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Poliomyelitis surveillance in England and Wales, 1969–1975

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SUMMARY

Poliomyelitis continued to be a rare disease in England and Wales in the period 1969–75. Only 31 paralytic and 44 cases of possible non-paralytic poliomyelitis were recorded during the 7 years.

Of the 31 paralytic cases approximately one third were vaccine-associated; 3 were patients who had recently received oral poliovaccine and 7 had been in contact with a vaccinated person. Five of these 7 patients were parents of recently vaccinated children. The rate of vaccine-associated poliomyelitis was estimated in recipients to be 0·2 and in contacts 0·4 per million doses of vaccine given.

Marker test results were reported on 555 strains of poliomyelitis virus isolated during 1969–75, using the reproductive capacity temperature test. Forty-eight (8·6%) resembled wild virus in this property, 15 strains being type 1, 8 type 2 and 25 type 3. Most of these isolations of apparently wild virus were from excreters with no symptoms of poliomyelitis, although 3 of the 15 type 1 strains were from patients with paralytic poliomyelitis and 3 from possible cases of non-paralytic poliomyelitis. None of the 8 apparently wild type 2 viruses was from a case of paralytic illness and only 1 of the 39 type 3 strains.

Eleven of the 31 paralytic cases were in patients in whom the infection was likely to have been acquired abroad.

INTRODUCTION

Poliomyelitis surveillance was started by the Ministry of Health in 1958, when inactivated poliovaccine was first introduced for general use, and the surveillance became the responsibility of the Public Health Laboratory Service in 1962. Its main purpose is to monitor the effectiveness of the poliomyelitis vaccination programme and also the safety of vaccines – both for the recipients and, with the introduction of live vaccines in 1962, for contacts of vaccinated persons. Previous reports (Geffen & Spicer, 1960; Geffen, 1960; Galbraith, 1963; Roden, 1964; Miller & Galbraith, 1965; Miller, Reid & Diamond, 1970; Miller, 1970) have presented the results up to December 1968 and the present report is concerned with the 7-year period, 1969–75.

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METHODS

Sources of information

The surveillance concerns patients with paralytic and non-paralytic poliomyelitis and the vaccination programme in England and Wales, i.e. excluding Scotland and Northern Ireland. The surveillance is based on the following information.

Notified poliomyelitis

In all cases notified to the medical officer of health (MOH) and the Office of Population Censuses and Surveys (OPCS), enquiry forms are sent to the MOH (since 1973, the Medical Officer of Environmental Health, MOEH), and to the clinician and the laboratory concerned with the patient in order to secure appropriate clinical, epidemiological, virological and pathological details. Information on the vaccination history is particularly sought.

The number of cases reported in this paper do not necessarily correspond to the number recorded in the OPCS returns. Differences arise in part because, like most other infectious diseases (Haward, 1973), poliomyelitis may be undernotified and because, by follow-up of laboratory isolations (see below), cases which have not been notified may be discovered. In addition, a small number of cases are notified which are subsequently given different diagnoses, but the notification to the OPCS is not always withdrawn. Cases in which the infection is acquired abroad are sometimes notified but later withdrawn from corrected OPCS returns.

Laboratory isolations of polioviruses

Public Health Laboratory Service (PHLS) and other laboratories routinely report each week to the Epidemiological Research Laboratory of the PHLS the virus isolations they have made, together with data concerning cases of virus infection diagnosed serologically or by other means. The virologist is requested to provide in addition to the laboratory findings the age and clinical condition of the patient in whom infection with a poliovirus was diagnosed and also information on the vaccination history. When the infection concerns a patient with neurological symptoms, information is also sought from the clinician and the MOEH.

R.c.t. marker tests

Laboratories are asked to send poliovirus isolates to the PHLS Virus Reference Laboratory, Colindale, where the strains are examined by the reproductive capacity temperature (r.c.t.) test to determine whether in this respect they resemble vaccine or wild strains (Cossart, 1967).

Other information

Certain other returns, such as the number of doses of poliomyelitis vaccine distributed each year, the number of persons vaccinated, and the batch numbers of the vaccines issued in England and Wales are provided by the Department of Health and Social Security (D.H.S.S.).

Poliomyelitis vaccination in England and Wales

The vaccination practice in England and Wales in general followed the recommendations of the Department of Health and Social Security (D.H.S.S., 1972). A primary course of three spaced doses of triple, live-attenuated oral vaccine (OPV) was recommended for all infants at approximately 6, 8 and 12 months of age. Single booster doses were recommended at 5 years, when children start school, and again at 15–19 years, before they leave. During the period with which this report is concerned, about 85% of infants were estimated to have received the primary course of vaccine, about 60% the pre-school booster, but only 25% the school-leaving booster dose. A small amount of vaccine is also given to reinforce the immunity of persons travelling to countries where the infection is common, and it is also the practice to offer vaccine to people in contact with, or living in the locality of, any case of poliomyelitis. Very little killed poliovaccine has been used since 1962.

Definitions

Paralytic poliomyelitis. Inclusion of a patient in this category depends upon the final diagnosis made by the clinician responsible for the care of the patient. This criterion differs from that adopted by the World Health Organisation (WHO) for surveillance purposes, which includes only patients with spinal paralysis persisting for more than 6 weeks, or which proved fatal within 6 weeks (Report, 1976). In many cases the diagnosis is supported by laboratory evidence, but laboratory investigations are initiated by the clinician in charge and, although they are often decided in consultation with a virologist, it is inevitable that in some cases, usually when the clinician is sure of the diagnosis or when virological facilities are not locally available, full investigations will not be made.

Non-paralytic poliomyelitis. In this category are placed patients whose illness has been clinically diagnosed as non-paralytic poliomyelitis, together with cases of encephalitis or aseptic meningitis in patients with cultural or serological evidence of infection with a poliovirus. Such patients may well include those in whom the association between illness and the virology findings is coincidental; they are included to provide an estimate of the highest possible number of non-paralytic cases.

Recipient vaccine-associated case. Poliomyelitis in a person who has recently had oral poliovaccine (OPV) is considered to be vaccine-associated when the onset of illness occurred 4 or more days, or paralysis 6 or more days, after receiving vaccine, and provided the illness or paralysis began within 30 days of vaccination.

Contact vaccine-associated case. Poliomyelitis in a person in known contact with someone who recently had OPV is considered to be vaccine-associated if the contact received the vaccine between 4 and 60 days before onset of the patient's illness.

Inclusion of a patient in either vaccine-associated category does not imply that the illness has necessarily been caused by the vaccine – the association could be a chance one. However, the categories should include all cases caused by the vaccine, and thus provide an estimate of their highest possible number.

Infection acquired abroad. Poliomyelitis is considered to have been acquired

Table 1. *Numbers of cases of poliomyelitis in England and Wales reported to the P.H.L.S., 1962–75. Infection acquired in the U.K.*

Year	Paralytic	Non-paralytic	Year	Paralytic	Non-paralytic
1962	201	35	1969	7	4
1963	44	10	1970	4	3
1964	32	8	1971	5	13
1965	36	26	1972	4	10
1966	19	23	1973	6	7
1967	16	13	1974	2	3
1968	20	17	1975	3	4
			1969–75	31	44

outside the United Kingdom (U.K.) if the illness started either when the patient was abroad, or if the onset of illness occurred within 4 days, or paralysis within 6 days, of arrival in the U.K. In addition, the patient is required to have been outside the U.K. for more than 28 days in order to exclude patients who may have acquired the disease in the U.K. and only incubated it while abroad. It is possible that these criteria may result in the exclusion from this category of some infections acquired abroad, e.g. patients who were abroad for less than 28 days, but only two such cases were reported in the 7-year period. Patients whose infection may have been acquired abroad are excluded from the analysis and from the tables; they are, however, considered under a separate heading in the Results section.

RESULTS

Incidence

A marked fall has occurred in the numbers of cases of poliomyelitis recorded since 1962, when OPV came into routine use (Table 1). Both paralytic and non-paralytic poliomyelitis were rare diseases in England and Wales in 1969–75 – only 31 paralytic and 44 non-paralytic cases acquired in the U.K. were recognized in the 7-year period.

Age and sex

Both paralytic and non-paralytic poliomyelitis were most common under the age of 15 years, and the age incidence was highest in the first year of life (Table 2).

There was no difference in the sex distribution of the paralytic cases, and no significant difference in that of the non-paralytic cases.

Season and geographic area

A tendency was evident for paralytic poliomyelitis to be most prevalent in the late summer; the seasonal distribution of the 31 cases was: January–March 6; April–June 6; July–September 14; October–December 5.

Of the 31 cases of paralytic poliomyelitis, 13 were from the South-Eastern region of England (Table 3), but it can be seen that when expressed in relation to the size of the population at risk this did not represent a marked excess. Only two cases of paralytic disease were reported from the combined Midlands regions and only

Table 2. *Age and sex distribution and vaccine association of poliomyelitis. Infection acquired in the U.K.*

	Vaccine association	Age in years <1	1–4	5–14	15–24	25+	M	F	Total
Paralytic poliomyelitis	No	1	5	9	3	3	11	10	21
	Yes–Recipient	2	—	1	—	—	1	2	3
	Contact	1	—	1	—	5	3	4	7
	Total	4	5	11	3	8	15	16	31
Non-paralytic poliomyelitis	No	7	2	15	3	5	19	13	32
	Yes–Recipient	10	1	—	—	—	7	4	11
	Contact	—	—	—	1	—	—	1	1
	Total	17	3	15	4	5	26	18	44
Estimated rate per annum/million at risk*	Paralytic	0·8	0·2	0·2	0·1	0·04	0·1	0·1	0·1
	Non-paralytic	3·2	0·1	0·3	0·1	0·03	0·2	0·1	0·1

M = male; F = female.
* Population at risk estimated from the 1972 Census.

Table 3. *Distribution of paralytic poliomyelitis by region, 1969–75. Infection acquired in the U.K.*

Region	1969	1970	1971	1972	1973	1974	1975	Total	No./million population/year
North	1	0	0	1	0	0	0	2	0·01
Yorkshire, Humberside	0	0	0	0	3	0	1	4	0·11
N. West	1	2	2	0	0	0	1	6	0·13
E. Midlands	0	0	0	0	0	1	0	1	0·04
W. Midlands	1	0	0	0	0	0	0	1	0·03
E. Anglia	1	0	0	0	0	1	0	2	0·16
S. East	3	2	3	3	2	0	0	13	0·11
S. West	0	0	0	0	1	0	0	1	0·03
Wales	0	0	0	0	0	0	1	1	0·06
Total	7	4	5	4	6	2	3	31	0·09

1 each from the South-West and Wales. There was no clustering of the cases, apart from a small outbreak in Sheffield in 1973, and an episode in South Wales in 1975 (see below).

Poliovirus types associated with paralytic and non-paralytic illness

Nineteen strains of poliovirus were isolated from the 31 paralytic cases and 50 strains from the 44 non-paralytic cases (Table 4). No particular serotype predominated among the paralytic cases, although type 1 was less common than types 2 and 3 among the non-paralytic cases.

Table 4. *Virus isolations from paralytic and non-paralytic poliomyelitis. Infection acquired in the U.K.*, 1969–75

Virus type	No. of viruses of the specific type(s) isolated from: Paralytic poliomyelitis (31 cases)	No. of viruses of the specific type(s) isolated from: Non-paralytic poliomyelitis (44 cases)
1	6	8
2	8	14
3	5	16
1+2	0	4
2+3	0	2

Recipient vaccine-associated poliomyelitis

Paralytic illness

Of the 31 paralytic cases reported in 1969–75, three were in patients who had been given OPV between 4 and 30 days before the onset of illness (Table 2); it is therefore possible that the vaccine was responsible for their paralysis.

The first case, in 1971, was that of a 5-month-old baby girl who developed paralysis of the left arm 15 days after her first dose of OPV. Triple diphtheria/tetanus/pertussis vaccine had also been give at the same time by injection into the left arm. A type 3 virus was isolated from the faeces; its r.c.t. marker test properties were not vaccine-like. Moderate paralysis of the left arm and right leg were still present 3 months after onset of the illness.

The second patient was a 7-year-old girl who had three doses of OPV in infancy and a fourth dose as a booster 11 days before she became ill in September 1973 with paralysis affecting one leg. No virus was isolated from the faeces, but only a single sample was collected 8 weeks after the onset of the illness. Sera taken 3 and $4\frac{1}{2}$ weeks after the onset of illness had the same neutralizing antibody titre of 4096 to type 1 poliovirus, and falling titres to types 2 and 3 (512 to 64, and 128 to 64 respectively). Mild residual paralysis remained 4 months after onset.

The third patient, a 5-month-old boy, developed severe paralysis affecting his arms, legs and respiratory muscles 8 days after his first dose of OPV in 1975. A type 1 poliovirus was isolated from his faeces; it resembled a vaccine strain on r.c.t. marker testing. Three months after onset this baby had residual paralysis affecting the arms and legs.

Non-paralytic illness

Of the 44 patients with an illness categorized as non-paralytic poliomyelitis, 11 had recently received OPV. From 8 of these patients, 14 polioviruses were isolated, and r.c.t. marker tests were done on 10 of these strains; none resembled wild virus (Table 5). In three patients the virus was type 3 and showed

Table 5. *Typing and marker test results on poliovirus strains from paralytic and non-paralytic cases, 1969–75. Infection acquired in the U.K.*

Strains from vaccine-associated cases		Paralytic				Non-paralytic			
		Type				Type			
		1	2	3	Total	1	2	3	Total
Recipient									
Marker test results	Wild	—	—	—	—	—	—	—	—
	Inter.	—	—	1	1	—	—	3	3
	Vacc.	1	—	—	1	3	4	—	7
	NT	—	—	—	—	1	3	—	4
	Total	1	—	1	2	4	7	3	14
Contact									
Marker test results	Wild	1	—	—	1	—	—	—	—
	Inter.	—	—	—	—	—	—	—	—
	Vacc.	—	4	1	5	—	—	1	1
	NT	—	—	—	—	—	—	—	—
	Total	1	4	1	6	—	—	1	1
Strains from non-vaccine associated cases									
Marker test results	Wild	2	—	1	3	3	—	2	5
	Inter.	—	—	—	—	—	—	—	—
	Vacc.	1	3	2	6	2	7	7	16
	NT	1	1	—	2	3	7	4	14
	Total	4	4	3	11	8	14	13	35
Total strains, all cases		6	8	5	19	12	21	17	50

Note: when two types of virus were isolated both are shown in the Table.
Inter. = intermediate; Vacc. = vaccine-like; NT = not tested.

r.c.t. marker characteristics intermediate between wild and vaccine-like strains. From two cases type 1 and type 2 viruses were isolated, all with vaccine-like characteristics. The remaining isolates, two type 2 and one type 1, were also vaccine-like. In none of these cases were the batches of poliovaccine identical, nor were they the same as those used to vaccinate the three paralytic cases referred to above.

Contact vaccine-associated poliomyelitis

Paralytic illness

Of the 31 paralytic cases 7 (23%) were in patients who had been in contact with a recently vaccinated person. Five of the 7 were parents, 3 mothers and 2 fathers, whose children had recently been vaccinated. From six of the cases a poliovirus was isolated. One was a type 1 strain which had the r.c.t. marker test

Table 6. *Vaccine-associated paralytic poliomyelitis in England and Wales in relation to doses of vaccine distributed and to doses given*

	1962–4	1965–8	1969–75
Doses of vaccine (millions)*			
Distributed	18	26	29
Given	12·6	12·7	18·8
No. of vaccine-associated cases			
Recipient	20	11	3
Contact	11	14	7
Rate per million doses of vaccine distributed			
Recipient	1·1	0·4	0·1
Contact	0·6	0·5	0·2
Rate per million doses of vaccine given			
Recipient	1·6	0·9	0·2
Contact	0·9	1·1	0·4

* Approximate figures.

characteristics of a wild virus. The remaining strains, four type 2 and one type 3, all resembled vaccine strains.

Non-paralytic illness

Only one of the non-paralytic cases is known to have been in contact with a recent recipient of OPV and from this patient a type 3 poliovirus was isolated with r.c.t. marker test characteristics of a vaccine strain.

Changing rate of vaccine-associated poliomyelitis

The rate of recipient vaccine-associated cases in 1969–75 was 0·1 per million doses of vaccine distributed, which may be compared with 1·1 in 1962–4 (Table 6). The rate for contact vaccine-associated cases, on the other hand, has shown less change: 0·6 per million doses of vaccine distributed for the period 1962–4 and 0·2 in 1969–75. The number of doses of vaccine actually given is less certain than the number distributed, but based on the reported figures of immunizations given, there was one case of paralysis in recipients for every 5 million doses of vaccine given and about 2 cases in contacts in 1969–75.

Age and vaccine association

Patients in whom paralytic poliomyelitis was vaccine-associated had a different age distribution from those in whom there was no evidence of vaccine association. Of 320 cases recorded since 1962 that were not vaccine-associated and in whom the age is known, the ratio of the number of patients 15 years and under to those over 15 years is 2.3/1·0. The corresponding ratio for recipient vaccine-associated cases is 4·3/1·0, but for the contact vaccine-associated cases the ratio is 0·6/1·0 (Table 7).

Poliovirus isolations and their marker characteristics

Of 555 isolations of poliovirus reported in 1969–75, there were 506 (91 %) from symptomless excreters (Table 8). These isolations were fairly equally distributed between the three virus types.

Table 7. *Age distribution of cases of paralytic poliomyelitis*, 1962–7

Age group	Vaccine-associated		Non-vaccine-associated
	Recipient	Contact	
<1	14 (1·30)*	2 (0·19)	21 (0·19)
1–5	10 (0·24)	7 (0·16)	130 (3·00)
6–10	2 (0·04)	2 (0·04)	53 (1·00)
11–15	0 (0)	0 (0)	20 (0·40)
16–20	1 (0·02)	1 (0·02)	19 (0·27)
⩾21	5 (0·01)	18 (0·04)	77 (0·16)

* Figures in parentheses are the average annual rate per million of population.

Table 8. *Marker test results on poliovirus isolates, England and Wales 1969–75 inclusive*

Marker test characteristic	Number of isolates from: Paralytic poliomyelitis, by virus type				Non-paralytic poliomyelitis, by virus type				Excreters, by virus type				
	1	2	3	Total	1	2	3	Total	1	2	3	Total	Total
Wild	3	—	1	4	3	—	2	5	9	8	22	39	48
Intermediate	—	—	1	1	—	—	3	3	2	4	17	23	27
Vaccine-like	2	7	3	12	5	11	8	24	152	168	124	444	480
Total	5	7	5	17	8	11	13	32	163	180	163	506	555

Table 9. *Number of cases with specified vaccination history, excluding vaccine-associated cases*

Fully vaccinated*	Paralytic	Non-paralytic
IPV only	5	1
IPV + OPV	0	2
OPV only	3	8
Incomplete vaccination†	5	8
Not vaccinated	8	10
Not known	0	3

* Fully vaccinated: three or more spaced doses of vaccine.
† Incomplete vaccination: less than three doses of vaccine.

Forty-eight (8·6 %) of the strains isolated had the r.c.t. marker test characteristics of a wild virus; 39 of these were from symptomless excreters, 22 of them (56 %) being type 3. However, the wild virus strains isolated from cases were mainly type 1 (Table 8).

Twenty-seven (4·9 %) of the strains were intermediate in their r.c.t. marker test characteristics between wild and vaccine-like strains, and again type 3 predominated (21/27 = 78 %).

The remaining strains (87 %) were vaccine-like and the numbers were fairly evenly distributed between the types. All the type 2 strains from cases of paralytic poliomyelitis were vaccine-like.

Outcome of paralytic poliomyelitis cases

Of the 31 patients with paralytic poliomyelitis one died, and in 6 the residual paralysis was classed as severe. A poliovirus was isolated from 6 of the 7 severe cases. R.c.t. marker tests were done on 5 of the 6 strains and 2 were wild type 1, but 3 proved to resemble vaccine virus – two type 2 and one type 3.

Vaccination history

The vaccination history could be established from records held by family doctors or health departments in 21 of the paralytic and 32 of the non-paralytic cases (excluding vaccine-associated cases). Eight of the 21 paralytic and 10 of the non-paralytic illnesses developed in non-vaccinated patients (Table 9). However 8 of the paralytic patients had received three doses of vaccine, 5 with IPV and 3 with OPV. Of the 29 non-paralytic patients 11 had been fully vaccinated, 1 with IPV, 2 with IPV and OPV, and 8 with OPV.

Other neurological illness

From time to time reports are received of the isolation of a strain of poliovirus from a patient with a neurological illness other than typical motor paralysis or possible non-paralytic poliomyelitis. Twenty-eight such cases were reported in 1969–75; in most a correct diagnosis became clear during the course of the patient's illness. The cases included 1 of Guillain-Barré syndrome, 7 of polyneuritis, and 9 of transient paresis – of which 3 were in children and 1 in an adult recently vaccinated with OPV. There was however no evidence that either vaccine-like or wild strains of poliovirus were responsible for neurological disease other than paralytic or non-paralytic poliomyelitis.

Infection acquired abroad

Eleven cases of paralytic poliomyelitis were reported in the period 1969–75 which could be classified as infection acquired abroad. The cases originated from: Indian subcontinent (4); Africa (3); Europe (2); Asia (1); North America (U.S.A.) (1).

The cases were all in unvaccinated or only partially-vaccinated persons. One of the cases was thought to be vaccine-associated. This patient was a 2-month-old baby boy with *spina bifida*, who went on holiday with his parents to Germany and became ill with flaccid paralysis of the left leg. The child was in contact with another child who had received OPV a few days previously.

Marker tests were carried out on only 5 strains of poliovirus from these patients; 2 were wild strains, both type 1. The other three were vaccine-like, one of these being from an adult who had visited Yugoslavia, and 2 from children who had apparently been infected in India.

Outbreaks

In 1973 two cases of paralytic and two of possible non-paralytic poliomyelitis were reported from a large housing estate in Sheffield. In addition a further case was reported later in the year from Chesterfield, a town 10 miles from Sheffield. The sequence of events appears to have been that a wild virus, type 1, was

isolated from an unvaccinated 2-year-old child who had become ill on 24 July with irritability, slight neck stiffness and a suggestion of a facial weakness; the final diagnosis was 'possible non-paralytic poliomyelitis'. Four days later the half-brother of the patient developed aseptic meningitis; no virus was isolated. The two paralytic cases occurred in the same area, the first 2 days later on 30 July in a 3-year-old boy, and the second in a 9-month-old baby on 18 August. A wild type 1 virus was isolated from faecal specimens in both cases. The second case had received two doses of OPV earlier in the year. The Chesterfield cases, which could not be associated directly or indirectly with the Sheffield cases, occurred in October; no virus was isolated, but there was no doubt about the clinical diagnosis of paralytic poliomyelitis.

In 1975 one paralytic and three possible non-paralytic poliomyelitis cases occurred in Wales. The first patient to be affected was an unvaccinated baby who developed paralytic poliomyelitis whilst on holiday, in late July, on a caravan site in New Quay, Dyfed. A girl of 9 years, who had spent a holiday on an adjacent caravan site, developed non-paralytic poliomyelitis just over 2 weeks later. Wild type 3 poliovirus was isolated from both patients. No association could be traced between the two cases, apart from the close proximity of the caravan sites at which they had stayed. The two cases led to widespread use, and demand for, poliovaccine in South Wales, particularly among families who had visited New Quay. Two children in the county of Gwent became ill in September and both were diagnosed as having aseptic meningitis; from both these children a vaccine-like poliovirus type 3 was isolated, and neither had had contact with the first two patients or had themselves recently received OPV.

DISCUSSION

The small annual number of cases of paralytic poliomyelitis recorded in the period under review, 1969–75, is evidence of the effectiveness of the vaccination campaign up to 1975. The rate of acceptance of poliovaccine among infants was about 85% during the period of study, but the rate is believed to have fallen since 1975, probably owing to public doubts about vaccination procedures associated with the current controversy on the side-effects attributed to pertussis vaccine. A low acceptance rate should cause concern since unvaccinated people in England and Wales evidently have a small but definite risk of infection. Of the 21 paralytic cases recorded in 1969–75, in which the illness was not associated with recent vaccination, there were 8 who were unvaccinated and 5 who had not received three doses of vaccine. Although the r.c.t. marker test must be an unreliable guide to human virulence, 48 of 555 (8·6%) of the poliovirus strains examined by this test in 1969–75 resembled wild virus. Most of these wild-type strains came from symptomless excreters, and only 4 were from cases of paralytic poliomyelitis, but the observation indicates that viruses indistinguishable from wild strains are by no means uncommon in the population, whether they are natural wild viruses or strains of vaccine origin that have reverted to virulence. If the acceptance rate of poliovaccine falls there is a danger that the number of cases will increase.

A risk of becoming ill with paralytic poliomyelitis is not confined to the

unvaccinated. Eight of the 21 non-vaccine-associated paralytic cases recorded in 1969–75 were in patients with a past history of having had three spaced doses of vaccine – 5 with IPV, in each case more than 8 years previously, and 3 with OPV, at 8, 4, and 1 year before. The absence of detectable serum antibody in a proportion of those who have previously only had IPV has been recorded in a study among police cadets from different parts of the United Kingdom, and antibodies to one or other poliovirus type may also sometimes be lacking in people who have received three doses of OPV (Smith *et al.* 1976). Such observations support the view that the poliomyelitis vaccination campaign should not be confined to infants – indeed booster doses at school-entry and school-leaving are recommended by the Department of Health and Social Security (D.H.S.S., 1972). The justification for such a recommendation is supported by the observation that 11 of the 31 cases (35 %) of paralytic illness recorded in 1969–75 were in persons over 15 years of age (Table 2), and in the period 1962–75, 96 of the 320 cases (30 %) were in this age group (Table 7). There is however a need to establish the best vaccination recommendation for reinforcing immunity, since a single dose of OPV is not always reliable in boosting serum antibody (Smith, *et al.* 1976).

Poliovaccine has proved remarkably safe and the incidence of paralytic illness in recipients of the vaccine, or their contacts, has been very small. In the period 1969–75 the rate was 0·2 per million doses of vaccine given in recipients of OPV and 0·4 per million doses given in contacts of vaccinated persons. The true risk in recipients may be lower; one of the three cases that occurred in the 1969–75 period (case 2) may not have been true poliomyelitis since there was a good vaccination history and no virus was isolated from the patient's faeces. The diagnosis in the contact cases was in each case reasonably certain, although one of the seven cases may have been due to natural infection with a wild type virus that was circulating in the area at the time. However, estimates of the risk from vaccination, as indicated by rates of vaccine-associated poliomyelitis, must be accepted as liable to be falsely high because the association will be coincidental in some cases, although it must also be accepted that other cases may not have been reported. The rates indicated here are not dissimilar from those recorded in a recent WHO collaborative study (Report, 1976) which included the cases reported here of persistent spinal paralysis. The WHO survey recorded that in six countries with a low rate of vaccine-associated poliomyelitis, there were 0·129 recipient cases per million doses of vaccine distributed or administered, and 0·195 cases in contacts and possible contacts of vaccinees per million doses of vaccine distributed. The WHO survey recorded that type 3 poliovirus was the type most commonly associated with recipient cases and type 2 with contacts. There were only two typed strains isolated of virus from recipient vaccine-associated cases in England and Wales in 1969–75, one was type 1 and the other was type 3, but there were six strains isolated from contacts, of which four were type 2. The age distribution of the cases of paralytic poliomyelitis was also similar to that recorded in the WHO study, approximately half the cases reported in 1962–75 being in children under 6 years of age. The age distribution of the vaccine-associated cases was also similar, only 19 % of recipient cases recorded since 1962 being over 15 years of age, compared with 63 % of

contact cases. The small risk of poliomyelitis that exists in contacts of vaccinated persons is most evident in adults. The reason for this is uncertain. A greater proportion of adults than children may be unimmunized or have lost their immunity, or possibly adults are more susceptible to paralysis from vaccine viruses (Henderson, Witte, Morris & Langmuir, 1964).

The rate of vaccine-associated poliomyelitis in relation to the number of doses of vaccine given has fallen in recipients from 1·6 per million in 1962–4 to 0·2 in 1969–75 (Table 6). A fall has also been observed in the U.S.A. (Schonberger, McGowan & Gregg, 1976). The reasons for this change are uncertain. Vaccines may have become safer, although there appears to be no other evidence to support such a view. Another possibility is that vaccine is now less commonly given to adults than when OPV was first introduced with widespread vaccination campaigns. If children are less susceptible than adults to acquiring poliomyelitis from vaccination, the falling rate could be accounted for.

Poliomyelitis is still common in some developing countries, so that travellers to such countries might be considered to be at a greater risk of infection from wild polioviruses. In addition to the 31 cases of paralytic disease recorded in 1969–75 originating in the United Kingdom, there were a further 11 which could be classified as acquired abroad.

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