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General outbreaks of infectious intestinal disease (IID) in hospitals, England and Wales, 1992–2000

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Summary: Between 1992 and 2000, 26.6% (1396/5257) of all general outbreaks of infectious intestinal disease (IID) reported to the Public Health Laboratory Service (PHLS) Communicable Disease Surveillance Centre (CDSC) occurred in hospitals. Over 29 000 patients and staff were affected and the mortality risk was higher than for outbreaks in other settings [relative risk 2.00 (95% CI: 1.52–2.63) $P < 0.001$]. Person-to-person spread was the predominant mode of transmission. The mortality risk was highest in foodborne disease outbreaks [relative risk 3.22 (95% CI: 1.41–7.36); $P = 0.003$]. Most outbreaks occurred between November and April. The pathogens most frequently reported were Norwalk-like virus (NLV) (54%) and *Clostridium difficile* (12.6%). These findings emphasize the public health importance of outbreaks of IID in hospitals, especially during the winter when pressures on hospitals are at their height.

Keywords: Hospital outbreak; food poisoning; gastrointestinal diseases; Norwalk-like virus; *Clostridium difficile*.

Introduction

Outbreaks of infectious intestinal disease (IID) in hospitals lead to avoidable mortality, closures to admissions and considerable disruption for patients and staff.[1,2] Reviews of the epidemiology of outbreaks of IID in hospitals have tended to be focussed on the management and epidemiology of outbreaks due to single, specified pathogens.[3,4] In order to describe the epidemiology and impact of outbreaks of IID as a whole in hospitals in England and Wales, we examined morbidity, mortality, aetiology and transmission factors associated with these outbreaks between 1992 and 2000 through analysis of the national database held by the Public Health Laboratory Service Communicable Disease Surveillance Centre (CDSC).[5]

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Methods

Outbreaks of IID in England and Wales are brought to the attention of the CDSC from a variety of sources, including the national laboratory reporting scheme,[5] microbiologists, Environmental Health Officers (EHOs), Hospital Control of Infection Officers, Consultants in Communicable Disease Control (CCDCs), and the press.[6] A structured questionnaire is sent to the appropriate CCDC, with a request that the lead investigator completes it when the outbreak investigation has ended (Figure 1). The questionnaire comprises a standard dataset, including details of the setting, mode of transmission, causative organism, and summary results of epidemiological and laboratory investigations.[6] Up to

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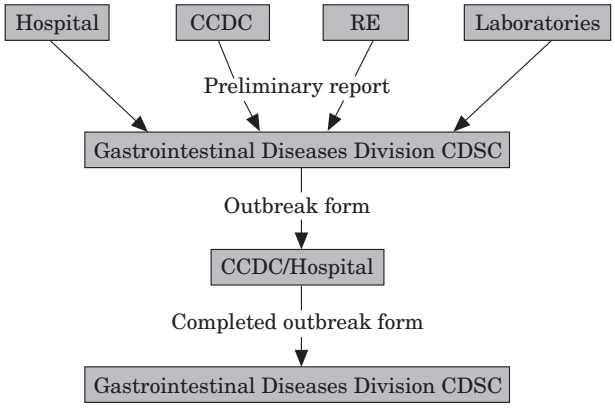

Figure 1 Surveillance of general outbreaks of IID in England and Wales. CCDC, consultant in communicable disease control; RE, regional epidemiologist; CDSC, Communicable Disease Surveillance Centre.

Table I *Terms and definitions*

Term	Definition
Food poisoning/ foodborne disease	Any disease of an infectious or toxic nature caused by or thought to be caused by consumption of food or water.
Outbreak	An incident in which two or more people, thought to have a common exposure, experience a similar illness or proven infection (at least one of them being ill).
General outbreak	An outbreak affecting more than one private residence or residents of an institution.

three reminders are mailed to non-responders. The response rate is consistently around 80%.

Data from the questionnaires are stored in a dynamic database derived from Epi Info version 5.[7] Definitions of the terms 'food poisoning', 'outbreak' and 'general outbreak' are provided in Table I.[8]

Descriptive and statistical analyses were undertaken using Microsoft Excel version 7, Epi Info version five and Stata version seven (Stata Corporation). Relative proportions were compared using the Chi-squared test. Means were compared using Student's *t*-test. The *t*-test assumes that the distribution of a variable is roughly normal in each of the groups being compared. However the data on persons affected and duration of outbreaks were skewed. In order to normalize these distributions, and satisfy the normality assumption for the *t*-test, logarithms were used. Data were then converted back using a reverse natural log transformation, the results of which are presented as geometric means.

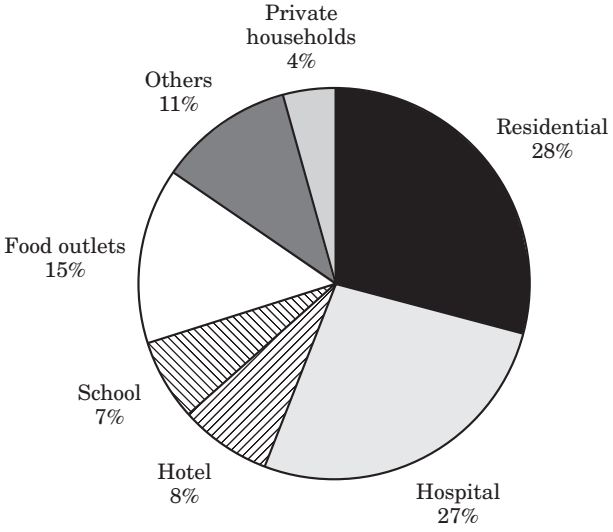

Figure 2 Settings for general outbreaks of IID in England & Wales 1992 to 2000. $N = 5257$.

Table II *All outbreaks, and hospital associated outbreaks of infectious intestinal disease, England and Wales, 1992–2000*

Year	General outbreaks	Hospital outbreaks (%)*
1992	373	44 (11.8)
1993	454	87 (19.2)
1994	490	93 (19.0)
1995	837	282 (33.7)
1996	733	235 (32.1)
1997	591	112 (19.0)
1998	609	182 (29.9)
1999	516	144 (27.9)
2000	654	217 (33.2)
Total	5257	1396 (26.6)

* Of all general outbreaks.

Results

One thousand, three hundred and ninety-six completed surveillance forms were returned to CDSC during the surveillance period out of a total of 1826 initial reports of hospital outbreaks received (response rate = 76.5%). The forms were completed by a variety of professionals [nurses 627 (44%); microbiologists 380 (27%); CCDCs 167 (12%); others 222 (16%)].

Hospitals were the setting for 26.6% (1396/5257) of all general outbreaks of IID reported to CDSC between 1 January 1992 and 31 December 2000 (Figure 2, Table II). Reporting of hospital outbreaks peaked in 1995 (Table II).

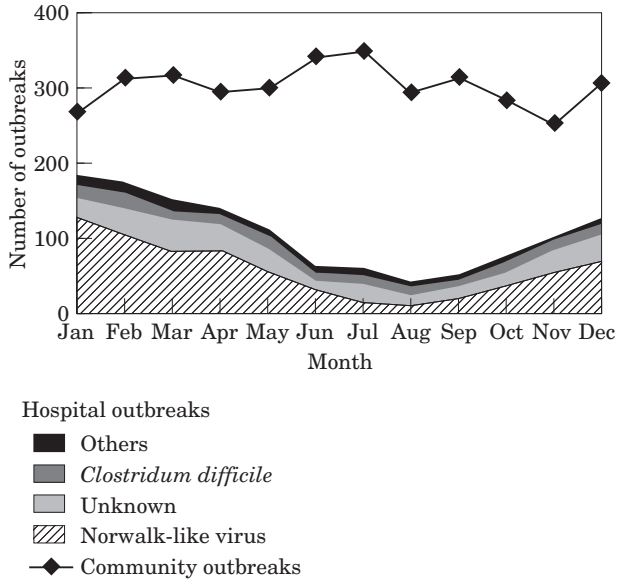

Figure 3 The seasonal distribution of hospital outbreaks compared with those in other settings including the community.

Table III *Outbreaks of infectious intestinal disease associated with hospitals by pathogen, England and Wales, 1992–2000*

Pathogen	Number of outbreaks (%)
Norwalk-like virus	754 (54.0)
Unknown	343 (24.6)
Clostridium difficile	176 (12.6)
Salmonella spp.	51 (3.7)
S. enteritidis	24
S. enteritidis PT4	23
S. typhimurium	13
S. virchow	1
Other salmonellae	13
Rotavirus	39 (2.8)
Clostridium perfringens	13 (0.9)
Other	8 (0.6)
Astrovirus	5 (0.4)
VTEC O157	3 (0.2)
Calicivirus	1 (0.1)
Campylobacter spp.	1 (0.1)
Shigella sonnei	1 (0.1)
Staphylococcus aureus	1 (0.1)
Total	1396 (100.0)

Seasonality

The month of outbreak (based on the first date of onset of symptoms) was recorded for 93.6% (1306/1396) of hospital outbreaks. Almost two thirds (890/1396; 63.8%) occurred between November and April, mainly due to Norwalk-like virus (NLV; 531/890; Figure 3). A higher proportion of hospital outbreaks ($P < 0.001$) took place during the winter months than outbreaks in other settings.

Aetiology

Viral pathogens accounted for 57.2% of hospital outbreaks, 17.6% were attributed to bacteria, 24.6% were of unknown aetiology. A higher proportion of the hospital outbreaks were due to viral agents ($P < 0.001$) than outbreaks in other settings. NLV accounted for 54.0% (754) of outbreaks (Table III). In addition 52.2% (179) of the outbreaks of unknown aetiology were suspected to be due to NLV based on clinical and epidemiological features. Other pathogens implicated were *Clostridium difficile* in 12.6% (176), *Salmonella* spp. in 3.7% (51), and rotavirus in 2.8% (39).

Mode of transmission

Person-to-person spread predominated, and was reported more frequently in hospital outbreaks than for those in other settings [1212/1396 (86.8%) vs. 1699/3861 (44.0%); $P < 0.001$]. Foodborne transmission was reported in 1.8% (25) of outbreaks, and equal or unknown proportions of foodborne and person-to-person spread in 1.6% (23). The mode of transmission was reported as unknown in 9.7% (136) of outbreaks.

Morbidity and mortality

In total 29 507 (range 2–552) people were affected in the 1396 hospital outbreaks for which data were available. Between 1994 and 1998 data on illness affecting staff were collected (479 outbreaks). Staff were reported to have been affected in 268 (55.9%) outbreaks. The number affected in hospital outbreaks (geometric mean = 13.7; 95% CI: 13.1–14.3) was lower than for other settings (geometric mean = 15.9; 95% CI: 15.5–16.3).

The risk of death was higher in hospital outbreaks (0.003) when compared with outbreaks associated with other settings (0.001) [relative risk 2.00 (95% CI: 1.52–2.63); $P < 0.001$]. The risk (0.008) was highest for foodborne outbreaks [relative risk 3.22 (95% CI: 1.41–7.36); $P = 0.003$]. Eighty-two deaths were reported during the surveillance period.

Duration

The median duration of hospital outbreaks was eight days (range 1–183). The duration of hospital

Table IV *Outbreaks of infectious intestinal disease associated with hospitals by ward type, England and Wales, 1992–2000*

Ward type	Number of outbreaks (%)
Geriatric	470 (63.6)
Other	87 (11.8)
Psychiatric	56 (7.6)
General	37 (5.0)
Orthopaedic	32 (4.3)
Paediatric	25 (3.4)
Surgical	21 (2.8)
Mixed	11 (1.5)
Total	739 (100.0)

outbreaks (geometric mean = 8.2; 95% CI: 7.9–8.6) was greater than for other settings (geometric mean = 6.2; 95% CI: 6.0–6.4; $P < 0.001$).

Ward type

The type of hospital ward affected was reported in 52.9% (739) of outbreaks. Geriatric wards were most frequently affected [63.6% (470/739)] of outbreaks (Table IV).

Foodborne outbreaks

More than one food vehicle was reported in 8.0% (2/25) of outbreaks. Red meat was reported as the vehicle in 16.0% (4/25) of outbreaks, eggs in 16.0% (4/25), poultry in 8.0% (2/25), vegetables or fruit in 8.0% (2/25) and desserts or miscellaneous vehicles in 8.0% (2/25). No specific food was identified in 52.0% (13/25) of outbreaks, a higher proportion ($P < 0.01$) when compared with foodborne outbreaks in other settings. The most commonly reported contributory faults were cross-contamination (eight outbreaks) and infected food handlers (six outbreaks). A bacterial aetiology was confirmed in 84% (21/25) of foodborne outbreaks.

Discussion

These analyses demonstrate that outbreaks of IID in hospitals have a considerable impact on public health with an average of over 100 outbreaks affecting in excess of 3000 patients and staff each year. However these data are likely to underestimate the true impact. Data collection is primarily through CCDCs rather than directly through infection control doctors or nurses. It is possible that the outbreaks, which come to the attention of the CCDC, are the larger and/or newsworthy ones, although the mean size of outbreak reported from hospitals was smaller than for outbreaks in other settings. This source of bias should be limited to some extent by information derived from diagnostic and reference laboratories, although small outbreaks might not be reported. It is noteworthy that outbreak reporting peaked in 1995 and 1996 during a two-year period of enhanced surveillance of outbreaks of viral gastroenteritis.[9] Reporting of greater numbers of outbreaks at that time lends further weight to the impact of under-ascertainment.

NLV was the most commonly reported pathogen, and the impact of outbreaks caused by NLV was greatest during the winter when pressures on hospitals are at their height. In almost a quarter of the outbreaks aetiology was not confirmed by laboratory investigations although investigators mostly indicated that illness was suspected to be due to NLV. Techniques being developed to improve identification and characterization of NLV[10] should make it possible to confirm the aetiology in a higher proportion of outbreaks, thus improving comprehension of the diagnostic gap. However, the absence of standardized protocols for the conduct of laboratory investigations in outbreaks, militates against understanding the true burden of infection.

Large numbers of people were affected in IID outbreaks and the mortality risk was significantly higher than for community outbreaks, despite the fact that NLV was the most commonly identified pathogen. This might be explained by the vulnerability of the populations affected since a high proportion of outbreaks was reported from geriatric units, where ward type was specified. Association of pathogens and ward type proved impossible because of missing information on ward type.

Hospitals were second only to residential homes as a setting for outbreaks of IID. There are striking similarities in the epidemiological characteristics of outbreaks seen in these types of institutions. The seasonality of NLV outbreaks within these healthcare settings appears to be distinct from other locations.[11] The role that transfer of individuals between residential nursing homes and hospitals plays in the propagation of NLV is an area that demands targeted epidemiological and virological studies.

Foodborne outbreaks were less common during this surveillance period than previously,[12,13] but the associated mortality risk was high. The most surprising finding was that eggs were implicated as the vehicle of infection in just under one sixth of all foodborne outbreaks. This is despite the

Government recommendation in 1988 that raw shell eggs should be replaced with pasteurized eggs in recipes in institutions with high-risk groups.[14] No specific food vehicles were identified in over half the foodborne outbreaks, although identification of food vehicles should be easier in hospitals where the affected population is easily definable and food histories ought to be readily available.

In order to understand fully the impact of IID outbreaks in the hospital setting, investigations need to be standardized and reporting systems improved, moving from passive to active surveillance. Surveillance of completed outbreak investigations can highlight trends, and hence control issues, to inform practitioners, policy makers and research funding bodies. Surveillance at national level is also important to determine the effects of interventions and improvements in healthcare practice on the transmission of IID in hospitals.

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