treated powdered milk contaminated with Salmonella ealing caused infection in

Table 1. Analysis of outbreaks of foodborne infection and intoxication according to etiological agent, Scotland, 1980–85

<table>
<thead>
<tr>
<th>Type of outbreak</th>
<th>Salmonella spp.</th>
<th>Campylobacter spp.</th>
<th>C. perfringens*</th>
<th>S. aureus b</th>
<th>B. cereus c</th>
<th>Viruses</th>
<th>Other d</th>
<th>Not known</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>885</td>
<td>95</td>
<td>—</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>26</td>
<td>1012</td>
</tr>
<tr>
<td>General</td>
<td>220</td>
<td>16</td>
<td>42</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>60</td>
<td>368</td>
</tr>
<tr>
<td>Total number of outbreaks</td>
<td>1105</td>
<td>111</td>
<td>42</td>
<td>11</td>
<td>8</td>
<td>6</td>
<td>11</td>
<td>86</td>
<td>1380</td>
</tr>
<tr>
<td>Total number of persons</td>
<td>6463</td>
<td>613</td>
<td>1108</td>
<td>137</td>
<td>53</td>
<td>133</td>
<td>126</td>
<td>1494</td>
<td>10 127</td>
</tr>
<tr>
<td>No. admitted to hospital</td>
<td>530</td>
<td>20</td>
<td>3</td>
<td>13</td>
<td>—</td>
<td>7</td>
<td>8</td>
<td>18</td>
<td>599</td>
</tr>
<tr>
<td>No. of deaths</td>
<td>30</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>33</td>
</tr>
</tbody>
</table>

* Clostridium perfringens.
b Staphylococcus aureus.
c Bacillus cereus.
d Includes other microorganisms (Escherichia coli, Giardia lamblia), other toxins, and chemicals.
Table 2. Analysis of outbreaks of foodborne infection and intoxication (and reported deaths) according to food vehicle and etiological agent, Scotland, 1980–85

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>B. cereus&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Campylobacter spp.</th>
<th>C. perfringens&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Salmonella spp.&lt;sup&gt;c&lt;/sup&gt;</th>
<th>S. aureus</th>
<th>Viruses</th>
<th>Other organisms</th>
<th>Chemicals</th>
<th>Other toxins</th>
<th>Unspecified</th>
<th>No. of outbreaks</th>
<th>Percentage of total outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakery products</td>
<td>—</td>
<td>—</td>
<td>4</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>—</td>
<td>—</td>
<td>2</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Cream</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>—</td>
<td>1</td>
<td>2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat and meat products</td>
<td>—</td>
<td>11</td>
<td>31 (2)&lt;sup&gt;d&lt;/sup&gt;</td>
<td>127 (1)</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>31</td>
<td>203</td>
<td>14.7</td>
<td></td>
</tr>
<tr>
<td>Milk</td>
<td>—</td>
<td>9</td>
<td>37 (7)</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>47</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Poultry</td>
<td>—</td>
<td>25</td>
<td>5 226 (11)</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6</td>
<td>265</td>
<td>19.2</td>
</tr>
<tr>
<td>Rice</td>
<td>7</td>
<td>—</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Shellfish</td>
<td>—</td>
<td>1</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>3</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>11</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>27</td>
</tr>
<tr>
<td>Total</td>
<td>8</td>
<td>50</td>
<td>40 (2)</td>
<td>426</td>
<td>10</td>
<td>6</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>59</td>
<td>608</td>
<td></td>
</tr>
</tbody>
</table>

No. of outbreaks for which vehicle is known

| No. of outbreaks | 8 | 49 | 40 | 413 (19) | 9 | 4 | 2 | 4 | 3 | 57 | 589 | 42.7 |

No. of outbreaks for which vehicle is not known

| No. of outbreaks | — | 62 | 2 | 692 (11) | 2 | 2 | 2 | — | — | 29 (1) | 791 | 57.3 |

Total number of outbreaks

| Total number of outbreaks | 8 | 111 | 42 (2) | 1105 (30) | 11 | 6 | 4 | 4 | 3 | 86 (1) | 1380 (33) |

<sup>a</sup> Bacillus cereus.

<sup>b</sup> Clostridium perfringens. Includes one outbreak in which C. perfringens and B. cereus were isolated from minced meat.

<sup>c</sup> Includes seven outbreaks (two were associated with poultry meat, one with milk, and four with unknown foods) in which Salmonella spp. and Campylobacter spp. were isolated from affected persons.

<sup>d</sup> Figures in parentheses indicate the reported number of deaths.
many areas of the United Kingdom and seven cases were identified in Scotland. Finally, two outbreaks of staphylococcal enterotoxin food poisoning were caused by consumption of untreated sheep’s cheese and goats’ milk (8), respectively.

Other foods. Rice, particularly re-heated rice, was frequently associated with Bacillus cereus food poisoning. Seafoods were incriminated in outbreaks of salmonellosis, Norwalk agent gastroenteritis, viral hepatitis, scombrotoxin fish poisoning, and several infections of undetermined etiology. Raspberries caused an outbreak of viral hepatitis (9) and contaminated Italian chocolate was responsible for infection by Salmonella napoli. In 57% of outbreaks (32% of persons), no food vehicle was identified.

Place of food consumption

The place where incriminated food was consumed was recorded in 838 outbreaks (61%) and, of these, 451 (54%) were in the home. Commercial catering establishments were associated with 200 outbreaks (24%), followed by hospitals (3%), other residential premises, e.g., old persons’ homes, military camps, and prisons (3%), as well as the workplace (3%).

Thirty outbreaks (4%), mainly of salmonellosis, were geographically widespread and involved two or more districts, with no single identifiable place of food consumption. In 542 outbreaks (39%), there was no indication where the food had been consumed.

Place of food mishandling and/or contamination

The place where food had been mishandled and/or contaminated was recorded in 500 outbreaks (36%). Of these, commercial catering was implicated in 180 (36%), the home in 175 (35%), farms in 43 (9%), and hospitals in 27 (5%). Transport, which included airline catering, supply ships involved in the North Sea oil industry, and a passenger ferry ship (10), was involved on seven occasions. In eight outbreaks, food was mishandled in two separate premises. For 880 outbreaks (64%), no evidence was available as to where the food had been mishandled.

Contributory factors

A total of 577 contributory factors were recorded in 317 (23%) outbreaks. Of these, most commonly reported were the use of an unsafe food source (27%), inadequate cooking (15%), cross-contamination (14%), improper cooling (9%), and inadequate refrigeration (9%). In 77% of outbreaks, no contributory factor was recorded.

DISCUSSION

The surveillance programme has been invaluable in Scotland for consolidating and improving pre-existing foodborne disease programmes. Experience gained throughout the 1970s was significant in enabling Scotland to be the first European country to contribute formally to the programme from January 1980.

In 1983 the implementation of legislation in Scotland requiring heat treatment of cows’ milk, which significantly reduced the incidence of milkborne infection, would not have been possible without the data provided by surveillance (11). This success, however, emphasized the continuing problem of milkborne salmonellosis in dairy-farming communities (6). In consequence, since September 1986 it has also been mandatory that only heat-treated milk can be supplied to farm workers in Scotland as a wage-benefit. The sale of untreated goats’ and sheep’s milk is not, however, prohibited since current dairy legislation in the United Kingdom applies only to cows’ milk.

The value of specialist reference laboratories in foodborne surveillance has proved itself on numerous occasions. For example, outbreaks involving foods that are distributed nationally or internationally, such as poultry, chocolate, or powdered milk, may not readily be recognized in the absence of a coordinated surveillance programme supported by reference facilities. Such outbreaks may be widespread both geographically and over a period of time because of prolonged storage and/or the use of deep-freezes.

A review of poultry-borne salmonellosis in Scotland since 1980, based on the results of the surveillance programme, has been undertaken (12). As with earlier studies of milkborne infections (4, 11), it is expected that this will provide data that support the implementation of more effective control measures. Estimated costs of a major poultry-borne outbreak that caused three deaths in an Edinburgh hospital in 1985 ranged from £199 579 to £884 744 (US$ 287 394–1 274 031) with an average of £825–£3655 (US$ 1188–5263) per case (13). These compared with the estimated average cost per case of £451–£6215 (US$ 649–8950) (at 1985 prices) for an outbreak of milkborne salmonellosis in 1981 that caused two deaths (14). A study of the 1985 Edinburgh outbreak with regard to the costs and benefits of preventing poultry-borne infection using gamma-irradiation has also been undertaken (15).

Surveillance of foodborne infections in hospitals, residential homes, and other institutions (16), as well as in association with the North Sea oil industry (17), also demonstrated the need to improve food hygiene.

Salmonella spp. were the predominant etiological agents involving a wide range of foods, catering and
food production premises. In contrast, *C. perfringens* was mostly associated with institutional catering where food, particularly meats, was cooked in bulk far in advance of consumption, a problem which was compounded by poor temperature control. The role of *Campylobacter* spp. in foodborne disease is not yet fully clear, largely due to a relatively long incubation period, the apparent sporadicity of most infections, and the lack of a readily available serotyping system. Also, little information is available on the role played in this respect by viral infections, which too often are considered only at a late stage of investigations, following negative bacteriological findings.

Accurate information is lacking on the contributory factors that lead to foodborne disease, an area where control measures could most effectively be applied. Improved temperature control would undoubtedly reduce the incidence of outbreaks of *C. perfringens*, while a greater awareness of potential cross-contamination between raw and cooked foods would prevent many salmonella and campylobacter infections.

**ACKNOWLEDGEMENTS**

We acknowledge the invaluable assistance given by the community medicine specialists, environmental health officers, and community health nurses who provided the epidemiological information, and the Directors and staff of the Scottish Salmonella Reference Laboratory, Glasgow, as well as the Food Hygiene Laboratory and the Division of Enteric Pathogens, Public Health Laboratory Service, London. Mrs Mary Graham, Mrs Suzanne Jardine, and Miss Irene Patterson are thanked for secretarial assistance.

**RÉSUMÉ**


En 1979, la Région européenne de l’OMS a établi un programme de surveillance des toxi-infections alimentaires consistant en un système d’alerte précoce pour les épisodes touchant plus d’un pays et un système de notification systématique permettant d’enregistrer les détails des flambees. Le système d’alerte précoce a été introduit en Ecosse le 1er juillet 1979 et le système de notification systématique le 1er janvier 1980. A la fin de 1985, 23 pays d’Europe participaient au programme de surveillance.

En Ecosse, les données épidémiologiques sur les toxi-infections alimentaires sont habituellement reçues par le fonctionnaire local de l’hygiène du milieu ou l’infirmière de santé communautaire après notification par le médecin de famille ou le laboratoire d’analyses. Les détails sur les flambees sont envoyés au centre national de surveillance (Communicable Diseases (Scotland) Unit). L’analyse des flambees à l’échelle nationale est réalisée à l’Information and Statistics Division, Scottish Home and Health Department, à Edimbourg, et expédiée au Centre collaborateur FAO/OMS de recherche et de formation concernant l’hygiène des denrées alimentaires, à Berlin-Ouest.

Au cours de la période de six ans de 1980 à 1985, un total de 1380 flambees de toxi-infections alimentaires, dont 1012 flambees familiales et 368 flambees collectives, a été enregistré; 2619 personnes (26%) ont été touchées par les flambees familiales (moyenne: 2,6 personnes par flambee) et 7508 personnes (74%) par les flambees collectives (moyenne: 20,4 personnes par flambee).

Sur les 10 127 personnes atteintes, 599 (6%) ont dû être hospitalisées et 33 (0,3%) sont décédées. Deux cent sept flambees (15%) avaient une origine extérieure à l’Ecosse et ont touché 757 personnes (7%), qui avaient contracté l’infection à l’étranger ou dans une autre région du Royaume-Uni.

À quatre reprises, le système d’alerte précoce a fonctionné à l’occasion d’épisodes internationaux de salmonelloses.

La participation au programme de surveillance a permis la création ou l’amélioration de plusieurs services ou prestations importantes en Ecosse: introduction d’un système standard de notification à l’échelle nationale; études spéciales sur la salmonellose due à la consommation de volaille; surveillance des toxi-infections alimentaires dans les maisons de santé et autres établissements de séjour, ainsi que sur les plates-formes pétrolières; estimation du coût de la salmonellose transmise par le lait et par les volailles; établissement de données en faveur du traitement thermique du lait de vache et de l’introduction de l’irradiation pour la lutte contre les infections transmises par les volailles.
REFERENCES


8. The compleat investigator—or is Koch still postulating? Communicable diseases (Scotland) weekly report, 19 (31): ix (1985).


