CRYPTOSPORIDIOSIS SURVEILLANCE
1990-1991

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WATER RESEARCH CENTRE

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This report presents the results of the epidemiological component of the "surveys of occurrence" of cryptosporidiosis, a programme of research proposed by the Badenoch Committee.

Seven Health Districts, with water supplied from five different sources, took part in the study. In total, 191 cases of cryptosporidiosis were followed up with a standard surveillance form.

Person to person spread accounted for over a quarter of the cases, and one fifth of cases gave a history of animal contact. Other potential risk exposures, including drinking unpasteurised milk, travel, beach visits and eating raw meat, but the distribution of these exposures was not consistent throughout the different areas.

Three clusters of cryptosporidiosis were investigated during the study period. An association with water was not demonstrated in any of them.

Hand washing and general hygiene measures will reduce the spread of the infection. Further research to quantify the role of different risk exposures is recommended.
PART 1

INTRODUCTION

Following the large waterborne outbreak of cryptosporidiosis in Swindon and Oxfordshire in 1989, an expert group was convened under the chairmanship of Sir John Badenoch to advise the Government on the significance of cryptosporidium in water supplies (Badenoch Report, 1990).

Recommendations of the expert group included the advice that a programme of research should be undertaken to improve knowledge about the organism and the illness it causes.

The National Cryptosporidiosis Study is part of this programme, forming the epidemiological component of the 'surveys of occurrence' recommended by the Badenoch Committee (paras 13.9 to 13.12 of their report).

This report describes the epidemiological results of the National Cryptosporidiosis Study. The results are presented within the context of other epidemiological work on cryptosporidiosis, including a review of recent knowledge about the disease and the progress of national surveillance of cryptosporidiosis by the Communicable Disease Surveillance Centre (CDSC) of the Public Health Laboratory Service.

The National Cryptosporidiosis Study has included the development of a primary care surveillance scheme for early detection of outbreaks of cryptosporidiosis and has enhanced surveillance of incidents known to CDSC since January 1990.

The significance of the findings of the surveillance and investigative work are discussed, and this report includes recommendations for protecting the public health and further epidemiological research.

Figures for Part 1 are at the back of the document.
BACKGROUND

General

Cryptosporidium is a protozoan parasite which was first recognised in the early 1900s as an infecting agent of mice (Tyzzer 1907). Little interest was shown in the organism at this time, as it was not recognised as a cause of illness in other animals and man. It was not until the 1970s that cryptosporidium was described as a cause of diarrhoea in calves (Pohlenz et al 1978) and in humans (Nime et al 1976, Meisel et al 1976). Many of the early case reports of human cryptosporidiosis were in immunocompromised patients, and interest in cryptosporidium grew in relation to the emerging new immunosuppressive disease AIDS.

Since the early 1980s, however, large numbers of cases in both immunocompetent and immunocompromised patients have been reported (Jukipat et al 1983, Wulfson et al 1985). Researchers in this field have investigated the nature of the organism, clinical aspects of cryptosporidiosis and potential sources of infection for man. Increased laboratory and epidemiological surveillance in the last decade has also identified cryptosporidium as the cause of several community outbreaks. The significant public health implications of cryptosporidium have added to current interest in the organism.

Biology

Cryptosporidium has hosts throughout the animal kingdom. Cryptosporidium parvum infects man and mammals, C muris affects mammals, C baileyi and C meleagridis infects birds. Further species of cryptosporidium have been identified in reptiles and fish (Smith 1990).

The parasite has a complex life cycle which it completes within a single host (Janoff and Reller 1987). In an infected animal, it multiplies in the gastrointestinal tract and ultimately oocysts of the parasite are excreted in faeces. The oocysts are tiny, measuring only 4-5 microns diameter, the same size as yeasts (Current and Bick 1989). These oocysts are the 'spore like' form of the organism capable of survival for several months in the environment until they are ingested by a host and a new cycle of infection commences.
Cryptosporidium is a successful parasite for several reasons:

1. The life cycle of cryptosporidium is completed within one host and autoinfection occurs within its lifecycle, thus ensuring that large numbers of infective oocysts eg $10^8$-$10^{10}$ per day are excreted in host faeces.

2. Paradoxically, the infective dose is low, probably between one and ten oocysts, enhancing the organism's ability to be transmitted from host to host.

3. The oocysts are environmentally resistant. They can survive drying, can survive in water for long periods and are also resistant to many common disinfectants including chlorine.

4. A single species, C parvum, infects livestock animals as well as man, ensuring a large reservoir of infection.

Detection of Cryptosporidium in Clinical and Environmental Samples

1. Clinical Samples

The diagnosis of cryptosporidiosis is generally made by detecting oocysts in faecal samples on microscopy. Stains used include a modified Ziehl-Neelso stain, a phenol-auramine stain and a saffranin and methylene blue stain.

Detection and identification of oocysts can also be achieved using monoclonal antibody fluorescence (IFA) tests, but these are expensive.

Identification of the endogenous (tissue) stages of the parasite in biopsy or necropsy specimens is also possible by processing and staining with conventional histological methods.

Developments are still being made to improve the speed with which clinical specimens can be examined and the reliability of the results (Casemore 1991).
2. **Environmental Samples**

Water samples are the most commonly examined environmental samples. A tentative standard method for the isolation and identification of oocysts in water has been developed, but further work on improvement of the method is being undertaken as there are a number of problems with the current procedure. As the method involves filtration and concentration of water, it underestimates oocyst numbers and has a low recovery efficiency (Vesey and Slade 1991). The identification of oocysts in water samples by bright field microscopy is limited by the presence of similar sized interfering debris. To overcome this problem fluorescein labelled monoclonal antibodies have been developed but the monoclonal antibodies presently available cannot distinguish between the different species of cryptosporidium. Thus oocysts from species not known to be infective to man are detected as well as *C. parvum*. A further problem is that no methods exist for differentiating viable and non viable oocysts: at present, each oocyst detected is regarded as being viable and hence potentially infective to man (Smith 1990).

**Frequency of Occurrence of Human Cryptosporidiosis**

Information about this is derived from routine surveillance data and from special surveys.

**Routine Surveillance**

In England and Wales, laboratories started reporting identifications of cryptosporidium oocysts to CDSC in 1983. Between 1983 and 1986 the annual number of reports increased from 61 to 3560. In 1987 there were 3277 identifications reported to CDSC and a similar number, 2750, in 1988. During 1989, the annual number of reports was 7768, a 282% increase. These results have to be interpreted with caution as laboratory reporting to CDSC is voluntary and individual laboratory policies for selecting stool samples for screening for the presence of oocysts were not standardised and consistent during this time. Furthermore there was an increase in the number of reporting laboratories.
Special Surveys

In an attempt to establish how commonly cryptosporidium causes acute gastroenteritis in humans, surveys of the frequency with which oocysts are detected in faecal samples from patients with diarrhoea have been undertaken by researchers in several countries. Methodological problems with some of these surveys have been reviewed (Casemore, 1990). These include selected populations and the fact that some surveys only took place over a short period of time; also, other potential pathogens were not always excluded. In many of these studies the samples examined were only from children. Overall, however, the previous studies suggest that in developed countries the prevalence of the infection is 1-4% in patients with diarrhoea, and in developing countries up to 16% in such patients (Tzipori 1988).

United Kingdom (UK) surveys suggest a prevalence of between 1-6% (Hunt et al 1984, Hart et al 1984, Thomson et al 1987), although again children form the group most often studied.

The PHLS in England and Wales carried out a two year survey from 1985-87 (PHLS Study Group 1990). Sixteen Public Health Laboratories (PHLs) examined stool specimens for the presence of oocysts. A total of 62, 421 specimens from general practice patients were investigated and oocysts were identified in 1295 (2%). When specimens submitted from children were analysed separately, however, oocysts were detected in 4% of patients and cryptosporidium was the second commonest pathogen isolated after campylobacter.

For the whole cohort, campylobacter was detected in 4775 (8%), salmonella in 2050 (3%) and shigella in 437 (0.7%), making cryptosporidium the third most common pathogen isolated. There were also 25 patients with mixed cryptosporidium and campylobacter infection and 10 patients with both giardia and cryptosporidium infection, suggesting possible common aetiologies.

Studies in the UK during the last decade would suggest that cryptosporidium is responsible for around 2% of diarrhoeal illness in the overall population, but accounts for a greater proportion of illness in children (Joce and Bartlett 1990).

There are problems with obtaining true incidence data for cryptosporidium infection in the UK. Most diarrhoeal illness is self limiting and medical intervention is not required.
Even when advice is sought, stool specimens are not always submitted to the laboratory for testing. These factors would lead towards underestimation of the cases of cryptosporidiosis in the population. Furthermore, the number of laboratories testing for the organism is probably still increasing and testing policies are not standardised. This makes trends in the number of reports difficult to interpret.

Clinical Features

In the immunocompetent patient cryptosporidium causes an unpleasant and often prolonged but self limiting gastroenteritis. The predominant symptoms are diarrhoea and abdominal cramps. Vomiting, anorexia, weight loss and fever have also been described, but gastroenteritis due to cryptosporidium in the immunocompetent patient cannot usually be distinguished from any other enteric infection on clinical grounds (Tzipori 1988). The relative frequency of symptoms other than diarrhoea is very variable. Adults appear to have more severe symptoms (Hunt 1984) but this could be due to the fact that adults would possibly only seek medical attention when symptoms were more severe. The average duration of illness in the collaborative PHLS study (PHLS Study group 1990) was nine days with a range of 1-90 days.

In the immunosuppressed individual cryptosporidiosis is a more serious illness with watery diarrhoea consisting of around 25 bowel motions per day with excessive fluid loss. Systemic infection may also occur. The infection can prove fatal because of dehydration.

The incubation period is between three to 11 days but is occasionally up to 25 days.

No therapeutic agents for cryptosporidiosis have yet been identified (Anderson et al 1990).

Transmission

Transmission can take place via the faecal-oral route from man to man, from animals to man and from the environment to man.
Epidemiological Features

Variations have been observed in seasonality, geographical distribution and in population groups.

Person

The disease is most commonly seen in children under five years. This may be for a number of reasons. Children are most likely to be seen by a doctor than older people when they have diarrhoea and also to have stool specimens submitted to the laboratory. If laboratories have a selective screening policy for cryptosporidium it is usually children's stools which will be tested. Children, like other young animals, are possibly more susceptible to the infection than adults. So far, no significant difference in distribution of the disease between the sexes has been noted.

Time

Seasonal peaks of the infection in spring and autumn have been described in the UK. Seasonal variation differs in other countries, for example summer and early autumn peaks have been noted in America (Skeels et al 1990) and Australia (Biggs et al 1987). Localised periodicity of the infection has been observed in some districts, with a decline in reports following a community outbreak - possibly due to temporary immunity to re-infection.

Place

The disease is seen globally, although it appears to be more common in less developed countries. Cryptosporidium is a recognised cause of traveller's diarrhoea (Jokipiiti et al 1985) reflecting the higher prevalence of the infection in some other countries. Mode of spread seems to be predominantly environment to man, as most imported cases are sporadic.
Risk Factors for Infection with Cryptosporidium

Contact With An Infected Person

Person to person spread of cryptosporidiosis via the faecal-oral route is common. Both family and more widespread outbreaks in the community occur. There are many reports of outbreaks in nurseries and day care centres where small children meet and there is frequent opportunity for the spread of infection (Hannah and Riordan 1988, Combee et al 1986, Taylor et al 1985).

Spread Within Hospital

Patient to patient spread in hospital has been recorded and can be especially problematic among immunocompromised patients, such as those undergoing bone marrow transplant (Martino et al 1988) and those infected with human immune deficiency virus (HIV). In a recently described nosocomial outbreak in Denmark (Ravn et al 1991), 18 HIV positive patients, one member of staff and one visiting relative developed cryptosporidiosis over a four month period. The source of the outbreak was identified as ice from an ice machine in the ward. This had been contaminated by an incontinent psychotic patient with cryptosporidium infection picking out ice for cold drinks. The outbreak demonstrated not only the susceptibility of immunocompromised patients, but also the ease with which the infection was spread to a presumably immunocompetent visitor and member of staff.

Asymptomatic Excreters

The role that asymptomatic excreters of the organism play in spreading infection is not clear, but evidence is growing that this may have some contribution to person to person spread.

Transient carriage was described in an incident where 19 people were exposed to calves with cryptosporidiosis. Two of the 12 who had oocysts in stools were asymptomatic (Current et al 1983).

In an outbreak of cryptosporidiosis in a day care centre attributed to person to person spread, 39/79 had oocysts in stool samples but 9/39 children did not have symptoms. Furthermore, 10 children were followed after their diarrhoea had ceased and they
continued to excrete oocysts for a mean of 16.5 days (Tangermann et al 1991). A survey in a day care centre in New York (Crawford et al 1988) found that 6 out of 22 asymptomatic infants and toddlers had stool specimens positive for Cryptosporidium spp.

In contrast to the study of Tangermann et al, workers in Scotland argue that diarrhoea is just one symptom of cryptosporidiosis (Shepherd et al 1988a) and shedding of oocysts is uncommon after all symptoms of infection disappear, 2/49 cases in their study (Shepherd et al 1988b). The Scottish studies, however, address only the problem of carriage of the organism after clinical infection and not carriage in people who have never been clinically ill.

Investigators in New York (Roberts et al 1989) took duodenal aspirates from 169 patients undergoing endoscopy. Oocysts were identified in 12.7%. Only half of these had demonstrable oocysts in stool samples and none had diarrhoea or could remember a recent episode of diarrhoea. There have also been reports of immunocompromised patients carrying cryptosporidium without symptoms (Zar 1985, Martino 1988). This leads to a tentative distinction being made between asymptomatic excretion of the organism following a clinical episode of illness, or during a recognised outbreak and carriage of the organism in the bowel for many months.

It is certainly possible that both asymptomatic excretors and carriers of the organism are efficient transmitters of the infection. While this constitutes a public health problem, it is difficult to quantify.

**Farm Exposure**

Sero-epidemiological surveys (Casemore 1987) suggest that babies living on farms are less likely to contract a severe infection if they are breast fed. Later in infancy, acquired immunity diminishes and infection with cryptosporidium is followed by clinical illness. With repeated infections the clinical symptoms of the illness become less severe until no clinical symptoms at all follow infection in immunocompetent individuals. This would account for less disease in adults being observed in rural areas.
Animal Contact

Results of serological investigations suggest that most animals have encountered this organism by adulthood (Tzipori and Campbell 1981). All newborn mammals are susceptible to the infection. An infected animal can cause considerable environmental contamination because of the number of oocysts it excretes. Animals can easily become infected, especially before they are three weeks old. Susceptibility to development of disease after infection depends on age, inoculating dose, acquired immunity and stress (Gregory 1990). Zoonotic transmission from animals to man is well recognised.

Occupational Exposure

Occupational zoonotic exposure is a recognised risk for developing cryptosporidiosis. Outbreaks in veterinary workers have occurred at the same time as epizootics in livestock (Reif et al 1989). Those who have frequent exposure to the infection, however, may develop some immunity and have only mild or asymptomatic infection.

Environmental Contact

Transmission of the infection via the environment has become increasingly recognised during the last decade, particularly with respect to water. The characteristics of the organism which make it a successful parasite also facilitate its waterborne spread. Environmental transmission of cryptosporidiosis, especially via water, will be considered in some detail in the next section.

Microbiological Aspects of Water Treatment

The potential for cryptosporidium oocysts contamination of water varies with the type of water source:

1. Ground water from wells and boreholes: water with minimal microbiological contamination because of the cleansing effect that percolation through porous rocks has on rainwater. There have been six major documented outbreaks of cryptosporidiosis since 1984, and of these the source of one was thought to be water from an artesian well (D'Antonio et al 1985).
2. **Upland surface water** from lakes and reservoirs: variable microbiological quality water depending on the use made of the surrounding catchment area. One documented outbreak has been associated with water from this type of source (M Watts, unpublished, Badenoch Report 1990).

3. **Lowland surface water** from rivers: generally low microbiological quality of water because of the potential for contamination with agricultural drainage of slurry and sewage effluents - possibly containing oocysts. Three out of six outbreaks of the disease have been associated with river abstracted water. (Dick 1989, Hayes et al 1989, Aston et al 1991).

**Water Treatment**

This depends on the quality of the source water but essentially consists of storage, chemical coagulation, filtration (rapid or slow) and disinfection. These methods of water purification were originally designed to remove faecal bacteria (Barer and Wright 1990). Slow sand filtration is more effective than rapid filtration for removing oocysts. Oocysts are not killed by chlorine so current water treatment relies upon physical methods of removal.

Treatment of borehole water may consist principally of chlorination. River water may need more intensive treatment to make it potable.

**Documented Waterborne Outbreaks**

A. **USA**

1. **Waterborne Cryptosporidiosis Outbreak from an Artesian Well Supply**

   **Braun Station, Texas 1984:**

   The first waterborne outbreak of cryptosporidiosis occurred in 1984 in Texas (D’Antonio et al 1985). The community where the outbreak took place, Braun Station, had an artesian well supply with the water being chlorinated but not filtered before being distributed to consumers.

   -14-
The investigators of the Texas outbreak identified two distinct outbreaks of gastroenteritis between May and July 1984. The May outbreak was investigated by a telephone survey of 100 Braun Station households and 50 households outside Braun Station. This survey demonstrated that the incidence of diarrhoeal illness was less in those resident outside Braun Station than in those living in Braun Station (2.5% vs 72%). Serological evidence of Norwalk virus infection, a possible cause of diarrhoea, was detected among the affected population.

In the second outbreak in July, 34% of persons living in Braun Station had a diarrhoeal illness compared with 2.5% of those living outside the community. Oocysts were identified in stool samples submitted from 47/79 Braun Station residents who were ill during July. In a control group not exposed to the water supply 12/194 had stools positive for cryptosporidium.

Investigations of the water supply showed clear evidence of sewage contamination but no oocysts were found in treated water.

The investigators concluded that the major pathogen in the first outbreak was Norwalk virus, and in the second outbreak, cryptosporidium. However, as Norwalk virus can persist in a community over a period of time, the amount of illness due to cryptosporidium in this outbreak is uncertain. The cause of the outbreak was assumed to be intermittent faecal contamination of water.

2. **Largest Waterborne Outbreak Reported**

**Carrollton, Georgia 1987**

This outbreak, the largest waterborne outbreak reported to CDC (Centers for Disease Control) (Levine et al 1991) occurred during January and February 1987. Investigators (Hayes et al 1989) conducted a telephone survey of 304 households and found that 61% of those exposed to the public water supply had a diarrhoeal illness since 1 January compared with 20% of those not exposed to this water supply. Oocysts were identified in the stools of 58/147 patients tested during the outbreak. After the telephone survey it was estimated that the overall attack rate for the county was 40%, possibly affecting 13,000 people.
River abstracted water supplied 7,900/19,000 households in Carrollton. Oocysts were identified in samples of treated water taken from the treatment plant on three occasions; four samples from dead end water mains were also positive. There was a sewage overflow caused by a blocked major sewer above the abstraction point, and there had been minor changes in water treatment processes. These were thought to allow oocysts (possibly from sewage) to pass into the treated water supply. The water system met current state and federal drinking water standards, indicating that these standards may not be sufficient to prevent outbreaks due to cryptosporidium.

Further evidence about the waterborne transmission of cryptosporidiosis was provided by a case-control study in New Mexico in 1986 which showed a strong association between drinking surface water and illness, although there were only 24 cases in this study (Gallaher et al 1989).

B. UK

3. Post-Treatment Contamination of Drinking Water

Ayrshire 1988

In April 1988, the first waterborne outbreak of cryptosporidiosis in the UK, in which oocysts were detected in treated water, occurred in Ayrshire (Smith et al 1989). There were 27 confirmed cases of the illness associated with the outbreak and many more reports of diarrhoeal illness in the two towns which had the same contaminated drinking water supply.

The water supply for the area passed via a break pressure tank from one treatment works to storage tanks at another. An old fire clay pipe land drain, which records incorrectly showed to have been disconnected, was discharging run off from the surrounding area in to the tank. Samples of water from the tank and a local stream, also samples of soil and grass from the nearby land were positive for oocysts.

Cattle slurry and dung had been sprayed on surrounding land and there had also been heavy rainfall just before the beginning of the outbreak. It was thought this combination of factors had contaminated the surrounding land with
cryptosporidium, the land drain had allowed oocysts a passage into the tank, thus post-treatment contamination was the cause of the outbreak.

4. **Large Waterborne Outbreak: No Failure in Treatment**

*Oxfordshire and Swindon 1989*

An outbreak of cryptosporidiosis occurred in Swindon and parts of Oxfordshire in early 1989 (Dick 1989). There were 500 laboratory confirmed cases and up to 5,000 people may have been affected. The number of cases peaked in February and March 1989. The geographical distribution of cases coincided with the water supply area of Farmoor Reservoir belonging to Thames Water. Water from Farmoor was treated at Farmoor or Swinford treatment works.

Microbiological and environmental investigations revealed the presence of oocysts in backwash water from the rapid gravity sand filters at Farmoor, in water leaving the Farmoor treatment plant and the end of the distribution system in Swindon. During the investigation, the capability of the Farmoor Works to remove oocysts was assessed. The rapid sand filters reduced the number of oocysts by over 99%, the settlement process for treating the filter backwash water and sludge achieved a reduction of only 83%. As a result the supernatant fluid from the settlement tanks which was returned to the start of the treatment process contained $10^3$ oocysts per litre and this combined with the numbers in raw water entering the works (up to 10 per litre) resulted in an average daily load of $10^9$ oocysts on each filter. Remedial measures were immediately taken including extensive washing and reduced filter run times. Following these measures at the works there was a rapid decline in the number of positive samples in the distribution system, confirming the hypothesis of contamination in the source water.

5. **Outbreak Associated with an Unfiltered Drinking Water Source**

*Loch Lomond 1989*

Loch Lomond is a source of water for central Scotland supplying parts of Lanarkshire, Renfrewshire and Lothian. Water from the Loch is passed through coarse screens, fine screens and microstrainers then chlorinated and put into
supply. The treatment process does not include sand filtration. Between January and June 1989, 224/442 cases reported in Scotland were from the three health board areas receiving Lomond water as part of their supply: Argyll and Clyde, Lanarkshire and Lothian. More intensive epidemiological surveillance of cases of cryptosporidiosis was undertaken in these Health Boards. Epidemiological details obtained for 206/224 cases showed that 54% were under 10 years of age, with 41% in the age group 1-4 years. Just over a fifth of the cases (22%), were admitted to hospital during the course of their illness. Ninety eight of the 206 cases were supplied at home with water from Loch Lomond. Statistical analysis confirmed a higher incidence of cryptosporidiosis in persons who were supplied with Lomond water compared to persons residing in the same area receiving other water supplies. However, additional follow-up information collected suggested that some of these 206 cases had other risk factors for development of cryptosporidiosis (M Watts, unpublished).

Sampling of the water for the presence of cryptosporidium oocysts was instigated in April 1989 and oocysts were detected in both the raw water and in treated water in the distribution system on subsequent sporadic occasions. As Loch Lomond water is not filtered, and filtration is currently the most effective means of removing oocysts from raw water, water must remain the likely source of these cases even in the presence of other possible risk factors.

6. **Outbreak Associated with By-Passing of Slow Sand Filtration**

**North Humberside 1990**

Between December 1989 and May 1990 there were 477 confirmed cases of cryptosporidiosis on North Humberside. A case control study of 85 of the primary cases showed a statistical association between illness and consumption of water from Barmby treatment works and between the risk of developing illness and the quantity of water consumed. Yorkshire Water Services had by-passed part of the flow past the slow sand filters at the Barmby treatment plant to boost supplies to the city of Hull during November and December 1989 and again from 6-8 January 1990. Prolonged drought had decreased ground water and river water supplies to a critically low level. Oocysts were not found in drinking water and only low numbers were found in filter backwash and filter core samples (Aston et al 1991).
Comment

It is of note that in the Carrollton outbreak, water met current state and federal drinking water standards. In the Thames outbreak, treated water was free from coliform bacteria and monitoring of turbidity, chlorine demand, coagulant residues and bacterial plate counts did not reveal any adverse changes in the quality of the treated water. The two outbreaks were associated with heavy surface water contamination by cryptosporidium oocysts which then persisted throughout subsequent treatment; neither the Thames nor the Carrollton incidents were associated with any failure in treatment. Cryptosporidium would appear to pose a new challenge for the water industry.

The Badenoch Committee reviewed the evidence about cryptosporidium thoroughly, recognising that evidence from the outbreaks suggests that conventional water treatment processes cannot guarantee the safety of drinking water at all times. Many gaps in epidemiological knowledge about the organism were revealed. The Committee recommended a full programme of research to improve knowledge of the organism and the disease.
NATIONAL SURVEILLANCE

Microbiology laboratories in England and Wales report identifications of cryptosporidium oocysts to CDSC on a voluntary basis. Most laboratories in England and Wales do report to CDSC but they are under no obligation to do so. The frequency of reporting is generally weekly, but some laboratories report fortnightly and some less frequently. The date on the report is that of the specimen and not the date of onset of illness in the patient. Clinical information is usually scanty.

Laboratories differ in their screening policy for cryptosporidium as this is determined by local prevalence, resources and economic restraints. Some laboratories employ selection criteria for testing, such as only screening stools from children under 14 years.

The total numbers of stools screened by each laboratory whether or not a positive result is obtained (ie denominator data) is not reported to CDSC. If the number of stools tested for cryptosporidium by each laboratory was known, percentage recovery rates could be calculated (No of stools containing oocysts/Total No of stools examined x 100) (Skirrow 1987). This has been investigated by a few PHLs but national data are not available.

If screening policies and reporting patterns remained consistent between 1983 and 1989, the increase in the number of reports of cryptosporidium to CDSC from 61 to 7768 would probably reflect a genuine increase in the number of cases of the infection. However, the increasing interest in cryptosporidium during this period probably altered screening patterns by individual laboratories. The trend is thus possibly a combination of real increase and heightened ascertainment. Percentage recovery rates would indicate more clearly than absolute numbers whether this rise was genuine.

Surveillance of cryptosporidiosis was undertaken during 1990 and 1991 by weekly inspection of the previous week's reports of identifications of cryptosporidium to CDSC from laboratories in England and Wales. A report of more than 10 identifications in one week by a laboratory prompted further investigations. The initial investigation was a check of specimen dates to determine whether the increase was due to the laboratory reporting to CDSC less than once weekly. If the specimens had all been examined and reported in one week, the next step was to contact the microbiologist and public health physician of that district to ask for further details and draw attention to the finding. In most instances, these enquiries revealed either clusters of cases which could be
explained by known exposures to recognised risk factors or a change in laboratory screening policies or a change in follow-up of contacts, such as collecting specimens from household contacts.

**Number of Reports:** The reports were collated by age, by region and by four weekly totals. The number of reports to CDSC in 1989 was 7768 and in 1990 was 4680. During 1991 there were less reports than for 1990 up to week 12. After week 12 (end March) the number of reports has been between 1989 and 1990 levels (Figure 1.2).

**Age distribution:** Approximately 65% of reports were from children under 5 and 90% are from people under 44 (Figure 1.1). This is consistent with the results of the PHLS Study Group.

**Regional distribution** of cases altered slightly during the study period (Figures 1.3 and 1.4). All regions except Yorkshire and the Northern Region reported fewer cryptosporidium isolates in 1990 compared to 1989. In Yorkshire a large community outbreak on North Humberside in early 1990 accounts for the large number of cases seen in that region last year. In the Northern Region, the reason for the excess number of cases in 1990 compared to 1989, against the national trend, is unclear, but may be due to changes in screening or reporting procedures. In 1991, the four Thames regions which made only a few reports of cryptosporidium identifications to CDSC last year, have already equalled or passed their 1990 totals. Two community outbreaks have occurred in South East England since January this year and these cases account for at least part of the observed increase in reports.

The decrease in the number of reports from 1989 to 1990 is surprising. The Badenoch Report was published in 1990 drawing attention to the problem of cryptosporidium. At the same time there was a move towards standardising procedures, probably meaning that more laboratories started testing more specimens. These events would be expected to lead to an increase in reports of cryptosporidium identifications so this decrease must be assumed to be genuine. Why should this happen? One explanation may be the weather. The weather in 1990 was very warm and dry and the low rainfall may have led to less environmental contamination. The organism was not distributed widely in the environment and so lacked opportunities to infect man.

Other possible reasons for the decrease in the number of reports include changes in laboratory screening and reporting policies.
THE NATIONAL CRYPTOSPORIDIOSIS STUDY

INTRODUCTION

This study was proposed following discussions by the Badenoch Expert Group. It is part of the programme of research recommended by the Badenoch Committee and forms the epidemiological component of the 'surveys of occurrence' (paragraphs 13.9 to 13.11) of cryptosporidium oocysts.

AIMS AND OBJECTIVES

Before the Badenoch Committee met only a limited amount of water sampling and examination for the presence of oocysts had been undertaken, mainly in relation to outbreaks. It was thought that more detailed and continuous examination of a few drinking water sources might provide more meaningful results about the extent, pattern of occurrence and possible sources of the oocysts than intensive sampling over a short period of time. The Communicable Disease Surveillance Centre was asked to conduct parallel epidemiological studies to determine whether measured occurrences of cryptosporidium oocysts in drinking water sources related to sporadic cases and clusters of cryptosporidiosis in the human population living in areas supplied with drinking water from the sources undergoing increased sampling. Water sampling was undertaken by five water companies. It was hoped that the results of this study would give a better understanding of the challenge posed by cryptosporidium to the water industry.

The overall objective of the study was to investigate if there is a relationship between the presence of Cryptosporidium spp oocysts in water supplies and cryptosporidiosis in the population.

The two main objectives of the epidemiological part of the study were:

1. To improve and standardise surveillance of reported cases of cryptosporidiosis, in order to define and quantify exposures suspected to be associated with acquiring the infection and to co-ordinate all sources diagnosing the infection.

2. To investigate promptly any rise in cryptosporidium reports and to conduct surveys to determine the proportion of cases, if any, which could be attributable to the water supply.
METHODS

The five water companies undertook water sampling for cryptosporidium oocysts in selected drinking water sources, chosen by the companies themselves. Three companies sampled river abstraction points and two sampled boreholes. The water companies informed CDSC of the sites they had chosen to sample and a member of the CDSC study team then approached the Consultant in Communicable Disease Control for the local district receiving water from the source being tested to invite them to participate in the study. This was followed up by letter and also in some cases by a personal visit to explain the study in more detail.

A surveillance form was designed at CDSC for the follow up of cases of cryptosporidiosis. The purpose of the surveillance form was to obtain information about possible risk exposures for acquiring cryptosporidiosis in the month before illness, particularly contact with another person with diarrhoea, travel, and animal contact. The amount of unboiled tap water typically drunk by the case in a day was also ascertained. Additional questions were included on food preferences to detract attention from the questions about water consumption. The questionnaire was drafted and circulated for comments to those who at that point had expressed an interest in the study. It was piloted in two areas which were not participating in the study. Suggestions and comments subsequently received were taken into account in the final version of the surveillance form.

During the study surveillance forms were completed locally for cases of cryptosporidiosis. The arrangements for this task were left to the discretion of individual districts. The forms were filled in by environmental health officers, community infection control nurses or public health physicians.

The surveillance forms were returned to CDSC and the information on the forms was checked. Any missing data was sought from the districts. Information from forms was coded and double entered onto an EPI-INFO database.

The numbers of laboratory reports of cryptosporidium identifications to CDSC were examined weekly as part of the national surveillance, reports from laboratories in study districts being subject to particular scrutiny.
During the course of the National Study a number of districts outside the study areas asked about the possibility of using the surveillance form. Although these districts could not take part in the National Study as testing of source waters was not taking place in them, the districts returned surveillance forms to CDSC and the information from them was also entered on to the database. This was done both to encourage surveillance in standard way as defined in the original study objectives and to collect information which would build an epidemiological picture of the disease. To maintain interest in the study, three intermediate reports about its progress were sent out during the study period to all participating districts.

Methodological Constraints

1. The choice of design for the study was descriptive epidemiology. There were three main reasons why a case control study was not attempted:

   a. As cryptosporidium was attracting both interest and concern, there was a need to start the research programme as quickly as possible so that gaps in knowledge about the organism could be filled. Much more time would have been needed to prepare for a case control study than a descriptive study.

   b. During 1989 there had been over 7,500 reports of identifications of oocysts in stool samples to CDSC. If this large number of cases of cryptosporidiosis continued to occur during 1990, the task of interviewing cases and their controls even in just five or six districts would have required resources beyond that available in the research funding.

   c. Two other national case control studies of other organisms were being conducted by CDSC in conjunction with colleagues in districts during 1990. These were already placing a considerable strain on districts and the investigators thought it would be trespassing on goodwill to institute a third case control study.

2. The water companies chose the sites which would be sampled and this determined the areas in which epidemiological studies had to be conducted. Unfortunately some potential study districts in these areas were unable to contribute to the study. The reason for this was usually a lack of manpower in public health or
environmental health departments and in one area the investigators were told that the local laboratory did not screen any stools for cryptosporidium.

3. Water supply zones are rarely co-terminus with local authority and health authority boundaries. Participating districts were asked to interview all their cases to ensure that as many potentially suitable cases as possible were included in the study. People tend to travel for school and work and often move between water supply zones. Postcodes were collected for home and school or work so these will be available when the epidemiological results and the water sampling results are analysed together.

4. If the laboratory in a participating district was not a CDSC reporting laboratory or if identifications of cryptosporidium were not reported by the laboratory to the Consultant in Communicable Disease Control it was intended to involve general practitioners in the project to enhance the flow of information about cryptosporidium cases. This would be in order to meet one of the study aims of co-ordinating information from all sources diagnosing the illness. All the districts in the study, however, had good communication mechanisms in place so this was not necessary.
RESULTS

1. ALL STUDY AREAS

During the study period of April 1990 to June 1991 a total of 191 surveillance forms were returned to CDSC from the survey areas which received water from 5 drinking water sources.

Age and Sex Distribution

The sex distribution was uneven with 103 cases (54%) in males and 88 cases (46%) in females. Most cases, 64% (123) were aged less than five, with 17 (9%) under one year of age. In the 5-14 years age group there were 17 cases (9%). In the age group 15-44 there were 36 cases (19%) and in the over 65 age group there were 9 cases (5%).

Household Composition and Occupation

The occupation of cases (or for children their parents) included 15 (8%) food handlers, 5 (3%) hospital workers, 4 (3%) care assistants and one childminder (0.5%). The rest (n=158, 83%) had other occupations including three who worked on farms. The occupation was unknown for 8 cases.

Just under half (n=54, 44%) of the pre-school age attended a group where they mixed with other children. For both adult and child cases, the household composition excluding the case contained at least one child under 5 in 69 cases (36%).

Clinical Features and Severity of Illness

Diarrhoea was the most common symptom, reported by 187 (98%) of all cases. There was a significant difference in the frequency of abdominal pain during the illness in adults and children, reported by 40 (80%) adults and 71 (50%) children (p=0.0005 by Chi-square). Vomiting was less frequent in adults (n=15 (30%)) than in children (n=83 (59%)) (p=0.002 by Chi-square). About three quarters of cases, 36 (72%) adults and 109 (78%) children lost their appetite and 33 (66%) adults and 79 (56%) children lost weight. Other symptoms mentioned included fever,
headache, backache and tiredness. Many cases (n=82, 43%) were still ill when interviewed. The length of illness ranged from 1-135 days in the 91 cases for whom length of illness is known with a median duration of 14 days. Most, 183 (96%), of cases saw their GP, a smaller number 26 (14%) were admitted to hospital.

Risk Exposures

1. **Contact with Other Cases**

   There were 135 primary cases (71%) and 51 (27%) presumed secondary cases. In four cases information on the surveillance form was insufficient to decide whether the case was primary or secondary, and one case was asymptomatic. The most common exposure of secondary cases was another household member with diarrhoea in the month before the case's illness. Eight cases probably acquired their infection in hospital.

2. **Travel and Animal Contact**

   In total 66 (35%) of cases had spent a night away from home in the month before the illness. Of these 23 (12%) had spent a night away from home locally, 30 (16%) had travelled further afield in the UK and 12 (6%) had been abroad. One of the 12 foreign travellers had also travelled within the UK. The travel destination was not disclosed by one case. Contact with young or sick pets was reported by 33 cases (17%) and 38 cases (20%) had contact with farm animals (the two categories were not exclusive). From information given in the free comments section on the surveillance form, it was apparent that many of these contacts were in children who had been taken to the farm or, in some cases, when the animals had been taken into the classroom. Activities listed included bottle feeding young lambs and going into pens containing baby goats and calves to pet them.

3. **Water Consumption**

   Most cases, 162 (85%) drank tap water, usually at home. There were 26 people who did not drink tapwater (14%) and 3 were unsure (2%). Of all
cases 67 (35%) drank 1 or 2 glasses per day at home, 38 (20%) drank 3 or 4 glasses per day at home, 26 (14%) drank 5-6 glasses per day at home, 25 (13%) drank six or more glasses per day at home. Only 3 cases (2%) drank 15 glasses per day at home.

Fewer people, 44 (23%), drank water at work or school with a range of 1-7 glasses per day. Fewer still, 31 (16%), drank water elsewhere. All except one of these cases drank 5 or less glasses per day, the one exception reporting consumption of 20 glasses per day!

One case drank spring water only (assumed to mean the home had a private water supply) and one had drunk from a water font in the month before the illness.

4. Recreational Water Exposure

Leisure contact with water included six children who used a paddling pool in their garden and five cases who had visited the seaside (three in the British Isles and two abroad).

5. Preceding Illness

There were three mentions of chickenpox in the month before illness and one mention of a case suffering from infection with *Haemophilus influenzae* type b. Other comments suggested that cryptosporidiosis occurred in some cases after a period of less than perfect health.

6. Raw Milk and Food Exposures

A small number of cases (12, 6%) had drunk unpasteurised milk and 2 (1%) had drunk goat’s milk. A surprising number of cases (20, 10%) reported eating raw meat, although other foods were more popular: 139, (73%) ate sausages, 127 (67%) ate cold meats, 76 (40%) ate hamburgers and 36 (19%) ate sausagemeat.
2. **INDIVIDUAL AREAS**

The letters identifying the areas are not the same as those used in the "occurrence in water" survey.

**Area A**

(53 forms returned, 28% of total).

(Figure A following page and Figures 2.1 to 2.5 in Part 4).

This was an area in which there had been a large community outbreak in early 1990. Following the outbreak, two follow up visits were made to the area in April 1990 to investigate the continuing large numbers of cases. Assessment of the situation led the conclusion that many of the cases then occurring were secondary cases resulting from person to person spread. This is described in more detail in the chapter on incidents. There were no further clusters of cases seen after April 1990 and the numbers of cases remained low.

The percentage of young adults in area A (26%) was higher than in all the study areas (19%) and the percentage of primary cases was also slightly higher (74% vs 71% in the combined survey results) and the proportion of children under five was lower than in the combined results 47% vs 64%) (Figure A).

Only 30% of children attended a child group in this area (44% in all study areas). More Area A cases (17%) travelled locally than in all the study areas (12%), but fewer travelled within the UK (9% vs 16%).

The proportion of Area A cases who drank tap water was similar to that in the study as a whole, but 19% of cases reported eating raw meat compared to 10% in all areas.

Only 5 cases out of 53 (9%) had had contact with a young or sick pet and only 4 (8%) had had farm animal contact. This was a much lower proportion than that in the combined study results (17% sick pet contact and 20% farm animal contact).
Main Differences Between Area A and All Study Areas

Percentage of Cases 100%

<table>
<thead>
<tr>
<th>Variables</th>
<th>Area A</th>
<th>All Study Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children aged &lt;5</td>
<td>47</td>
<td>64</td>
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<tr>
<td>Young adults</td>
<td>28</td>
<td>19</td>
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<tr>
<td>Child group</td>
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<td>44</td>
</tr>
<tr>
<td>Primary cases</td>
<td>74</td>
<td>71</td>
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<td>Local travel</td>
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<td>UK travel</td>
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<td>16</td>
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<tr>
<td>Pet contact</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>Farm contact</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Raw meat</td>
<td>19</td>
<td>10</td>
</tr>
</tbody>
</table>

JL/CDSC
Area B

(34 forms returned, 18% of total).

(Figure B following page and Figures 2.1 to 2.5 in Part 4).

During the study period there were no clusters of cases and numbers were low on a week to week basis in this area.

A higher proportion of cases were aged under 5 in this area (26/34, 76%) than in the combined study results (64%) and there were no cases over 65 in area B compared with 5% of the cases in all areas. Over half the children aged under five years (14/26 53%) attended a child group contrasting with 44% in all areas (Figure B).

A greater population of cases (41%) had spent a night away from home than in all study areas (35%), with less people travelling locally (6% vs 12%) but more travelling within the UK (23% vs 16%) and abroad (9% vs 6%).

A smaller proportion of cases (n=27, 79%) than in all areas. Less people ate cold meat and hamburgers than in combined areas (53% and 32% against 67% and 40% in the combined results respectively).

Animal contact was much commoner than in all study areas with 7/34 (21%) having contact with a young or sick pet and 13/34 (38%) having contact with farm animals.
Main Differences Between Area B and All Study Areas

Percentage of Cases 100%

<table>
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<tr>
<th>Variables</th>
<th>Area B</th>
<th>All Study Areas</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Adult 65+</td>
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<td>Male</td>
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<td>53</td>
</tr>
<tr>
<td>Nights away</td>
<td>41</td>
<td>35</td>
</tr>
<tr>
<td>Local travel</td>
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<td>12</td>
</tr>
<tr>
<td>UK travel</td>
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<td>16</td>
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<tr>
<td>Abroad</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Tap water</td>
<td>79</td>
<td>85</td>
</tr>
<tr>
<td>Pet contact</td>
<td>21</td>
<td>17</td>
</tr>
<tr>
<td>Farm animal</td>
<td>38</td>
<td>20</td>
</tr>
<tr>
<td>Raw meat</td>
<td>0</td>
<td>10</td>
</tr>
</tbody>
</table>
Area C

(23 forms, 17% of total).

(Figure C following page and Figures 2.1 to 2.5 in Part 4).

This is a mainly rural area. No previous reports of any cryptosporidium outbreaks here have been received by CDSC. Numbers during the study were low with no unexpected clusters.

The majority of cases were in children under five (n=16, 70%). Most cases drank tap water 22/23. There was more farm animal and pet contact in this area (6/23 for young or sick pets, 6/23 for farm animals (26%)). A small number (n=2, 10%) had drunk unpasteurised milk and one had drunk goat's milk, but did not report whether this was pasteurised or not. Fewer cases reported nights away from home than in the combined study area results (30% vs 35%) and only 4% had travelled locally and 13% in the UK (compared to 12% and 16% respectively in all study areas) but a greater proportion of cases had been abroad (13% against 6%) (Figure C).

Most cases, 96%, drank tap water. The pattern of food consumption was similar to that in all study areas except that more cases ate hamburgers (48% vs 40%).

-31-
Main Differences Between Area C and All Study Areas

Percentage of Cases 100%

<table>
<thead>
<tr>
<th>Variables</th>
<th>Area C</th>
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<tbody>
<tr>
<td>Farm Animals</td>
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<td>20</td>
</tr>
<tr>
<td>Children &lt;5</td>
<td>70</td>
<td>64</td>
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<tr>
<td>Nights away</td>
<td>30</td>
<td>35</td>
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<td>Locally</td>
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<td>12</td>
</tr>
<tr>
<td>UK</td>
<td>13</td>
<td>16</td>
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<tr>
<td>Abroad</td>
<td>13</td>
<td>6</td>
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<tr>
<td>Unpaste milk</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Goat's milk</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Tap water</td>
<td>96</td>
<td>85</td>
</tr>
<tr>
<td>Pets</td>
<td>26</td>
<td>17</td>
</tr>
</tbody>
</table>

Fig 3

JL/CDSC
Area D

(74 forms returned, 39% of total).

(Figure D following page and Figures 2.1 to 2.5 in Part 4).

This is a mixed urban and rural area. A cluster of cases of cryptosporidiosis was investigated in March 1990 before the study proper started. A further two clusters were investigated during the study period. An account of both investigations is presented in the chapter on incidents.

Age distribution differed slightly from that of all study areas, with fewer young adults and slightly more aged under 5 and over 65. Secondary cases accounted for 30% of all cases but 8 of these were possibly acquired in hospital. Only 2% of cases had travelled abroad, although 13% had travelled locally and 19% within the UK. Otherwise the frequency of distribution of risk exposures was similar to that in all areas (Figure D).
Main Differences Between Area D and All Study Areas

Percentage of Cases 100%

Variables

<table>
<thead>
<tr>
<th></th>
<th>Area D</th>
<th>All Study Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children &lt;5</td>
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<td>64</td>
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<tr>
<td>Child group</td>
<td>37</td>
<td>44</td>
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<tr>
<td>UK travel</td>
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<td>16</td>
</tr>
<tr>
<td>Abroad</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Secondary cases</td>
<td>30</td>
<td>27</td>
</tr>
<tr>
<td>Adult 65+</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

Fig D

JL/CDSC
Area E

(7 reports 4% of total).

(Figure E following page and Figures 2.1 to 2.5 in Part 4).

Area E is a mixed urban and rural area. Only 7 reports were received and there was no clustering of cases.

All except 2 cases were under five years old. Four cases were primary and three were secondary. One child was admitted to hospital with *H influenzae* type b infection before developing his illness. All cases drank tap water. One of the cases had been in contact with a young or sick pet. No case gave a history of farm animal contact. Four out of the five children attended a child group (Figure E).
Main Differences Between Area E and All Study Areas

Percentage of Cases 100%

<table>
<thead>
<tr>
<th>Variables</th>
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</tr>
</thead>
<tbody>
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<td>Children &lt;5</td>
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<tr>
<td>Child group</td>
<td>80</td>
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<td>UK travel</td>
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<td>Secondary cases</td>
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<tr>
<td>Unpasteurized milk</td>
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</tr>
<tr>
<td>Goat's milk</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pets</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Farm animals</td>
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<td>20</td>
</tr>
<tr>
<td>Adult 65+</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

JL/CDSC
Note

A further 64 surveillance forms were returned to CDSC from non-study areas. When these forms were analysed in conjunction with surveillance forms received from the study areas the age and sex distribution and frequency of risk exposures were similar to those already described including the same percentage who had contact with farm animals and pets, and the small percentage who drank unpasteurised milk and goat's milk (Figures 3.1-3.4).
DISCUSSION

The study was successful in its attempt to improve and standardise surveillance in the study areas. It was also encouraging that some districts outside the survey areas used and returned the surveillance form to CDSC. The study emphasised the continuing importance of animal contact, especially with farm animals, in the transmission of infection. The importance of person to person spread of the disease was highlighted and also the possible risk from drinking unpasteurised milk. Some interesting differences in the distribution of risk exposures were noted in the five survey areas which will be discussed below.

The majority of cases in this study were young children aged less than five years old. There are probably several reasons for this. Parental concern ensures that children with diarrhoea are more likely to see a doctor than adults. Also, in the absence of standardised screening policies, laboratories are more likely to examine specimens from children for the presence of cryptosporidial oocysts. The proportion of child cases may be exaggerated because of this presentation and screening bias, but nevertheless the disease is almost certainly commoner in children. Young animals are more likely to suffer from cryptosporidiosis than older animals and young human animals are no exception to this.

Nearly half of the preschool children in the survey mixed with other children in playgroups and nurseries, increasing the potential for spread among this susceptible group. These children could then spread the infection to siblings and adults at home.

The results of our surveillance suggest that young children are a susceptible group in whom cryptosporidiosis is commoner than in adults. This agrees with the results of the PHLS Study Group which found higher positivity rate in children aged 1-4 years. Furthermore, contact with young children would appear to be a risk factor for acquiring the disease.

A higher percentage of cases lived in a household where there was a child under five years (36%) than in the 1981 Census for England and Wales (12.8% of households nationally contained a child or children under five).

Our data suggest that children have a milder illness than adults. There was a significant difference in the amount of abdominal pain suffered by adults and children and extra
comments were also received from adults about the severity of the abdominal pain. Children were more likely to vomit during their illness, but this is a fairly non-specific response to many childhood infections.

The ease with which the organism passes from person to person is demonstrated by the finding that nearly one third of the cases were secondary, including eight cases who possibly acquired their infection in hospital. Evidence outlined in the background section of this paper suggests that asymptomatic excretion of the organism as well as clinically symptomatic cases, plays a part in spreading infection particularly in households, nurseries and institutions.

Many of our cases had had animal contact, 17% with young or sick pets and 20% with farm animals. The amount of farm animal contact confirms the findings of the PHLS Study Group which recorded this exposure for 22% of cases.

There is unquestionably great educational value in farm visits for young children but guidelines to limit exposure to zoonotic infections such as those drawn up by Casemore (1989) should be followed.

The percentage of cases travelling abroad (6%) was slightly lower than that identified by the PHLS Study Group (12%) but it is clear that foreign travel is a risk factor for acquiring cryptosporidiosis. Travel within the UK, reported by 16% of cases, may also be a risk factor for acquiring the infection if journeys expose susceptibles to potential sources of cryptosporidiosis.

That most of our cases drank water is not surprising. Many of them were children and probably drank water or squash diluted with water, unlike many adults who tend to drink tea and coffee made with boiled water.

Small numbers of cases drank unpasteurised cow's milk and a few cases drank goat's milk, also generally sold without heat treatment. Both types of milk are thus possible sources of infection with cryptosporidium.

Contamination of milk usually occurs on the farm, either during or after milking, from infected cattle, infected humans or carriers or from the environment. Both sporadic cases and outbreaks of a variety of infections, such as salmonella and campylobacter, continue to be associated with the consumption of raw milk (Barrett 1989). Our survey
provides further epidemiological evidence that raw milk is a possible source of cryptosporidium infection and adds weight to the argument for introduction of heat treatment of all milk prior to sale and consumption. In Scotland where legislation to enforce this was introduced in 1985, infections associated with raw milk have been virtually eliminated.

It is possible that a few cases who claimed to have eaten raw meat possibly misunderstood the question, and had in fact used raw meat to make a cooked dish. Nevertheless, the proportion of raw meat eaters differed amongst the study areas, being commonest in area A (19%) a mainly urban area.

A fifth of the cases with recreational water exposure had used a paddling pool in the garden, presumably sharing it with other young children so the risk factor here may be proximity of young children to each other. Five children had visited beaches. Beach visits are not normally considered a risk factor for acquiring cryptosporidiosis unless the beaches are so crowded that person to person transmission is a possibility or beaches are extremely polluted with sewage. Sewage pollution of the sand or sea may be a possible risk factor on some beaches.

That some cases gave a history of another illness such as chickenpox, *Haemophilus influenzae* b infection or a cold before developing cryptosporidiosis is compatible with current thinking on immune mechanisms in this disease. Susceptible people will develop clinical illness after infection. In the immunologically normal individual, repeated infections facilitate the development of immunity; thus clinical illness does not automatically follow infection and these people may asymptomatically excrete the organism. Clinical illness will develop in those who have no immunity or who have lost their immunity, even temporarily.
Discussion of Differences in the Results from the Five Areas

Main Differences from Overall Results:

Area A

(More young adults; less pet and farm animal contact).

Comment: Some of the early cases included in the surveillance may be associated with the large community outbreak in early 1990 rather than sporadic cases. This would account for the higher percentage of young adults and for lack of risk factors such as animal contact and attending a child group. Low numbers subsequently may indicate that the population had acquired some immunity to the disease.

Area B

(More young children; more animal contact).

Comment: After a previous outbreak, many of the population of this area may have been immune to developing the disease. The susceptible members of the population would be young children who have not been exposed to the infection before, accounting for the higher proportion of children under five seen in this area.

That this area is rural and also the greater proportion of young children may account for more reports of animal contact than in all study areas.

It is possible that the previous waterborne outbreak may have led people to drink bottled water rather than tap water. This theory is substantiated by the finding in a recent survey of this population that 19% do not drink tap water (R Mayon-White, personal communication).
Area C

(More animal and raw milk contact).

Comment: The epidemiological pattern noted here probably reflects the fact that this is a mainly rural area.

Area D

(More elderly; clusters; less foreign travel).

Comment: More cases occurred in this area than in any of the other areas. Three clusters of cases were investigated during 1990 and 1991. Exposures conformed to the pattern in all study areas with the exception that there were slightly more cases aged under 5 (69% vs 64% in the combined study areas), more cases aged over 65 (10% vs 5%), less travel abroad (2% vs 6%) and more secondary cases (30% vs 27%), including eight possible hospital acquired cases. Although investigation of the clusters did not find an association between illness and any known risk exposures such as travel, animal contact and drinking water, it is probable that secondary spread accounted for a proportion of the cases.

Area E

(Very low numbers of reports).

Comment: Whilst it is difficult to interpret such low numbers, cases' exposures differed from the overall pattern with none reporting any contact with young or sick pets or farm animals, or drinking unpasteurised milk or goat's milk. Whereas the most usual type of farming in Britain is mixed with both crop and livestock production, area E lies in an area where cereals, potatoes, sugar beet and vegetables are grown and little livestock farming occurs. This would account for the lack of animal contact among cases and may be correlated with the low level of cryptosporidiosis.
INCIDENTS IN STUDY AREAS

Clusters or Outbreaks of Cryptosporidium Occurring Within the Study Period in Survey Districts

1. March 1990 - Area D

A cluster of cases occurred in this area in Winter 1989-90. Between these dates, 103 cases of cryptosporidiosis were identified, compared to 16 in the same time period 12 months before.

At the time of the investigation there was no local follow-up of cases of cryptosporidiosis in the area and it was difficult to obtain details on some of the cases from November and December. Since the beginning of 1990 there had been 47 cases and interviews elicited some epidemiological/exposure information. Most of the cases were under five years old (30/47) although a relatively high proportion were over 60 years old (8/47 6%) compared with national data. Five of the older cases were hospital in-patients. Cases were distributed throughout the area and the surrounding areas, and the peak appeared to have occurred in November 1989. Details collected by interviewing 6 cases implicated secondary spread in 4 of the six. Monthly reports had since declined.

When CDSC became involved during the declining phase of the incident, a large scale investigation was not considered worthwhile. Advice and forms for local follow up of cases were provided and CDSC liaised with the CCDC on further surveillance.

2. April 1990 - Area A

An account of the outbreak in this area which CDSC investigations demonstrated to be waterborne has already been presented to the Committee of Enquiry.

The case-control study which demonstrated an association with water took place during January 1990. At the end of March 1990, large number of cases of cryptosporidiosis were still being seen in the area. Two visits were made by Dr Marshall to assess the situation. Information about the cases which had occurred since 1 February was gathered from records held in the Public Health Laboratory.

-40-
and the Department of Public Health Medicine.

Between 1 February and 1 April, 159 cases of cryptosporidiosis had occurred. All age groups were affected. Many of the cases had dates of onset of illness at the beginning of February or end of March. Although cases were still occurring the rate had declined.

It was concluded that this pattern of infection was being seen at the end of the epidemic curve of a large community outbreak, with much secondary spread. As with Area D, the situation was kept under review and local follow-up of cases recommended by CDSC.

3. 1990-91 - Area D

There were 45 faecal identifications of cryptosporidium oocysts in stool samples between Autumn and Winter 1990-1991 at the Public Health Laboratory; thirty six further identifications were made between mid-February and mid-April.

As the cases of the November to February upsurge appeared to be geographically as well as temporally clustered, and no other common exposures emerged from analysis of the standard follow up questionnaires, a case-control study was conducted to test the hypothesis that illness was associated with consumption of cold drinking water. The outcome of the first investigation was awaited before a decision on investigating the second cluster was made.

Primary cases only were included in the study. Names of controls were provided by the Family Health Services Authority (FHSA). The study was carried out using a postal questionnaire.

Local ethical approval for the study was obtained.

The response rate was 75% for cases and 65% for controls.

Of the fifteen primary cases, 13 were aged under 5 years, one case was in the age group 6-10 years and one was a young adult in the age group 26-45 years. The median age of the cases was 1 year. The duration of illness ranged from 7-35 days, with a median of 15. Thirteen cases consulted their GP, three were
admitted to hospital.

On analysis of the questionnaires, there was no association between illness and contact with sick animals or surface water, nor between illness and drinking cold tap water and unpasteurised milk.

This investigation of a small number of cases did not produce a conclusive result. The delay between identification of the outbreak and obtaining ethical approval may have contributed to this.

As no common factor other than a geographical association emerged from the descriptive study, a local environmental source such as water seemed likely. The outbreak was not, however, characterised by an increase in cases amongst young adults, typically seen in a water associated outbreak and although the cases were geographically clustered, they also resided in the most populated part of the area.

As the results of the case-control study were inconclusive, the second cluster was monitored by enhanced surveillance, but no further analytical study was carried out.

Area D experiences recurrent upsurges of cases of cryptosporidiosis. Local monitoring of cases is in place and analytical studies of future outbreaks may help to ascertain the cause of these clusters. The water supply company is aware of the problem and has recently implemented new catchment control procedures and plans to sample surface water routinely for the presence of cryptosporidium oocysts.
Figures for Part 2 immediately follow this section.

Introduction

Recognition of outbreaks of cryptosporidiosis is currently dependent on laboratory identification and reporting of the pathogen. However, screening and reporting policies for cryptosporidiosis have a number of limitations. These include the variation of screening policies between laboratories and the voluntary nature of reporting both locally to Consultants in Communicable Disease Control and nationally to CDSC.

The laboratory reporting system is particularly inefficient for early detection of waterborne outbreaks. In outbreaks associated with drinking water the whole community is at risk. Surveillance to detect these outbreaks, therefore, should be community based. However, water supply zones seldom have boundaries coterminous with those of laboratory catchment areas or district and local health authorities. Delay in recognition of outbreaks may delay the investigation and implementation of appropriate control measures. This section describes an attempt to develop a community based surveillance of cryptosporidiosis.

The research comprised:

1. A prospective study of patients presenting to their general practitioners with diarrhoea suspected to be of infective origin.

2. A retrospective study of patients presenting to their GP with infectious diarrhoea in areas where there had been an increase in the number of laboratory reports of cryptosporidium identifications, to establish whether a rise in laboratory reports in an area is preceded or coincides with a rise in the number of GP consultations for presumed infective diarrhoea.

The aim of the surveillance studies was to establish the feasibility of a general practice monitoring system. In conjunction with laboratory reporting this could act as an early warning system for outbreaks of waterborne cryptosporidiosis.
1. **PROSPECTIVE STUDY**

**Objective**

To evaluate the feasibility and efficiency of this form of monitoring, particularly the amount of workload imposed.

**Method**

The study was undertaken in one of the study areas (area E). Approaches were made to a number of general practices. Three practices (seven GPs) agreed to participate in a pilot study of patients presenting with diarrhoea, suspected to be on an infective origin, over a six month period starting in January 1991. General practitioners were given brief questionnaires to complete on each patient (see Appendix). The questionnaires enquired about age and sex of the patient, date of consultation, whether it was a repeat consultation, date of onset of illness, number of days of illness prior to consultation and whether a stool specimen had been submitted to the laboratory for examination. In addition, information was sought about any travel away from home in the month before onset. Questionnaires were returned to CDSC and analysed using EPI-INFO 5 software.

**Results**

(Figure 1)

Questionnaires were completed for 73 consultations over a 27 week period. No outbreaks of cryptosporidiosis occurred during the study period.

The age range of patients was from under one year to 101 years of age, with half the cases aged less than ten years. Just under half the cases (45%) were male.

The average number of diarrhoea consultations per GP per week was 1.46. Only four patients revisited their GP with similar or recurring symptoms. The duration of illness between onset and GP consultation ranged from one to 90
days, with a median of two days. In total 44% of patients had a stool sample submitted for examination.

A similar proportion of cases (17%) had spent a night away from home as in the national study (35%).

2. RETROSPECTIVE STUDY

Objectives

1. To determine whether a rise in laboratory reports of cryptosporidiosis is paralleled by a rise in the number of GP consultations for diarrhoeal disease;

2. To develop a GP surveillance system which monitors consultation rates for diarrhoeal disease;

3. To develop an early warning system for possible water associated outbreaks based on changes in consultation rates for diarrhoeal disease.

Methods

Retrospective data about GP consultations were collected retrospectively in two areas:

a. Study Area D where two practices took part in the study. One practice was in an area supplied mainly by deep borehole water and the other practice was in an adjacent area supplied by a mixture of borehole and surface water. In this area three clusters of cryptosporidiosis occurred in 1990 and 1991.

b. Area X where eight practices took part in the study. This was an area supplied by surface water and a rise in the laboratory identifications of cryptosporidiosis occurred in January 1991.

Computerised general practices in the two areas were approached an
consultations for diarrhoea and gastroenteritis extracted from their computer databases in an anonymised aggregated form.

Consultation rates were compared with the number of laboratory identifications of cryptosporidiosis in both areas.

Results

In study Area D two increases in the number of consultations for diarrhoea and gastroenteritis were seen during the summer months of 1990 and 1991 in one of the two practices. Neither increase occurred at the same time as an increase above the background level of laboratory reports of cryptosporidiosis (Figure 2a and 2b), but may have been associated with increases in other pathogens. In the other practice consultations were spread more evenly throughout the year and again there was no obvious correlation between the number of laboratory reports and the number of GP consultations (Figure 3a and 3b).

In Area X, however, the overall number of consultations increased at the same time as the increase in laboratory identifications of cryptosporidium.

Discussion

Prospective Study

As the median duration of illness of patients in the national surveillance data was 14 days, it was hoped that prolonged diarrhoea might be an indicator of illness caused by cryptosporidium. In this prospective study, however, the median delay between start of illness and consultation was only two days and only a small proportion of patients re-presented with recurrent of similar symptoms. Stool specimens were submitted for less than half the patients. Thus the indicator of prolonged diarrhoea as a marker for probable cryptosporidiosis could not be examined in any detail in this study. The difficulty of differentiating illness caused by cryptosporidium from other causes of diarrhoea on clinical grounds has been noted by other investigators (Tzipori 1988).

As there were no outbreaks of cryptosporidiosis in the area during the time of the study, the feasibility of using this system for early detection of outbreaks
could not be easily assessed.

A number of GPs invited to participate in the study felt unable to collaborate because of other priorities arising from recent changes in general practice management. Extensive GP surveillance would be needed to detect outbreaks and would require specific resources and funding. Our approaches to several general practices suggested that other commitments during 1990/1991 prevented them from contributing to this kind of research. Except for specialised schemes such as the Weekly Returns Service of the Royal College of General Practitioners, such prospective practice based studies are probably not feasible in the current climate of change.

Retrospective Study

The results from Area X were encouraging in that a rise in the number of cryptosporidium identifications was accompanied by a rise in the number of GP consultations for diarrhoeal disease, suggesting that this is a possible method for surveillance of community based outbreaks. The increases in GP consultations in area 1 may be related to an increase in the incidence of other pathogens in the community.

In theory, practice computers could be linked by telephone line to a mainframe computer and each night the practice computers would download information to a network from where the mainframe computer would collect the data. These data could then be centrally monitored on a week to week basis. Rises in the number of GP consultations for diarrhoea would initiate scrutiny of reports in all laboratories serving the area. The potential value of the system might encourage laboratories with a selective screening programme to introduce examination of all specimens so that a clearer epidemiological picture could be compiled. This system would, of course, also detect community outbreaks due to other pathogens and could be used in conjunction with other results of microbiological investigation of specimens.

While these results are initially encouraging, concerns have been expressed recently about the quality of computerised general practice data (Johnson et al 1991, Pringle and Hobbs 1991). Although two suppliers of computers, VAMP Health and AAH Meditel, have offered computers to practices a low cost in
return for access to aggregated patient data, practices are only obliged to report what their contracts with the computer suppliers specify: such specifications are mainly confined to prescribing data. The financial difficulties of one of these companies have aggravated the problem as the agreement to purchase aggregated data has now ended. Evaluation of these systems has demonstrated that data entry is inconsistent, particularly for domiciliary consultations (i.e., outside the surgery) and those which did not result in a prescription. A further problem is the lack of experience of disease surveillance in most general practices.

However, the problems associated with using the data from large computer databases in general practice may be resolved, with good management of data and prompt feedback of information to GPs. Further research is required to validate the method and the collaborative study is continuing.

**Acknowledgement**

We are indebted to Dr C Sinclair, W Surrey & N E Hants, for his work on the retrospective study.
References


Diarrhoea and gastroenteritis
Area D1
Five weekly moving averages (backwards)
Diarrhoea and gastroenteritis
Area D2
Five weekly moving averages (backwards)
CRYPTOSPORIDIOSIS
Area D2 - Specimen Weeks 9028-9136

No of Cases

Week No's

1990

1991

JL/CDSC
General practice consultation rates for diarrhoea and gastroenteritis in eight practices (Area X)

Note: total actual numbers per week
by specimen date

Area X

Number of reports

Week Number

0  1  2  3  4  5  6  7  8  9  10  11

9045  9046  9047  9048  9049  9050  9051  9052  9101  9102  9103  9104  9105
We would be grateful if you could give details of all patients presenting with diarrhoea suspected to be due to infectious intestinal disease.

<table>
<thead>
<tr>
<th>1. Name of Patient/Identification No</th>
<th>DOB</th>
<th>Sex</th>
<th>Date of Visit/Contact</th>
<th>Is this a Repeat Visit?</th>
<th>Date of Onset of Symptoms</th>
<th>No of Days of Illness to Date</th>
<th>Has a Specimen Been Sent?</th>
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</table>

Please tick water supply if known:

- Anglian Water
- Private Supply
- Other
- Not Known

Has case spend any nights away from home in the month before onset? (specify UK or Abroad):

- Yes
- No
- Not Sure

If yes, Place(s) Visited

Date(s) Returned:

---

<table>
<thead>
<tr>
<th>2. Name of Patient/Identification No</th>
<th>DOB</th>
<th>Sex</th>
<th>Date of Visit/Contact</th>
<th>Is this a Repeat Visit?</th>
<th>Date of Onset of Symptoms</th>
<th>No of Days of Illness to Date</th>
<th>Has a Specimen Been Sent?</th>
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</tbody>
</table>

Please tick water supply if known:

- Anglian Water
- Private Supply
- Other
- Not Known

Has case spend any nights away from home in the month before onset? (specify UK or Abroad):

- Yes
- No
- Not Sure

If yes, Place(s) Visited

Date(s) Returned:

---

Any other information:

Thank you for your help. Please return to Dr E Holmes, CDSC, PHLS, 61 Colindale Avenue, London, NW9 5EQ. Telephone No: 081-200-6868 X4640.
PART 3

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Standardisation of Screening and Reporting Policies in Laboratories Throughout England and Wales

The voluntary nature of the reporting scheme for laboratory identifications of cryptosporidium in England and Wales and also the lack of standardised screening policies for the presence of oocysts in stool samples means that National figures must be interpreted within these limitations. Standardisation of screening and reporting policies (Badenoch recommendations 14.9 and 14.10) will allow a more accurate assessment of the incidence of cryptosporidiosis and will enable trends to be interpreted more meaningfully.

2. Surveillance

The results of our surveillance show that previously recognised risk exposures for acquiring cryptosporidiosis continue to be important.

   a) Travel

   Although only 6% of cases in our study had been abroad, fewer than the 12% identified by the PHLS study group, 16% of cases had travelled within the UK. This suggests that travel within this country can potentially expose susceptibles to previously unencountered sources of infection.

   b) Animal Contact

   Educational farm visits accounted for the contact with livestock reported by one fifth of cases. There is unquestionably great educational value in farm visits, but measures must be taken to limit exposure to zoonotic infection (Casemore 1989). Only slightly fewer cases (17%) reported contact with young or sick pets, again simple hygiene measures could
reduce this number.

Similarly, drinking unpasteurised milk should be discouraged, the risk of infection with cryptosporidium being just one of many reasons for this (Barrett 1989).

c) Secondary Spread

Presumed secondary cases accounted for 27% of all those in the study, including the eight cases who possible acquired their infection in hospital. Following the outbreak on North Humberside there was evidence of secondary spread and also asymptomatic carriage among household contacts of cases. These findings highlight the importance of person to person transmission in apparently sporadic cases and in the propagation of common source outbreaks.

Furthermore, if asymptomatic carriers of the organism are also efficient transmitters of infection then secondary spread, though difficult to quantify, would account for more than the 27% cases detected in our study.

Most of our cases were in children, 44% of children attended a child group and 35% of all cases lived in a household where there was a child or children under five (compared with 12% of the general population). This suggests that not only are young children susceptible to infection, as are other young mammals, but also that contact with young children appears to be a risk factor for acquiring cryptosporidiosis. These young children have opportunities to mix, pass infection among themselves and then to spread it within their homes.

While concerns about water quality prompted the current survey, there was no evidence on this review of sporadic cases that water was a more likely source than the other risk exposures.

Many of our cases had recognised risk exposures for cryptosporidiosis, suggesting that water infection did not play a significant role in the aetiology of these cases, unless these other transmission routes concealed
the role of water as a source of infection.

In contrast, five outbreaks have occurred in the UK which a combination of microbiological and epidemiological evidence suggested were waterborne.

It is possible that for cases of cryptosporidiosis as with campylobacter, another organism with seasonality, sources of infection for sporadic cases are quite different from sources of cases in outbreaks (Tauxe et al 1988).
Recommendations

Control Measures

1. Handwashing and general hygienic precautions are as important in preventing spread of infection from sporadic cases as in control of larger outbreaks. This should be drawn to the attention of health care professionals, environmental health officers and the public.

2. Strict enteric precautions should be taken to prevent spread of cryptosporidiosis amongst vulnerable patients in hospitals, nursing homes and other institutions.

3. The risk of zoonotic transmission of cryptosporidiosis should be re-emphasised and guidelines such as those produced by Casemore (1989) should be brought to the attention of farmers, public and environmental health departments and the public.

4. The risks of drinking unpasteurised milk should be publicised and the legislation in England which still permits sales of raw milk direct from farm and deliveries of green top milk direct from licensed producers and retailers of such milk should be amended in line with Scottish legislation.

5. People should be made more aware of the hazards of drinking water not intended for consumption and the possibility that apparently treated water consumed on journeys and visits may be of questionable quality.

Surveillance

1. Standardisation of screening policies and enhanced reporting of the infection should be expedited.

2. Surveillance in the form of local follow-up of cases should continue, in addition to national monitoring of reports. This will provide information about prevalent risk factors for the disease in different areas and at different times which can be examined alongside the national data. The national data will provide information about trends in the disease from year to year and place to place.
Research

We recommend a national case-control study to test some of the hypotheses generated by the surveillance programme: that sporadic cases of cryptosporidiosis are associated with person to person spread, travel, unpasteurised milk and contaminated drinking water. As our surveillance demonstrates, the frequency of distribution of risk factors is not consistent throughout the country and careful selection of study areas should take place. Discussion with microbiological colleagues would be essential to establish the expected contribution of water sampling to such a study, in view of the limitations of the methods for examining water for the presence of oocysts.
PART 4

REFERENCES


LIST OF FIGURES FOR PART 1

1. NATIONAL SURVEILLANCE
   1.1 Reports by Age Distribution - 1989, 1990 and 1991*.
   1.3 Reports by Region - 1989, 1990.
   1.4 Reports by Region - 1989, 1990 and 1991*.

2. INDIVIDUAL STUDY AREAS
   2.1 Age Distribution in Each Study Area.
   2.2 Sex Distribution in Each Study Area.
   2.3 Symptoms in Each Study Area.
   2.4 Onset in Each Study Area.
   2.5A Exposure Risks.
   2.5B Exposure Risks.

3. ALL SURVEILLANCE FORMS RETURNED TO CDSC (N=255)
   3.1 Age Distribution.
   3.2 Sex Distribution.
   3.3 Symptoms.
   3.4A Exposure Risks.
   3.4B Exposure Risks.

* 1991 Figures Still Provisional
CRYPTOSPORIDIOSIS
Reports to CDSC by Age

1989 (n=7768)

1990 (n=4680) (Provisional Figures)

1991 to Wk 32 only (n=3061) (Provisional Figures)
CRYPTOSPORIDIOSIS
Reports to CDSC by 4 Weekly Totals
For 1989, 1990 and 1991 (to Wk 32)

Week No's

No of cases

1-4 6-8 9-12 13-16 17-20 21-24 25-28 29-32 33-36 37-40 41-44 45-48 49-52


RM/CDSC
CRYPTOSPORIDIOSIS
Regional Reports for 1989 and 1990

No of Cases

1200
1000
800
600
400
200
0

NOR YOR TRE EA NWT NET SET SWT WES OXF SW WM MER NW WAL

Region

RM/CDSC
CRYPTOSPORIDIOSIS
Regional Reports for 1989, 1990 and 1991 (to Wk 32)

No of Cases

1200
1100
1000
900
800
700
600
500
400
300
200
100
0

Region
NOR YOR TRE EA NWT NET SET SWT WES OXF SW WM MER NW WAL

1989
1990
1991

RM/CDSC
CRYPTOSPORIDIOSIS
Age Distribution in Each Study Area

Area A (n=53)

Area B (n=34)

Area C (n=23)

Area D (n=74)

Area E (n=7)

JL/CDSC
CRYPTOSPORIDIOSIS
Sex Distribution in Each Study Area

Area A (n=53)
- Male 28 (53%)
- Female 25 (47%)

Area B (n=34)
- Male 18 (53%)
- Female 16 (47%)

Area C (n=23)
- Male 15 (65%)
- Female 8 (35%)

Area D (n=74)
- Male 42 (57%)
- Female 32 (43%)

Area E (n=7)
- Male 2 (20%)
- Female 5 (80%)

JL/CDSC
CRYPTOSPORIDIOSIS
Symptoms in Each Study Area

Area A (n=53)

Area B (n=34)

Area C (n=23)

Area D (n=74)

Area E (n=7)
CRYPTOSPORIDIOSIS
Onset by Month in Each Study Area

Area A (n=53)
Surveillance Commenced April 1990

Area B (n=34)
Surveillance Commenced June 1990

Area C (n=23)
Surveillance Commenced June 1990

Area D (n=74)
Surveillance Commenced September 1990

Area E (n=7)
Surveillance Commenced November 1990

JL/CDSC
CRYPTOSPORIDIOSIS
Exposure Risks in Each Study Area

Area A (n=53)

Area B (n=34)

Area C (n=23)

Area D (n=74)

Area E (n=7)

JL/CDSC
CRYPTOSPORIDIOSIS
Exposure Risks in Each Study Area

Fig 2.5B

Area A (n=53)

Area B (n=34)

Area C (n=23)

Area D (n=74)

Area E (n=7)
CRYPTOSPORIDIOSIS

Sex Distribution All Surveillance Forms (n=255)

Male 133 (52%)
Female 122 (48%)
CRYPTOSPORIDIOSIS

Symptoms Described for All Areas (n=255)

No of Cases

- Nausea
- Headache
- Fever

Symptoms

- Diarrhoea: 249
- Vomiting: 132
- Abdopain: 149
- LossApp: 190
- Weightloss: 146
- Other: 41

JL/CDSC
CRYPTOSPORIDIOSIS
Exposure Risks All Surveillance Forms (n=255)

No of Cases

250
200
150
100
50
0

Unpasteurized milk: 13
Goats milk: 2
Tap water: 216
Sausages: 182
Sausage meat: 44
Cold meat: 166
Hamburger: 111
Raw meat: 21
Raw veg: 130

Weekly
Less than weekly

Exposure

JL/CDSC
CRYPTOSPORIDIOSIS
Exposure Risks All Surveillance Forms (n=255)

No of Cases

- Nightsaway: 94
- Sickpeople: 74
- Other Water: 120
- Sick/Young pets: 42
- Farm animals: 53

Exposure

UK & Abroad | Abroad | UK | Local | Contact with

JL/CDSC
LIST OF APPENDICES

1. Cryptosporidiosis Surveillance Form
CRYPTOSPORIDIOSIS SURVEILLANCE

CONFIDENTIAL

Serial no: 

Date of interview: 

Date Int: 

Interviewers initials: 

Area Code: 

Answer questions in the spaces provided or fill in boxes as directed.

CODING ONLY

Section 1: Personal details of case

Forename ___________________ Surname ___________________

Address ____________________________________________

Postcode ___________ Telephone _______________________

Sex M / F 4. Age ______ years

1 = Male, 2 = Female

______ months (if under 5 years)

Usual place of work/school __________________________

________________ Postcode _______________________

Occupation (If a child, give occupation of parents)

Food Handler [ ] Hospital worker [ ]

Care assistant [ ] nursery worker/childminder [ ]

Other [ ] Unknown [ ]

Other (please specify) _____________________________

GP ___________________ Tel. No. ____________________
Section 2: Clinical Details

Prompt: suggest that case may find it helpful to have a diary or calendar in front of them to answer questions about the illness itself and about the time before the illness.

1. Date of onset of symptoms

2. What were the symptoms?
   - Diarrhoea
     - Yes
     - No
     - Not sure
   - (3 or more loose stools a day)
   - Abdominal pain
   - Vomiting
   - Loss of appetite
   - Weight loss
   - Other (state)

3. How many days did the illness last? _______ days

NS = 98, NK = 99, Still Continuing = 88

4. Did case see GP?
   - Yes
   - No
   - Not sure

5. Was case admitted to hospital?
   - Yes
   - No
   - Not sure
Section 3: Household Details

6. How many people lived in the household, excluding the case but including overnight guests, in the month before the illness?

SEX: M = male  F = female
AGE: years, or months if under 5 years
FAMILY OR GUEST  F = family member  G = guest
DIARRHOEA IN THE MONTH BEFORE CASE'S ILLNESS  I = ill  2 = not ill

<table>
<thead>
<tr>
<th>Name</th>
<th>Sex</th>
<th>Age</th>
<th>Occupation</th>
<th>Family/Guest</th>
<th>ill/not ill</th>
</tr>
</thead>
<tbody>
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**Prompt:** check that illnesses occurred in that one month period and not before/after. Use a calendar.

17. IF ILL: dates of onset of illness: (List up to 3 illnesses - closest to the time of the case's illness)

   / /  / /  / /

18. IF ILL: dates of recovery from illness:

   / /  / /  / /
9. Did the case come into contact with any other people with diarrhoea in the month before illness outside the home?

Yes  No  Not sure
1  2  8

IF YES: Nature of contact

Classmate  Other family member (not household)
1  2

Nursery/childminder  neighbour
3  4

Other  Not known
5  9

Other (please specify)

0. Date(s) ill if known:

/ /  / /

(refer to calendar as prompt)

Section 4: Assessment of risk activities

1. In the month before the onset of illness had the case spent one or more nights away from home?

Yes  No  Not sure
1  2  8

IF YES: Was this

Locally  Elsewhere
1  2

in the UK  Abroad
2  3

(UK + abroad codes 4)

<table>
<thead>
<tr>
<th>Place Visited</th>
<th>Date Returned</th>
<th>No of days away</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>
2. Does the case regularly drink (ie. at least once per week):

<table>
<thead>
<tr>
<th></th>
<th>Yes</th>
<th>No</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unpasteurised milk</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>Goats/sheep's milk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unheated tap water/diluted</td>
<td>1</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>in fruit squash or juice</td>
<td></td>
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</tr>
</tbody>
</table>

3. If case drinks unheated (cold) tap water:

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<table>
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<tbody>
<tr>
<td>How many glasses per day at home?</td>
<td></td>
</tr>
<tr>
<td>How many glasses per day at work/school?</td>
<td></td>
</tr>
<tr>
<td>How many glasses per day elsewhere?</td>
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</tbody>
</table>

4. How often would the case have been likely to have eaten any of the following foods in the month before the onset of illness?

<table>
<thead>
<tr>
<th></th>
<th>At least once a week</th>
<th>Less than once a week</th>
<th>Never</th>
<th>Not sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sausages</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sausage meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold cooked meats</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hamburgers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any product</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>containing raw</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>meat</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fresh raw</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>vegetables (e.g.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lettuce)</td>
<td></td>
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</tr>
</tbody>
</table>
THE FOLLOWING QUESTIONS REFER TO THE MONTH BEFORE THE ONSET OF ILLNESS:

3. Did the case use a swimming pool in the month before onset of illness?  
   - Yes  
   - No  
   - Not sure

   IF YES: Name/Location of pool if possible)

4. Did the case have any other leisure contact with water in the month before onset of illness?  
   - Yes  
   - No  
   - Not sure

   IF YES: State what

5. Did the case have any contact with young (< 6mths) or sick pets in the month before onset of illness?  
   - Yes  
   - No  
   - Not sure

6. Did the case have any contact with farm animals in the month before onset of illness?  
   - Yes  
   - No  
   - Not sure

7. Any other information which may be helpful?

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
LAB DETAILS (please complete after interview)

30. Name of laboratory identifying cryptosporidium

31. Type of laboratory:
   NHS Hospital lab  Private
   1                  3
   Public Health lab  Other
   2

32. Normal screening policy
   All specimens  Age under 15 y
   1             3
   Liquid stools  Other
   2

33. Lab reports to CDSC?
   Yes  No  Not sure
   1   2   3

THANK YOU FOR HELPING

PLEASE RETURN THIS FORM OR A COPY TO:

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CDSC
PHLS
61 Colindale Avenue
London NW9 5EQ

Tel: 081-200-6868
Fax: 081-200-7868