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Surveillance and control of *Shigella sonnei* infection*

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Summary
Shigella sonnei infection continues to present a challenge to those responsible for the control of communicable disease. It is readily passed from one person to another by faecal-oral spread, particularly in children. Traditionally, control measures have emphasised hygienic precautions and exclusion of infected individuals from schools and nurseries. The extent to which these measures have been effective appears to be limited. This review of the literature and recent epidemiological data was conducted to identify interventions which contribute to the control of the infection without unjustifiably restricting the freedom of individuals.

Introduction
In an editorial in the *British Medical Journal* in 1973[1] it was observed that outbreaks of sonnei dysentery in England were common but often inadequately managed although the mechanisms of transmission were well understood. The article concluded that, since outbreaks were virtually confined to primary schools and nurseries, a series of actions designed to ensure early diagnosis, together with prompt and effective hygiene measures, could do much to reduce the incidence of infection. This article examines the extent to which such a judgement is warranted.

The illness
The incubation period is usually 1-3 days but may be less than 24 hours or as long as a week[2,3]. The most common presentation is diarrhoea but abdominal cramps, fever, nausea, and vomiting may also occur. *S. sonnei* infection is mild in most cases, the diarrhoea frequently having subsided by the second day, although loose motions may continue for several more days[4].

Life threatening complications are rare in developed countries, but include septicaemia, toxaemia and hypovolaemia[5]. Less typical presentations may pose diagnostic problems[6]. Rates of asymptomatic infection within households have been reported to range from 8% to 20%[2,7,8], or even higher[9].

The organism
S. sonnei is the most common species of *Shigella* in the United Kingdom and, in recent years, has accounted for over 90% of isolates reported to the PHLS Communicable Disease Surveillance Centre (CDSC). *S. dysenteriae* and *S. boydii* are not indigenous and the majority of *S. flexneri* infections originate elsewhere[10].

Transmission
Infective dose
Shigellosis is highly communicable, the causative organism being 100 times more infective than *Salmonella species*[11]. Infection may follow the ingestion of 10-100 organisms[2]; challenge studies have shown that ingestion of 500 *S. sonnei* organisms causes infection in 35%-50% of volunteers[12].

* This article summarises a more extensive literature review prepared for a PHLS Working Group.

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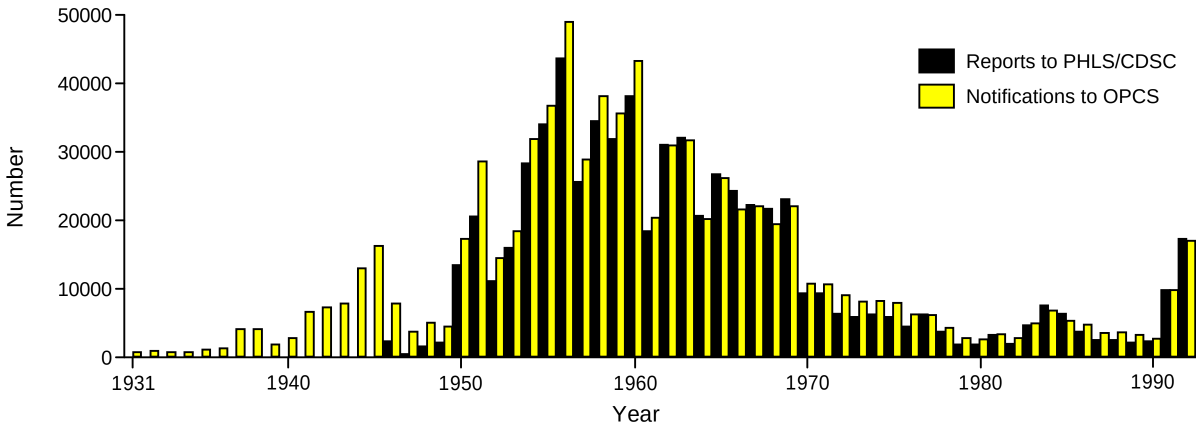
Figure 1 Laboratory reports of *Shigella sonnei* infections and notifications of dysentery in England and Wales



Mechanisms of transmission

In Britain, *S. sonnei* dysentery is spread mainly by personal contact[4]. The principal route of transmission is faecal-oral, which may be facilitated by a contaminated environment, particularly toilets or fomites, and is influenced by behavioural factors resulting in poor personal hygiene[13,14]. Less frequently, food vehicles have been implicated in the transmission of the disease[3,15,16]. Such outbreaks are rare in the UK and attract attention because of this[4,17]. In a few outbreaks, water has been identified as a vehicle of infection, including the inadvertent consumption of contaminated fresh water when swimming[15,18-20].

Epidemiology

Dysentery was made notifiable in England in 1919 following an increase in cases during the First World War. The incidence fell rapidly after the war, so that during most of the following decade less than 1000 notifications were received each year. Apart from a short decline in the late 1940s, there was a steady rise from the mid 1930s to a peak incidence of almost 44,000 in 1956. Notifications fell precipitately in 1970 to levels of less than 10,000 per year (Figure 1).

The provisional number of notifications increased to 9830 in 1991 and to about 17,000 in 1992[21]. In 1991, the largest numbers of reports were received from Yorkshire and North Western regions (Figure 2). Variations between regions have been apparent since the disease became notifiable[22]. Despite this recent increase, notifications remain lower than the peak years of 1950-1970. Dysentery has been regarded as a winter disease in Britain[4] but the seasonal variation is currently less well marked (CDSC data).

Age distribution

The most striking feature of outbreaks of *S. sonnei* infection is that most cases occur in children. In 1991 and 1992, children less than ten years of age accounted for 54% and 50%, respectively, of all cases reported to CDSC. In two large outbreaks in Yorkshire, children in this age group accounted for 70% of cases (reference 9 and CPS Newman, unpublished data). In community outbreaks, the incidence of shigellosis is typically high in the pre-school age group and highest in primary-school children, with substantially lower rates in secondary school children, and lower rates still in adults (references 9, 22 and CPS Newman, unpublished data). In two separate outbreaks, where whole communities were exposed to point source infection by contaminated drinking water supplies, few secondary cases occurred[18,19]; in one of these incidents, attack rates were highest (120 per 1000) in the 1-14 year age group[19].

Households

The extent of spread of *Shigella* in households is not always fully appreciated[7]. Studies in the UK have shown that almost half the family contacts exposed to the illness subsequently developed infection[23,24]. Similar high attack rates in the home have been observed in the United States with young children being most likely to transmit or acquire infection and babies appearing to be at greatest risk from their parents (and *vice versa*)[25,26].

Schools and nurseries

Traditionally, schools and nurseries have been regarded as playing a key role in the transmission of *Shigella* during outbreaks, with both symptomatic and asymptomatic excreters contributing to dissemination of the infection[27,28]. This view is supported by the observation that, during outbreaks, organisms can be identified in places intimately associated with the disposal of faeces[14]. Such positive isolates are associated with low ambient temperature, high humidity and diminished light, characteristics shared by old-fashioned school toilets. However, studies of the relationship between school buildings and outbreaks revealed no association between the physical attributes of the building and the occurrence of infection in pupils[28]. Moreover, although clusters may present in schools, direct spread in the classroom is not necessarily important in the progression of an outbreak[24,29]. Infection rates reported from schools and nurseries are lower than those reported from households[23-28].

Social factors

The shift from other species of *Shigella* to *S. sonnei* over recent decades in England and Wales and other industrialised communities, may have been associated with an improvement in hygiene and sanitary conditions. Many, but not all, studies within communities have shown that the risk of infection, whether sporadic or as part of an outbreak, is greater in people of lower socio-economic status or those subject to household congestion and poor housing[7,8,26].

Control measures

The two arms of intervention commonly used to control shigella infection are hygienic precautions and exclusion

Figure 2 Regional distribution of reports of *S. sonnei* infection to CDSC in 1991

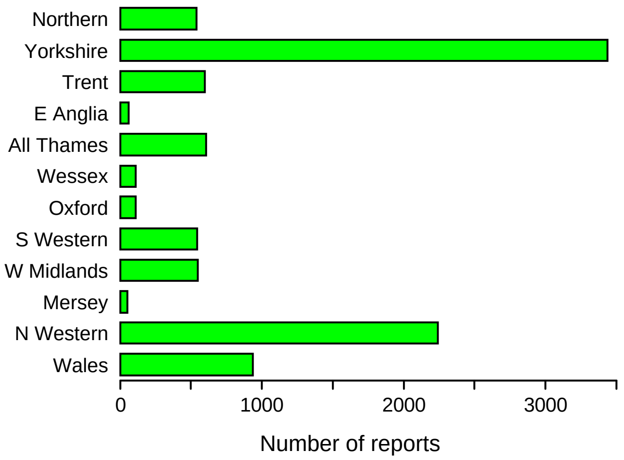
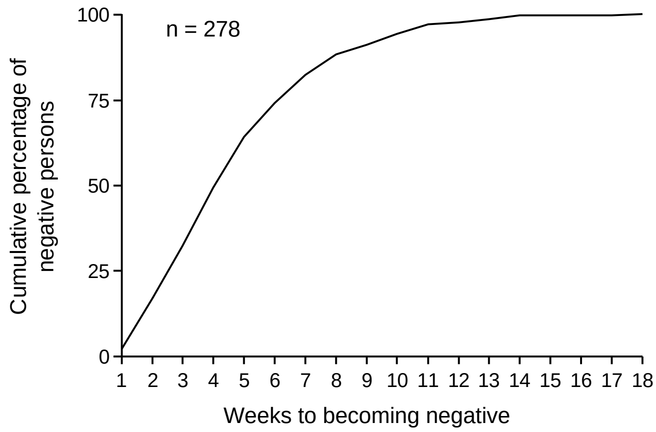


Figure 3 Clearance of *S. sonnei* from faecal samples of symptomatic cases



from certain communal activities. Despite the considerable efforts that have gone into implementing control measures in community outbreaks, the effect such actions have on the course of an outbreak remains in doubt. Thirty years ago it was stated that there was "no convincing evidence that any deliberate measures help to terminate an epidemic"[30]: review of the literature suggests that this statement remains true. Effective control relies on the identification of interventions that have a demonstrable impact on the spread of infection.

Hygienic precautions

The effectiveness of high levels of personal hygiene in the prevention of spread has long been extolled. The availability of water in quantities which enable bathing and washing together with the use of soap reduces secondary attack rates of infection[31]. In industrialised societies, however, community programmes aimed at improving personal hygiene, including supervised handwashing, appear to have had little impact on limiting the spread of diarrhoea due to shigellosis[32,33].

Exclusion

In both the UK and the United States, exclusion of affected individuals from particular activities has been advised to limit the spread of infection[2,34]. Children attending day care centres were reported as more likely to be the first case within a household and a major cause of intrafamilial spread[26]. Exclusion of children from nurseries may reduce the number of cases arising in the nursery itself, and closure may reduce the total number of attenders who ultimately become infected[28]. However, such exclusion policies have been associated with higher attack rates in the households of those subjected to these measures[24]. Thus, the extent to which such interventions lead to increased attack rates elsewhere needs to be borne in mind.

Asymptomatic excreters

The existence of asymptomatic excreters in outbreaks together with the highly infective nature of *S. sonnei* infection raises concern about their ability to propagate infection[2,34]. However studies of the impact of asymptomatic excreters in schools suggest that, in general, such concern is not warranted[27].

Clearance

An exclusion strategy involves a judgement about when restrictions should be invoked and withdrawn. It also involves consideration of clinical and microbiological criteria on which such judgements are based.

The excretion of shigella following apparent recovery from illness may be both intermittent and prolonged, thereby presenting a challenge to definitions of clearance. Guidance from the American Public Health Association[2] (APHA) (Table 1) differs significantly from that issued by the PHLS (Table 2)[34]. In particular, the former advises that microbiological clearance should be determined by two consecutive negative faecal specimens rather than three. The ability to identify intermittent excreters is not improved by using three rather than two specimens, and using the criterion of one negative specimen does not confer a disadvantage in terms of outbreak control (references 23, 24 and CPS Newman, unpublished data).

The period of excretion of the organism during convalescence is frequently prolonged, with median rates of 17-29 days being reported (Figure 3) (references 27, 28 and CPS Newman, unpublished data). Given the social impact of exclusion strategies, there needs to be a demonstrable benefit before such an approach can be considered appropriate.

Treatment and the use of antibiotics

In the UK, the emphasis in treatment, particularly of children[35], is on dealing with dehydration consequent upon infection. In the United States, symptomatic shigellosis is considered an indication for antibiotic treatment in most cases[36]. Despite this difference of emphasis, current advice from the APHA implies a selective use of antibacterials when warranted by the severity of the illness or to protect contacts[3].

The emergence of each successful antibiotic for treating shigellosis has been followed by its widespread use which has been succeeded by an increasing prevalence of drug-resistant strains[37]. Nevertheless, the treatment of sensitive strains with tetracycline, ampicillin or co-trimoxazole has been effective[37]. Currently, shigellae are sensitive to quinolones which have been helpful in the treatment of resistant strains[38].

Ampicillin and sulphonamides are effective in treating the clinical illness and reducing faecal excretion of the organism in the short term[39,40]. However, asymptomatic

Table 1 Advice from the AMERICAN PUBLIC HEALTH ASSOCIATION

CONTROL OF PATIENT, CONTACTS AND THE IMMEDIATE ENVIRONMENT

1. *Report to local health authority*.
2. *Isolation*:
   During acute illness, enteric precautions. Because of the extremely small infective dose, patients with known shigella infections should not be employed to handle food or provide child or patient care until two successive faecal samples or rectal swabs (collected ≥24 hours apart, but not sooner than 48 hours following discontinuance of antimicrobials) are found to be free of shigella. Patients must be advised of the importance and effectiveness of handwashing with soap and water after defaecation as a means of curtailing transmission of shigella to contacts.
3. *Concurrent disinfection*:
   Of faeces and contaminated articles. In communities with a modern and adequate sewage disposal system, faeces can be discharged directly into sewers without preliminary disinfection. Terminal cleaning.
4. *Quarantine*:
   None.
5. *Management of contacts*:
   Whenever feasible, ill contacts of shigellosis patients should be excluded from food handling and the care of children or patients until diarrhoea ceases and two negative stool cultures are obtained. Thorough handwashing after defaecation and before food handling or caring for children or patients must be stressed if such contacts are unavoidable.
6. *Investigation of contacts and source of infection*
   The search for unrecognised mild cases and convalescent carriers among contacts may be unproductive in sporadic cases and seldom contributes to the control of an outbreak. Cultures of contacts should generally be confined to foodhandlers, attendants and children in hospitals, and other situations where the spread of infection is particularly likely.
7. *Specific treatment*:
   Fluid and electrolyte replacement is important when diarrhoea is watery or there are signs of dehydration. Antibacterials (cotrimoxazole, ampicillin and quinolones) shorten the duration and severity of illness and the duration of pathogen excretion; they should be used in individual cases if warranted by the severity of the illness or to protect contacts (ie, in day-care centres or institutions) when epidemiologically indicated. Multi-resistance to antibiotics is common, so the choice of specific agents will depend on the antibiogram of the isolated strain or on local antimicrobial susceptibility patterns. Antimotility agents are contraindicated; they may prolong the illness.

EPIDEMIC MEASURES

1. Report to local health authority.
2. Investigate food, water and milk supplies, and use general sanitation measures.
3. Prophylactic administration of antibiotics is not recommended.
4. Publicise the importance of handwashing after defaecation; provide soap and individual paper towels if otherwise not available.

(Source: adapted from reference 2)

reappearance of the organism has been observed following treatment with co-trimoxazole and ampicillin[41].

An increasing incidence of drug resistance in *S. dysenteriae, S. flexneri* and *S. boydii* strains originating abroad was observed in England and Wales in 1981, in contrast to a declining incidence of resistance among indigenous *S. sonnei*[10]. These differences were attributed to differences in antibiotic usage.

Control regimens

Study of a range of control regimens, based on PHLS or APHA advice, some of which included innovative ways of ensuring effective implementation, has failed to reveal a package of measures that is reproducably effective in the control of outbreaks[9,29,42-44]. Although some interventions were regarded as "successful", none was shown to work promptly and convincingly.

Conclusion

The illness

In the overwhelming majority of cases of shigellosis in the UK, the infecting organism is *S. sonnei*. Such infections tend to be mild and seldom result in fulminant dysentery. Supportive measures to redress dehydration, particularly in children, are the most frequently required therapeutic measures. Antibiotics are indicated infrequently.

Transmission

The low infective dose of *S. sonnei* contributes to the highly transmissible nature of the disease. Prior infection confers no long lasting protection against the disease.

During the acute illness, *S. sonnei* is readily passed from one person to another within households. A range of behavioural and other factors render young children most susceptible to infection. Whilst suffering from diarrhoea they contribute to the ease with which the disease is passed to other members of the family. The particularly close physical contact between parents and babies appears to assist the transmission of infection. Microbiological studies suggest that faecal contamination of the environment, particularly in relation to the toilet, is significant in the transmission of infection.

Younger children may act as a bridge between households. For a range of educational and social reasons

Table 2 Previous advice from the PUBLIC HEALTH LABORATORY SERVICE
(new guidelines are published on pages R69-70)

GENERAL:
Causative organisms are members of the genus *Shigella* which comprises four species. *S. sonnei* and *S. flexneri* are endemic in the United Kingdom; *S. boydii* and *S. dysenteriae* infections are usually contracted abroad.

SOURCE:
Human cases with diarrhoea. Symptomless excreters with normal stools are rarely a source except in special risk groups 1 - 4 (see page R70 for definitions).

SPREAD:
Usually by the faecal-oral route in young children and adults in institutions. Shigellas spread very readily in nurseries and nursery schools; spread also takes place in infant schools, especially if there are unhygienic or inadequate toilet facilities and poor hygienic practices. Spread may be by flies, by food or by water.

CONTROL OF HUMAN SOURCE:
Case: dysentery is statutorily notifiable. Gastroenteric precautions at home.

Contacts: in households, bacteriological screening of persons in special risk groups 1-4 is necessary. Screening of other symptom-free contacts is usually unnecessary except for epidemiological purposes. In primary schools, screening may be limited to children with diarrhoea or loose stools but in nurseries and nursery schools it may be considered necessary to screen symptomless contacts.

Exclusion: cases and excreters posing a special risk (groups 1-4) should be excluded or isolated until free from diarrhoea and three consecutive faeces specimens collected at intervals of at least 24 hours are negative. In large outbreaks it is not necessary to obtain laboratory clearance of every case before individuals return to school or work.

Positive household contacts in special risk groups 1-4 should usually be excluded until three faeces specimens taken at intervals of at least 24 hours are negative. However, other persons should be allowed to work or attend school if symptom-free, with normal stools.

(Source: reference 34)

they may attend nurseries, infant schools or other communal activities. These children have high levels of physical contact with their peers and carers. The combination of these circumstances with underdeveloped skills to maintain personal hygiene and control defaecation, particularly in the presence of diarrhoea, facilitate transmission of the organism. However, there is little evidence that structured activities, such as attendance at nurseries, are more likely to result in the transmission of infection between children than other informal social contacts.

Outbreaks
The origins of the majority of community outbreaks or epidemics are obscure. Presumably, a susceptible individual is exposed to organisms originating from an asymptomatic carrier. Given the endemic nature of the infection, intervening factors must come into play to instigate an outbreak. The absence of routinely available epidemiological markers inhibits the identification of these factors.

In an epidemic, almost all infections are acquired from symptomatic individuals. Transmission to secondary cases will frequently have occurred before the primary case has been diagnosed. It is inevitable, therefore, that the traditional interventions taken in outbreaks, which can only be initiated once an incident has been identified, are likely to be of limited value.

Limiting the spread of infection
Evidence that the energetic implementation of a set of predetermined control measures results in the rapid control of an outbreak has not been found in the literature reviewed.

Given the ease with which the infection can be transmitted, the restriction of individuals with diarrhoea (particularly children and those in high-risk occupations) to their own home together with the adoption of high standards of hygiene and limitation of social contact is prudent both for the individual and the public health. Infection is seldom transmitted in the absence of diarrhoea, and exclusion from specific activities can be justified only where the consequences of such transmission would be particularly serious. Specifically, the exclusion from school of children who are clinically well contributes little to the control of an outbreak. There is anecdotal evidence to suggest that such actions may be counterproductive, producing an unwillingness in parents to report illness in their children. The identification of asymptomatic excreters is unlikely to contribute to the management of an outbreak.

Determining the clearance of infection
For those individuals in high risk occupations where exclusion on the basis of continued excretion of the organism has hitherto been considered appropriate, a decision was needed to determine which criteria should be adopted to judge ‘clearance’. On those occasions where exclusion was considered appropriate, the use of three rather than two consecutive negative faecal samples or even a single negative specimen to determine clearance appears to have conferred no additional benefit.

The place of antibiotics
The use of antibiotics is associated with a shorter clinical illness. While this may be of benefit for the individual patient, there is little evidence to suggest that their more widespread use assists in the management of an outbreak and such use is likely to be associated with the emergence of antibiotic-resistant strains.

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Revised guidelines for the control of *Shigella sonnei* infection and other infective diarrhoeas

PHLS Working Group on the control of Shigella sonnei infection

The considerable increase in *Shigella sonnei* infection during 1992, and the realisation that there has been little success in controlling outbreaks, despite energetic application of current control measures, has led the PHLS to review its recommendations for control. In the 1990 PHLS guidance notes[1] all Shigella species are considered together as one group. However, it is now generally accepted that *S. sonnei* infection often causes only mild and transient diarrhoea and rarely causes dysentery (with bloody watery stools). It was, therefore, considered reasonable to review *S. sonnei* control separately from other Shigella species.

The PHLS Working Group reviewed published and unpublished data in 1992 and came to the following conclusions:

a) Transmission of *S. sonnei* is usually by faecal-oral spread and is particularly associated with exposure to liquid infected stool. Fomites outside the toilet, such as toys, probably play a small part in transmission. Food and water vehicles are uncommon but important when they occur.

b) The most important control measures are the provision of toilet facilities (including toilet paper) and thorough hand-washing after use of toilets and before meals, using soap and warm water.

c) Pre-school, nursery and infant school children are most likely to spread infection and are at highest risk of infection.

d) Asymptomatic excretion during convalescence or in apparently healthy individuals, although common and often prolonged, poses a minimal risk of direct faecal-oral spread provided good hygiene measures are followed.

e) Good hygiene is difficult to achieve in patients who are mentally handicapped or who are children in nappies, so that the risk of transmission by asymptomatic excretion in such individuals is increased. Contamination of the environment with faecal organisms by asymptomatic children in nappies is significantly reduced when the child wears clothing over the nappies.

f) Antimicrobial treatment of cases is seldom indicated but may reduce the duration of excretion. However, routine use of antimicrobial agents is not recommended solely to speed return to school or work, not least because of the possible development of antibiotic resistance.

g) Routine laboratory methods of isolation of *S. sonnei* from faecal samples are relatively insensitive and may miss a significant proportion of asymptomatic excreters.

h) Control policies for *S. sonnei* infection in the community vary from place to place and data on the relative effectiveness of these policies are lacking.

i) Any exclusion policy will have problems of compliance. For example, parents who fear that their children will be excluded from school or nursery until three consecutive negative faecal samples have been obtained may be reluctant to report diarrhoeal illness. Similarly, if exclusion is based on the presence of symptoms, parents may return children to school or nursery before complete recovery.

On the basis of these conclusions, the PHLS Working Group recommends that cases at home should be nursed with enteric precautions[1] with clear advice on personal hygiene being given to cases and their carers. Control measures outside the home should focus on establishing high standards of hygiene in nurseries and schools (including adequate toilet facilities) and on the exclusion of children as soon as they become ill with diarrhoea and until they have normal stools.

Specific recommendations

1. Schools and nurseries should provide toilet facilities (including toilet paper) appropriate to the age of the children in their care. They should teach children to wash their hands thoroughly after the use of toilets and before meals, using soap and warm water. There is no need to use expensive hand cleaners. The additional value of post-wash antiseptic hand rub is unclear. It is bad practice to provide a continuous loop towel for communal use. Disposable paper towels or warm air hand driers are the preferred options.

2. Hand-washing by children after use of toilets, and before meals, should be supervised routinely in nurseries and infants' schools and is particularly important during outbreaks.

3. Formal written regimens to ensure regular and frequent cleaning of nursery and school toilets, cubicles, changing areas and rooms, and for dealing with environmental contamination due to accidents, are essential. Attention should be paid to the cleaning of toys and equipment, especially during outbreaks, when consideration should be given to suspending play with water, sand and play-dough.

4. A child with diarrhoea should be excluded from school or nursery until symptom-free and with formed stools. Microbiological clearance is unnecessary where appropriate hygiene measures have been instituted in schools. Additional measures to help ensure compliance with exclusion have been adopted in some areas*, although use of these measures needs evaluation.

5. In outbreaks, we consider there is little to be gained from routine screening of asymptomatic children in school or nursery since, with good hygiene, they pose a negligible risk to others. Children with diarrhoea should be identified and excluded from school or nursery. The school or nursery staff, pupils and household contacts should be offered hygiene advice.

6. Children who are identified as asymptomatic excreters need not be excluded from nursery or school routinely if good hygiene can be practised, but hygiene advice must be given to the child, parents and staff.

* In Manchester, for example, children in nappies, who pose a greater risk of transmission of infection, are excluded from nurseries for two weeks from the onset of illness.

Table 1 Groups posing a special risk of spreading infection

All cases of gastroenteritis or enteritis should be regarded as potentially infectious and should normally be excluded from work or school until the person is free of diarrhoea and vomiting. Thereafter, it is particularly important to assess the risk of spreading infection in the four groups of persons (below) in whom special action should be considered. The circumstances of each case, excreter, carrier or contact in these groups should be considered individually and factors such as standards of personal hygiene should be taken into account.

Persons who do not fall into risk groups 1 or 2 may return to work when the diarrhoea has ceased and they feel well enough to do so. These persons may return to work before the results of tests are available. There are many instances where individual cases have to be assessed on their merits.

GROUP 1

Food handlers whose work involves touching unwrapped foods to be consumed raw or without further cooking.

GROUP 2

Health-care, nursery or other staff who have direct contact, or contact through serving food, with highly susceptible patients or persons in whom an intestinal infection would have particularly serious consequences.

GROUP 3

Children aged less than 5 years attending nurseries, play-groups, nursery schools, or other similar groups.

GROUP 4

Older children and adults who are unable to implement good standards of personal hygiene, eg the mentally ill or handicapped or the infirm aged, and those in circumstances where hygienic arrangements may be unreliable, eg temporary camps housing displaced persons. Children in infants' schools may be considered under exceptional circumstances to fall into this group.

(reproduced from reference 1)

7. Staff in nurseries should be made aware that children in nappies who are symptomless excreters pose an increased risk of transmission of infection. Changing nappies should be carried out in an area separate from other children, and on surfaces which may be cleansed easily. Staff must wash their hands thoroughly after changing nappies, and surfaces must be cleaned frequently.

8. The closure of schools and nurseries to control outbreaks of *S. sonnei* is seldom indicated. The possibility that school closure may increase transmission in the community should be borne in mind. However, local education authorities should ensure that schools are inspected and that there are adequate toilet facilities with toilet paper, hot water, soap and hand drying facilities, and that toilet and environmental cleaning and disinfection programmes are in place.

9. Information (in appropriate languages) on prevention and control measures should be made available to teachers, ancillary staff and assistants, school nurses, parents and general practitioners.

10. Food handlers (Group 1 – see table 1) with diarrhoea must be excluded from work until at least 48 hours after symptoms have abated and stools have returned to normal. Hygiene advice should be given prior to return to work. Household contacts, of a person with *S. sonnei* infection, who are known to be food handlers must be given hygiene advice.

11. Health care workers (Group 2) with diarrhoea should be excluded from work until symptom-free and with normal stools. Household contacts, of a person with *S. sonnei* infection, known to be health care workers must be given hygiene advice.

12. Household contacts who are handicapped (Group 4) may pose problems because of faecal smearing or incontinence. Exclusion from school or other care facilities may cause severe social problems. If such contacts are allowed to continue at school, extra care must be taken with hygiene, and hygiene advice must be given to school staff. The opportunity should be taken by environmental health officers to inspect hygiene facilities.

13. Recommendations for the control of *S. boydii*, *S. dysenteriae* and *S. flexneri* remain as described previously[1].

14. These recommendations draw on current knowledge. Nevertheless, there is a need to evaluate these recommendations, as well as other policies which may be adopted by local and health authorities.

Membership of the Working Group

Professor R Y Cartwright, Dr J G Cruickshank, Professor R Feldman, Dr R Gross, Dr J Leese, Dr S L Mawer, Dr C P S Newman, Dr M J Painter, Dr S R Palmer (Chairman), Dr B Rowe and Dr M Schweiger.

Reference

1. PHLS Salmonella Subcommittee. Notes on the control of human sources of gastrointestinal infections, infestations and bacterial intoxications in the United Kingdom. *Communicable Disease Report* 1990; Suppl 1.

'COVER' (Cover of vaccination evaluated rapidly): 25

The COVER programme, a scheme for the rapid evaluation of vaccine coverage, started in January 1987 with 14 districts contributing data (*Communicable Disease Report* 1987; (12): 3-6). This twenty-fifth quarterly report includes information from 189 districts. The proportion of districts reporting has remained at about 95% since the beginning of 1991 (Figure 1).

Methods

Data were collected at the beginning of February 1993 for quarterly cohorts whose youngest member had reached the target ages for completion of immunisation: 18 months for the third dose of diphtheria (D3) and pertussis (P3) vaccines and 24 months for measles. For D3 and P3, data were also requested for quarterly cohorts whose youngest member had reached a lower target age of 12 months. The cohorts studied were those born in October to December 1991 (for D3 and P3 by 12 months), April to June 1991 (for D3 and P3 by 18 months) and October to December 1990 (for measles by 24 months).

In two regions (South-East Thames and Wales), data were also collected on the third dose of *Haemophilus influenzae* type b vaccine (Hib 3) (as well as D3 and P3) in a cohort of children born in August to September 1992. This two month cohort was the first to be included in the Hib immunisation programme which was introduced in October 1992. The children studied were aged 5-6 months at the time of evaluation.

Results

One hundred and eighty-nine districts participated from 14 English regions, Wales and Northern Ireland. Data were available for every district in eleven English regions, and for Wales and Northern Ireland. In all other regions (except Mersey) at least 80% of districts participated. The average cover (Table 1) by 12 months was **94%** for D3 (district range 79-99%) and **91%** for P3 (district range 77-97%). Cover by 18 months was **95%** for D3 (district range 83-99%) and **92%** for P3 (district range 79-96%). For measles, average cover by 24 months was **93%** (district range 79-98%). The 95% target was achieved by 96 districts for D3 (at 12 months), by 31 districts for P3 (at 12 months) and by 70 districts for measles (Figure 2). Only four districts had coverage below 80% for any sentinel antigen.

In South-East Thames, coverage for Hib 3 at 5 months

Figure 1 Proportion of districts participating in the COVER programme

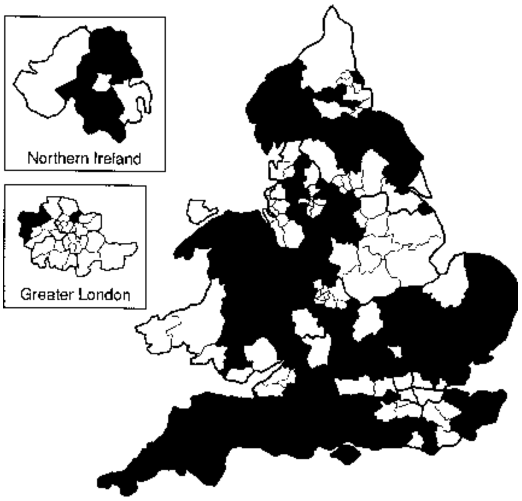
Table 1 Diphtheria and pertussis vaccination at 12 and 18 months, and measles vaccination at 24 months: February 1993

Region	Number of participating districts (total)	% coverage at 12 months* D3 by evaluation date	% coverage at 12 months* P3 by evaluation date	% coverage at 18 months* D3 by evaluation date	% coverage at 18 months* P3 by evaluation date	% coverage at 24 months* Measles by evaluation date
England:						
Northern	16 (16)	94 (90–99)	91 (88–97)	96 (93–99)	92 (89–96)	94 (91–98)
Yorkshire	14 (16)	94 (90–99)	91 (86–97)	95 (92–99)	91 (86–96)	93 (90–98)
Trent	10 (12)	93 (90–97)	91 (88–95)	94 (91–98)	91 (88–95)	93 (90–97)
E Anglia	8 (8)	96 (94–99)	94 (90–96)	97 (95–99)	95 (93–97)	96 (94–98)
NW Thames	13 (13)	92 (84–97)	90 (82–95)	95 (87–99)	92 (85–96)	92 (85–98)
NE Thames	15 (15)	93 (84–99)	90 (81–97)	95 (88–99)	92 (84–97)	91 (85–98)
SE Thames	15 (15)	92 (79–96)	89 (77–95)	94 (83–98)	91 (80–95)	91 (80–97)
SW Thames	13 (13)	92 (79–99)	90 (77–95)	92 (83–98)	91 (81–97)	90 (81–97)
Wessex	10 (10)	96 (95–98)	94 (90–97)	97 (95–98)	94 (92–96)	96 (94–97)
Oxford	8 (8)	95 (94–97)	94 (92–95)	95 (92–97)	93 (90–95)	94 (90–97)
S Western	9 (9)	95 (94–98)	93 (91–95)	97 (95–99)	94 (92–95)	95 (93–97)
W Midlands	20 (20)	93 (83–97)	90 (85–95)	95 (84–98)	91 (82–95)	92 (79–96)
Mersey	6 (10)	90 (85–96)	87 (81–92)	93 (87–98)	88 (82–93)	90 (83–96)
N Western	19 (19)	93 (86–98)	90 (82–95)	95 (86–97)	91 (79–94)	92 (83–96)
Wales	9 (9)	95 (93–97)	89 (86–95)	96 (94–97)	89 (86–93)	92 (90–96)
N Ireland	4 (4)	95 (92–98)	91 (89–94)	97 (95–98)	92 (91–94)	93 (91–95)
Total	189 (197)	94 (79–99)	91 (77–97)	95 (83–99)	92 (79–96)	93 (79–98)

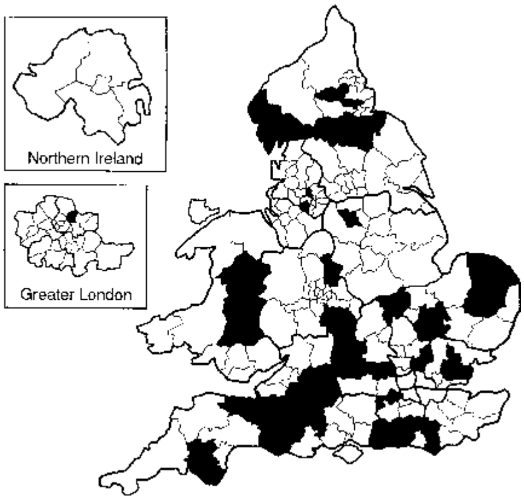
* The district range is given in brackets

Figure 2 Districts that had achieved 95% vaccine coverage by February 1993

a) Diphtheria (D3) at 12 months



b) Pertussis (P3) at 12 months



c) Measles at 24 months

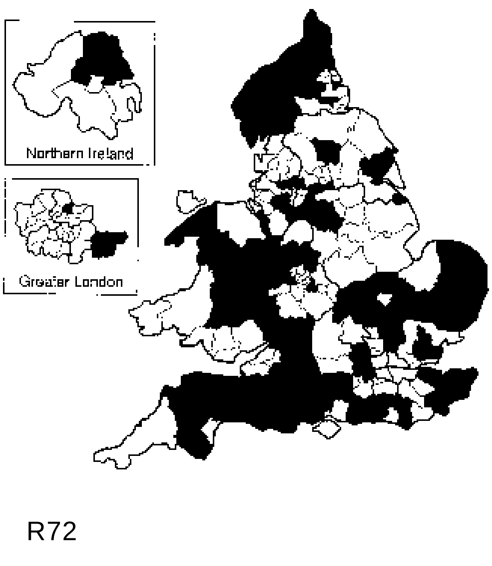


Table 2 Diphtheria, pertussis and Hib vaccination at five months: February 1993

Region	Number of children evaluated	Number vaccinated by evaluation date (% coverage)		
		D3	P3	Hib 3
SE Thames	8747	4661 (53%)	4603 (53%)	4433 (51%)
Wales	6333	4691 (74%)	4521 (71%)	4453 (70%)

was 51% (Table 2). Coverage for both P3 and D3 (at 5 months) was 53%. In Wales, coverge for Hib 3 at 5 months was 70%; for D3 it was 74% and for P3 it was 71%.

Comment

We report COVER data from 189 of 197 (96%) districts in England, Wales and Northern Ireland. Vaccine coverage for D3 (at 12 months) and P3 (at 12 and 18 months) has improved by 1% since the previous report (*Communicable Diseaase Report* 1993; **3**: R34). Coverage for measles (at 24 months) is unchanged. The impact from adverse publicity about recent changes in the supply of vaccines and reports of vaccine shortages appears to be negligible in the cohort of children evaluated in this report.

This report includes preliminary data on coverage for Hib 3 in South-East Thames and Wales. In South-East Thames, coverage for D3, P3 and measles is lower than the national average (Table 1). The observed coverage for Hib 3 at 5 months was lower than for D3 and P3 at the same age. Although the number of children evaluated was relatively small, the pattern of slightly lower Hib coverage was consistent for all districts in the region. Coverage for D3 and measles in Wales is similar to the national average. However, coverage for P3 (at 12 and 18 months) is lower than average. Coverage for Hib 3 at 5 months was 4% lower than for D3, but only 1% less than P3 (in more than half the districts Hib 3 coverage was the same as for P3). It is not clear whether the relatively low Hib 3 coverage in South-East Thames and Wales is due to scheduling delays and vaccine shortages in the early stages of the Hib programme or to lower acceptance of the new vaccine.

Hib vaccine will be included as a sentinel antigen in the COVER programme from November this year; thus, national data on coverage will be available early in 1994 (COVER 28). In the meantime, it is intended that surveillance will continue in selected regions, in order to ascertain any continuing discrepancy in coverage between Hib and other sentinel antigens. When national COVER data on Hib become available, routine assessment of vaccine efficacy (using the screening method[1]) should be possible by obtaining vaccination histories for all reported cases.

Reference

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COVER in Wales: May 1987 - February 1993

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Introduction

In 1984, the World Health Organisation set the goals of eliminating indigenous measles, poliomyelitis, neonatal tetanus, congenital rubella and diphtheria from Europe by the year 2000[1]. To achieve this, a target of 90% vaccination coverage by 1990 was set[2] and, in 1991, the target for 1995 was raised to 95%[3]. The COVER programme was started in February 1987[4] to monitor vaccine uptake rapidly in the United Kingdom. Welsh health authorities began contributing data in May 1987 and all nine health authorities in Wales were participating by February 1988.

Methods

The three sentinel antigens monitored from 1987 were the third dose of diphtheria (D3) and pertussis (P3), and measles. In October 1988, combined measles-mumps-rubella (MMR) vaccine replaced single antigen measles vaccine in the childhood vaccination programme. *Haemophilus influenzae* type b (Hib) vaccine will be included in the COVER scheme from November 1993, following its incorporation into the childhood vaccination programme in October 1992.

From 1987 to 1991, diphtheria and pertussis vaccine uptake was monitored in successive cohorts of children reaching the age of 18 months, and measles vaccine was monitored in cohorts reaching the age of two years. Since the introduction of the accelerated schedule for primary vaccination in 1990, additional cohorts of children have been monitored at 12 months of age, starting in the February 1991 quarter. In February 1993, the cohorts under surveillance were children born between April and June, and October and December 1991 for D3 and P3, and between October and December 1990 for MMR.

In Wales, data are obtained directly from the Welsh Health Common Service Authority (WHCSA) computing centre, which holds the child health system[5] dataset on behalf of districts. The number of resident children, and the percentage who have completed vaccinations, are requested from each district as soon as the youngest member of each cohort reaches the target age for receiving the particular antigen. This evaluation date is set as the first Friday of the following month. The data are received as a computer printout and are then aggregated. Graphs are produced and distributed to all health authority immunisation coordinators and other health professionals. In addition, a quarterly table giving uptake of all the antigens for the appropriate cohorts by health authority, and for Wales as a whole, is sent to the immunisation division of the PHLS Communicable Disease Surveillance Centre (CDSC) for inclusion in national surveillance data.

Results

For Wales as a whole, coverage of D3 in the 18 month old cohorts increased from 83% in May 1987 to 96% in February 1993, and coverage of P3 for these cohorts increased from 60% to 89% (Figure 1). For the 12 month old cohorts, coverage of D3 increased from 90% to 95% between February 1991 and February 1993, and coverage of P3 increased from 81% to 89%. All districts in Wales achieved the 90% target for D3 at 18 months by February 1991 and all but one achieved the 95% target in February 1993. In the 12 month old cohorts, all districts achieved the 90% target by August 1991 and four reached the 95% target in February 1993. By February 1993, four health authorities had achieved the 90% target for P3 in 12 month olds and one had reached the 95% target. Uptake of measles or MMR vaccine in the two year old cohorts increased from 61% in May 1987 to 92% in August 1992 (Figure 2). By February 1993, all health authorities in Wales had achieved the 90% target and two had reached the 95% target. The overall rate of increase in uptake of all three antigens has slowed since 1991; D3 and P3 uptake did not increase in either the 12 or 18 month old cohorts in February 1993. MMR uptake has remained at 92% for the last three quarters.

Comparison with combined data for England and Northern Ireland

One hundred and eighty of the 188 health districts in England and Northern Ireland contributed to the COVER programme in February 1993 (see accompanying report). D3 uptake in Wales has been consistently higher, and P3 uptake consistently lower, than the combined figures (Figure 1) although the gap for P3 at 18 months has narrowed, from twelve percentage points in May 1987 to three in February 1993. Single antigen measles vaccine uptake in Wales was thirteen percentage points lower than in England and Northern Ireland in May 1987 but, since the introduction of MMR, coverage in Wales quickly caught up with the rest of the country (Figure 2).

Comment

The COVER programme has proved to be a valuable system for providing district immunisation coordinators with timely information on trends in childhood vaccine uptake, and we believe it has contributed to the improvement in uptake rates. In Wales, copies of the tabulated and graphical information are sent out within a few days of the data being received by the CDSC Welsh Unit, and these have contributed to the success of the COVER programme by enabling health authorities to compare their performance with other areas. The willingness of health authorities to identify their own uptake rates in the tabulations has demonstrated their commitment to improving performance. More detailed analysis can be undertaken by individual districts to pinpoint clinics or general practices with low uptake rates.

The interpretation of trends has to take into account the completeness and accuracy of the child health database. In one district, for example, investigation of a sudden fall in uptake for D3 during 1988 revealed an administrative backlog in entering data into the child health sytem. The use of these data for public health surveillance provides a cogent reason for health authorities to strive to improve the completeness and accuracy of the database.

Overall, the trend data have been encouraging, especially in those parts of Wales which have traditionally had very low uptake rates. Rapid and consistent increases in uptake

Figure 1 Coverage of D3 and P3 at 18 months

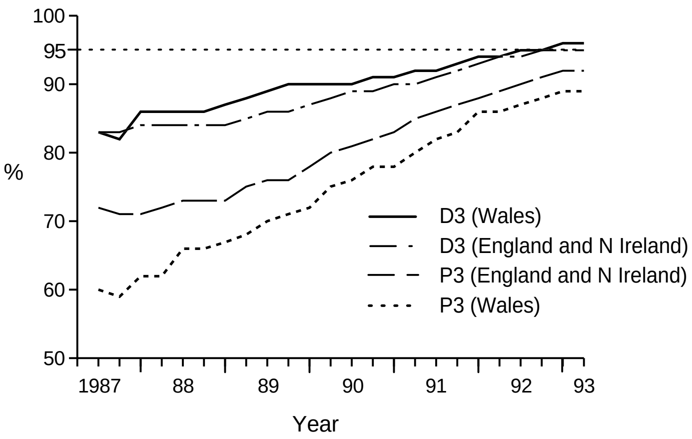
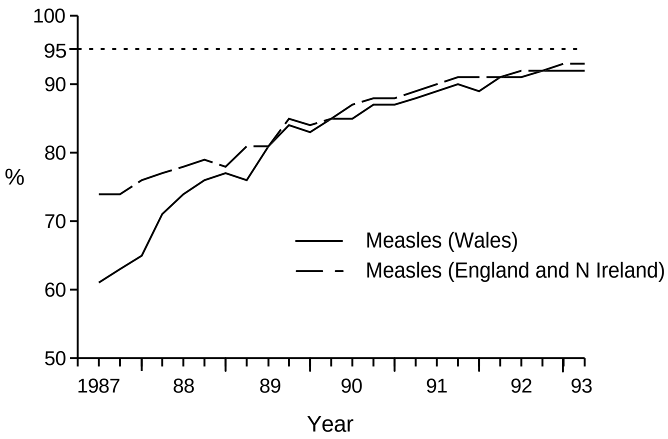


Figure 2 Coverage of measles at 24 months



were observed from 1987 until the end of 1991, by which time six districts had achieved 95% targets for D3 in 18 month old cohorts. These districts have since maintained their coverage of D3 at this level. In two of the three other Welsh districts, the 95% target was reached by November 1992, but cover in the remaining districts has levelled just below the 95% target.

Wales has had a poor record of pertussis vaccine uptake, but there has been rapid improvement since 1987. Coverage in districts which initially had the highest uptake has levelled out at around 90%.

A similar pattern is emerging for MMR vaccine. Steady but slow improvments in coverage are being maintained by those districts which had the lowest levels in 1987, but coverage in the other districts has levelled out below the 95% target. Further studies are needed to identify reasons for these trends, so that new strategies can be developed to enable the 95% target to be reached for both MMR and pertussis.

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