ANNUAL POLIOMYELITIS SUMMARY - 1971

March 1973

CENTER FOR DISEASE CONTROL

NEUROTROPIC DISEASES

SURVEILLANCE

POLIOMYELITIS

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U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
HEALTH SERVICES AND MENTAL HEALTH ADMINISTRATION

PREFACE

Summarized in this report is information received from state health departments, university investigators, virology laboratories, and other pertinent sources, domestic and foreign. Much of the information is preliminary. It is intended primarily for the use of those with responsibility for disease control activities. Anyone desiring to quote this report should contact the original investigator for confirmation and interpretation.

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*Until June 1971
**Until June 1972

I. SUMMARY

Seventeen cases of paralytic poliomyelitis, with 2 deaths, were reported in the United States in 1971. This is the lowest annual total reported to the Center for Disease Control (CDC) since poliomyelitis surveillance was initiated in 1955. The cases were scattered among 12 states. California and Texas with 3 cases each, and Montana with 2 cases, were the only states to report more than 1 case. Over half (53%) of the cases were in adults and 47% were in pre-school age children. The 3 types of poliovirus were implicated with paralytic disease with almost equal frequency. One case was "recipient vaccine-associated"; 8 cases were "contact vaccine-associated." Eight is the highest annual number of such cases reported to CDC since live, attenuated oral poliovirus vaccines became widely used in 1962. None of the persons who contracted paralytic polio in 1971 gave a history of receiving adequate polio vaccinations.

In relation to total doses of oral poliovirus vaccine (OPV) distributed in the United States, there has been a statistically significant decrease in the rate of "vaccine-associated" paralytic poliomyelitis after 1964 for vaccine recipients $p<.0001$ and a statistically significant increase in this rate after 1964 for contacts of vaccine recipients, $p<.0001$. A theory is offered to explain this data in terms of the general curtailing of routine immunization for adults after 1964, a shift in emphasis from mass immunization campaigns and community-wide programs to routine immunization of infants, and a switch from monovalent to trivalent OPV.

The 1971 National Immunization Survey showed a leveling off of the downward trend in the percent of pre-school children who received at least 3 doses of oral poliovirus vaccine or at least 3 doses of inactivated poliovaccine. Nevertheless, 45.7% of the 1-4 year-olds in the poverty areas of United States Central Cities with populations greater than 250,000 did not receive as many as 3 doses of either type of poliovaccine and 14.0% received no poliovaccine.

II. EPIDEMIOLOGY OF POLIOMYELITIS IN 1971

This 17th annual report of poliomyelitis surveillance, published by the Neurotropic Diseases Unit, CDC, summarizes selected epidemiologic and laboratory characteristics of the reported cases of poliomyelitis for 1971. These data are based upon official reports from the states to the Epidemiology Program, CDC.

A. Total Disease Associated with Poliomyelitis, 1971

1. Paralytic Disease. In 1971, the "best available paralytic poliomyelitis case count" was 17 cases. This designation, utilized since 1958 as the best available representation of the number of cases of paralytic illness of poliovirus etiology, includes those clinically and epidemiologically compatible cases known to have residual paralysis at 60 days, plus those cases reported initially as paralytic poliomyelitis, for which no 60-day report on residual paralysis was available. Limitation of the summary count to those cases with proved residual paralysis permits exclusion of cases with more transient weakness possibly due to echovirus, Coxsackie virus, or other viruses, although not proven as such. All 17 paralytic cases in 1971 have pathologic and/or virologic supporting evidence for the diagnosis of poliomyelitis. Follow-up reports from 1 to 11 months after onset of illness were submitted for 13 of the 15 surviving cases. All these reports indicated residual paralysis.

2. Non-Paralytic Disease. No official non-paralytic poliomyelitis case reports were received from the states in 1971, although laboratory isolations of poliovirus from persons with varying illnesses, including encephalitis and aseptic meningitis were reported by several laboratories (see Table 13).

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B. Epidemiology of Paralytic Cases, 1971

1. Characteristics of the Cases. The total number of cases included in the "best available paralytic poliomyelitis case count" has declined since this number was first tabulated in 1958 (Figure 1). The 17 cases reported for 1971 represents the lowest annual total reported to CDC since initiation of surveillance in 1955. In 1971 cases occurred throughout the year, with a plurality of 5 occurring in June (Figure 2). The classic summer-fall peak, last observed in the early 1960s (Figure 3), has not persisted.

Fig. 1 "BEST AVAILABLE PARALYTIC POLIOMYELITIS CASE COUNT," BY YEAR, UNITED STATES, 1958-1971

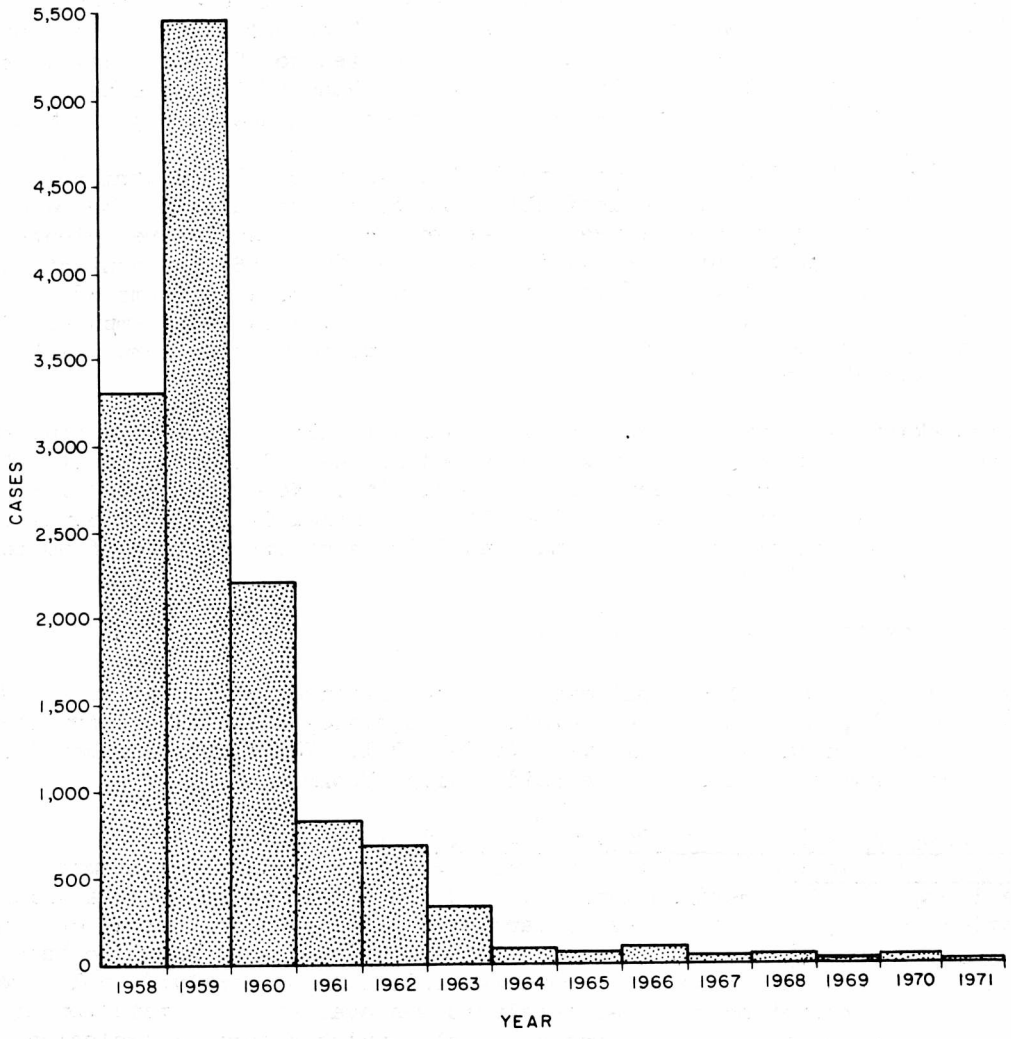


Fig. 2 PARALYTIC POLIOMYELITIS, BY ONSET, U.S.A., 1971

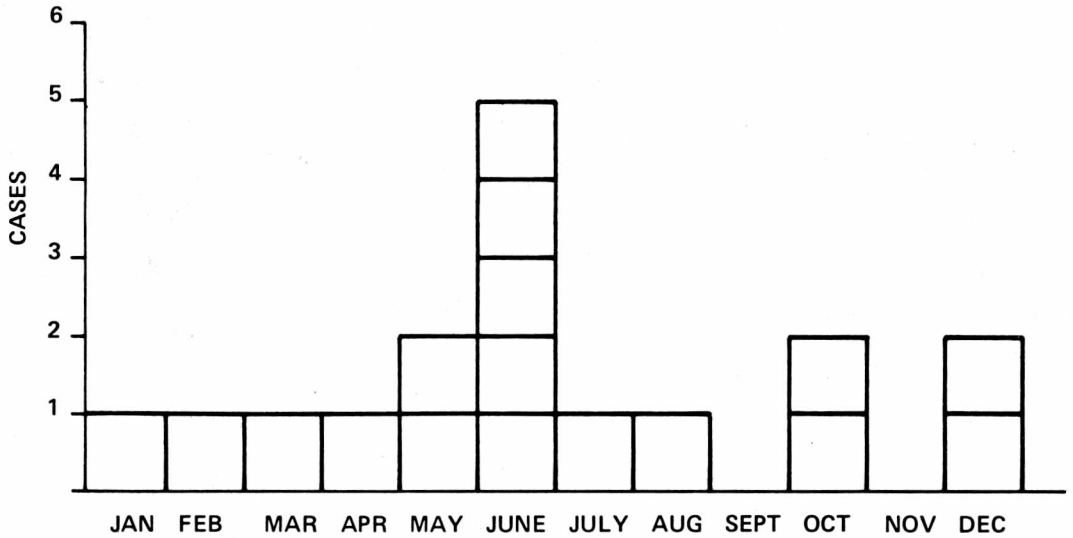
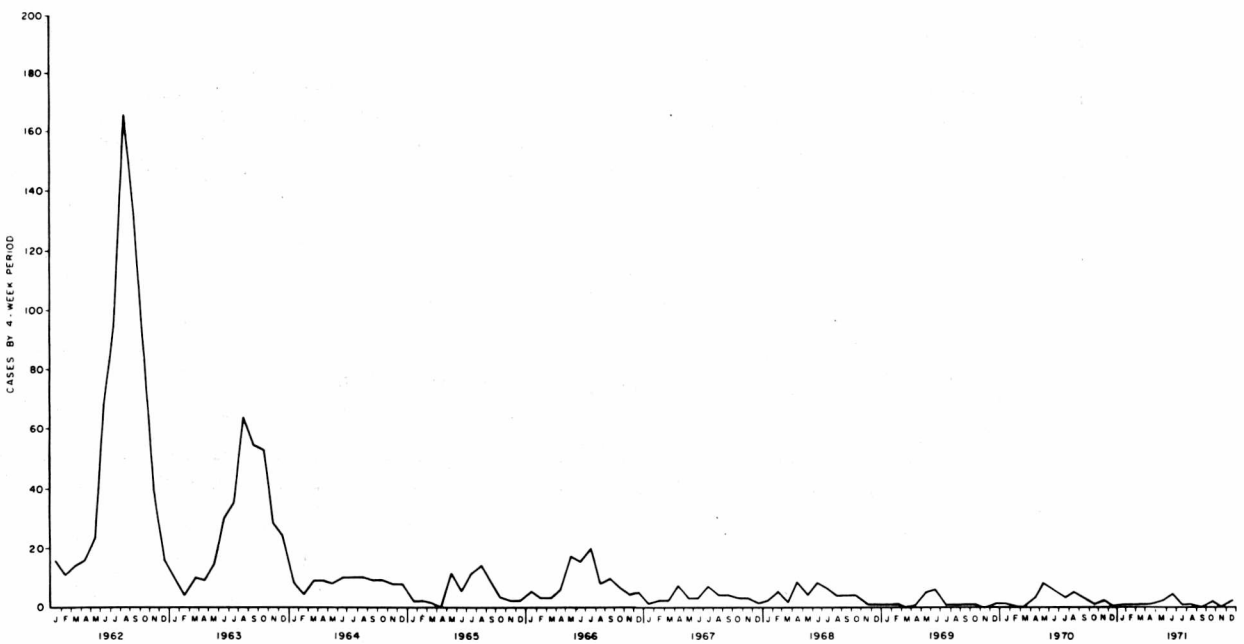
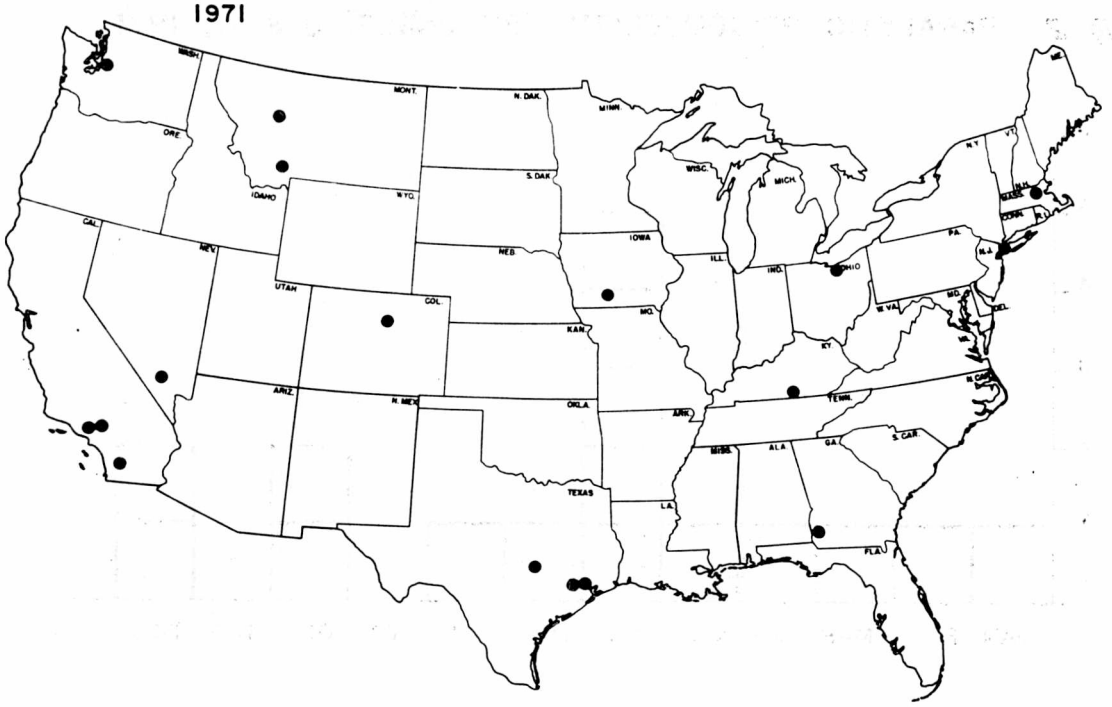


Fig. 3 PARALYTIC POLIOMYELITIS CASES, BY MONTH OF ONSET, UNITED STATES, 1962-1971



Geographic distribution of cases by county of residence (Figure 4) shows that unlike previous years, there was no large cluster of cases in any one section of the country in 1971. Cases were scattered among 12 states. California and Texas with 3 cases each and Montana with 2 cases, were the only states reporting more than 1 case.

Fig. 4 **PARALYTIC POLIOMYELITIS CASES, BY COUNTY OF RESIDENCE, U.S.A., 1971**



Residual paralysis in the cases parallels that reported for the past 3 years, despite the variable time of follow-up in 1971 (Table 1). Comparison of age distribution for the past 10 years is presented in Table 2. In 1971, over half (53%) of the cases were in adults and 47% were in pre-school age children.

Three cases were temporally related to travel outside the United States. The Massachusetts case occurred in a woman who had recently visited Quebec, Canada, a non-endemic area. The Cameron County, Texas case and the Nevada case occurred in persons who had recently traveled to Mexico, an endemic area; both cases were due to type 1 poliovirus.

Table 1

PARALYTIC POLIOMYELITIS
BY STATUS OF RESIDUAL PARALYSIS AT 60 DAYS,* 1968-71

Status	1968		1969		1970		1971	
	Cases	%	Cases	%	Cases	%	Cases	%
Death	5	10	0	0	2	6	2	12
Severe residual	8	17	4	22	1	3	2	12
Significant residual	18	38	11	58	21	66	9	53
Minor residual	10	21	3	15	3	10	2	12
Unknown	7	14	1	5	6	15	2	12
Total	48	100	19	100	33	100	17	101

* In 1971, status of residual paralysis is based on 1 to 11 month follow-up reports

Table 2

PARALYTIC POLIOMYELITIS CASES, BY AGE GROUP, 1962-71

	1962		1963		1964		1965		1966		1967		1968		1969		1970		1971	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
0-4	338	49	165	49	38	42	31	51	79	77	25	61	31	65	9	46	30	91	8	47
5-9	139	20	60	18	16	17	10	16	10	10	2	5	3	6	2	11	2	6	0	-
10-14	70	10	38	11	7	8	7	11	3	3	0	-	4	9	1	5	0	-	0	-
15-19	26	4	15	4	8	9	2	3	1	1	1	2	1	2	4	22	0	-	0	-
20-29	52	8	24	7	7	4	4	7	3	3	4	10	4	8	0	-	0	-	3	18
30-39	36	5	18	5	7	8	3	5	5	5	7	17	2	4	2	11	0	-	5	29
40+	22	3	8	2	11	12	4	7	1	1	2	5	3	6	1	5	1	3	1	6
Unkn.	8	1	8	2	0	-	0	-	0	-	0	-	0	-	0	-	0	-	0	-
TOTAL	691		336		91		61		102		41		48		19		33		17	100

2. "Type Specific Etiology" of Poliovirus Associated with 1971 Paralytic Cases. The basis for establishing a type specific etiology for the 1971 paralytic cases is summarized in Table 3. Of the 17 cases, 6 were confirmed by both viral isolation and diagnostic (4 fold) rise or fall in serotype-specific antibody titer. In 2 cases, the type specific etiology was indicated by serology alone. Although the presence of an enterovirus in the alimentary tract does not constitute proof of an etiologic role, isolation of poliovirus from throat washings or stool specimens in the context of compatible illness and absence of evidence for another etiology has been accepted by the respective states as adequate documentation of etiology, and is included in this summary as the probable agent.

Table 3

PARALYTIC POLIOMYELITIS
BY DESIGNATION OF "ETIOLOGIC" POLIOVIRUS TYPE, 1971

	Poliovirus Type 1	Poliovirus Type 2	Poliovirus Type 3	Unknown	Total
Viral isolation and diagnostic serology	1	2	3	0	6
Serology as only laboratory confirmation	0	2*	0	0	2
Viral isolation as only laboratory support	4	2	2	0	8
Diagnosis made on clinical and epidemiological basis only--no evaluation of etiology possible	0	0	0	1	1
Total	5	6	5	1	17

*Includes 1 patient with residual paralysis at 3 months and a detectable convalescent titer to only type 2 poliovirus

Thus, 8 cases were designated as to type on the basis of viral isolation only. In 1 instance, the diagnosis of paralytic poliomyelitis was based on clinical and pathologic criteria alone. Comparison of "etiologic" poliovirus types for 1966-1971 (the only years in which this method of definition has been used) shows that type 1 poliovirus comprises a smaller percentage of all cases in 1971 than was true for the preceding 5 years (Table 4).

Table 4

PARALYTIC POLIOMYELITIS CASES
BY "ETIOLOGIC" POLIOVIRUS TYPES, 1966-71

	Type 1		Type 2		Type 3		Unknown		Total Cases
	No.	%	No.	%	No.	%	No.	%	
1966	60	59	13	13	6	6	23	22	102
1967	18	44	8	19	7	18	8	19	41
1968	27	56	7	15	4	8	10	21	48
1969	6	32	5	26	4	21	4	21	19
1970	28	85	4	12	1	3	0	0	33
1971	5	29	6	35	5	29	1	6	17

Tabulation of the 17 paralytic cases by age group and "etiologic" virus type (Table 5) shows no significant difference in age distribution of persons with each poliovirus type.

Table 5

PARALYTIC POLIOMYELITIS CASES
BY AGE GROUP AND "ETIOLOGIC" POLIOVIRUS TYPE, 1971

Age Group	Poliovirus Type 1	2	3	Unknown	Total
0-4	2	2	4	0	8
5-19	0	0	0	0	0
20-29	1	2	0	0	3
30-39	2	2	1	0	5
40+	0	0	0	1	1

3. Viral Isolations Associated with 1971 Paralytic Poliomyelitis Cases. The number of cases in which viral isolations were attempted and the number in which isolation attempts were successful for the period 1961-1971 appear in Table 6. Samples for viral isolation were obtained in a higher percentage of cases in 1970 and in 1971 than in each of the previous 9 years. This probably reflects a continuing increased utilization of laboratory testing to confirm clinical impressions.

Table 6

PARALYTIC POLIOMYELITIS
BY NUMBER OF SPECIMENS SUBMITTED AND RESULTS
OF VIRUS ISOLATION ATTEMPTS BY YEAR, 1961-1971

	Best Available Paralytic Case Count	Cases with Specimens Submitted for Isolation No.	%	Cases With Poliovirus Isolated No.	% of Cases	% of Specimens Submitted in Which Isolation Successful
1961	829	481	58.0	382	46.1	79%
1962	691	472	68.3	408	59.0	86%
1963	336	242	72.0	197	58.6	81%
1964	91	77	84.6	51	56.0	66%
1965	61	50	81.9	38	62.3	76%
1966	103	82	79.6	74	71.8	90%
1967	40	31	77.5	29	72.5	93%
1968	48	39	81.2	35	72.9	90%
1969	19	16	84.2	14	73.7	88%
1970	33	33	100	31	93.9	94%
1971	17	15	88.2	14	82.4	93%

For 1971, 14 stool specimens submitted from 15 cases were positive for poliovirus. Four cases also had positive throat cultures and poliovirus was isolated from the spinal cord of 1 fatal case. A comparison of the frequency of isolation of each poliovirus type from the annual total of paralytic cases is shown in Table 7 for the years 1961-1971. In 1971, as only seen before in 1969, the 3 types of virus were isolated from paralytic cases with almost equal frequency.

Table 7

PARALYTIC POLIOMYELITIS CASES
BY TYPE OF POLIOVIRUS ISOLATED
AND PERCENTAGE OF TOTAL CASES BY YEAR, 1961-1971

Year	Type	Number of Isolates				Percentage		
		1	2	3	Unknown	1	2	3
1961		231	6	145	0	60.5	1.6	37.9
1962		300	8	100	0	73.5	2.0	24.5
1963		160	6	31	0	81.2	3.0	15.7
1964		21	6	24	0	41.1	11.8	47.0
1965		19	8	11	1	50.0	21.1	28.9
1966		55	13	6	1	74.3	17.6	8.1
1967		16	6	7	0	55.2	20.7	24.1
1968		25	7	3	0	71.4	20.0	8.6
1969		5	5	4	0	34.6	34.6	30.8
1970		26	4	1	0	83.9	12.9	3.2
1971		5	4	5	0	35.7	28.6	35.7

C. Association of Immunization with Paralytic Poliomyelitis

1. Paralytic Poliomyelitis in Recent Vaccine Recipients. In July 1964 the Surgeon General's Special Advisory Committee on all poliomyelitis vaccine reviewed all cases of paralytic disease consistent with poliomyelitis that had occurred within 30 days following receipt of all oral poliovirus vaccine (OPV). At that time, 57 cases were judged to be compatible with vaccine association by virtue of meeting the following criteria:

a. Onset of illness between 4 and 30 days following feeding of the specific vaccine, plus onset of paralysis not sooner than 6 days after the feeding.

b. Significant residual lower motor neuron paralysis.

c. Laboratory data not inconsistent with respect to multiplication of the vaccine virus fed.

d. No evidence of other motor neuron disease, definite sensory loss, or progression (or recurrence) of paralytic disease 1 month or more after onset.

The cases reported since 1964 have not been formally reviewed by an advisory committee. However, the Neurotropic Diseases Unit continues to use the above criteria to determine whether such a case is consistent with vaccine association, recognizing that such association does not necessarily imply a causal relationship. The cases fulfilling the above criteria are termed recipient vaccine-associated cases. In 1971, the 1st case of this type in 3 years, and the 16th such case for the period July 1964 through December 1971, was reported to CDC. The case was in a 5 month-old boy who received type 1, type 3, and type 2 monovalent oral poliovirus vaccine (MOPV-1, MOPV-3, and MOPV-2) on April 28, May 26, and July 12, 1971, respectively. Sixteen days after oral ingestion of the type 3 vaccine and 4 days after the onset of fever, the boy developed flaccid paralysis of the right arm. Minor residual disability remained at 8

months. Type 3 poliovirus was isolated from a stool specimen collected June 24. The isolate was antigenically vaccine-like and "T"+ at 39.5° centigrade, and "T"± at 40.1° centigrade. (See Section IIIA "Characterization of Poliovirus Isolations".) Sera collected June 24, July 20, and September 28 showed titers to type 3 poliovirus of 1:20, and 1:20 and <1:10, respectively. Though low, these titers were interpreted as consistent with multiplication of the vaccine virus fed.

2. Paralytic Poliomyelitis in Contacts of Recent Vaccine Recipients. In addition to the group noted above, it has been recognized that cases of paralytic illness have also occurred in persons with a history of close relationships to OPV recipients. The working definition of these contact vaccine-associated cases has specified that onset of illness shall have occurred between 4 and 60 days following feeding of the specific vaccine in question to the recipient in contact with the case. In addition, contact of the case with the recipient shall have occurred within 30 days prior to the onset of illness; criteria b, c, and d in the definition of a "recipient vaccine-associated" case also applies. This definition of "contact vaccine-association" does not require isolation of a vaccine-like virus from the case. Nevertheless, of the 26 "contact vaccine associated" cases reported to CDC from 1965 through 1970, isolation of a vaccine-like virus was made from 21 cases. For the other 5, a non-vaccine-like virus (1 case) untested viruses (2 cases) and no virus (2 cases) were identified.

Table 8

Paralytic Disease in Close Contacts of Vaccine Recipients-1971

STATE	AGE	SEX	PRIOR IMMUN	CONTACT		INTERVAL	PT'S	ANTIGENIC & RCT	4-Fold	RES.
				Rel' ship	Vacc. Adm'd.	Admin to Onset	ISOL. TYPE	CHAR.	AB CHANGE	DISABIL.
Cal.	33	M	0	Son	TOPV	24 days	2	Vacc-like T(±)39.5° T(-)40.1°	Yes	Significant
Col.	26	F	1-MOPV	Son & Daughter	TOPV	5 days 7 days	2	Vacc-like T(+)39.5° T(-)40.1°	Yes	Significant
Ga.	4 mos	M	0	playmate	TOPV	35 days	3	Vacc-like T(+)40.1°	Yes	Unknown
Iowa	20	M	0	Daughter	TOPV	19 days	2	Vacc-like T(±)39.5° T(-)40.1°	No	Significant
Ky.	33	M	0	Son	TOPV	26 days	3	Vacc-like T(+)39.5° T(±)40.1°	Yes	Significant
Wash.	36	M	1-IPV	Son	TOPV	27 days	2	Vacc-like T(±)40.1°	Yes	Unknown
Mont.	3	M	0	brother	OPV*	10 days	No Culture		Yes (type 2)	Minor
Mont.	11mos	M	0	playmate	TOPV	23 days	1	Non-Vacc-like T(+)39.5° T(±)40.1°	Not done	Significant

*The OPV type was not reported. However, TOPV comprised 97.2% and 98.2% of the OPV distributed in the United States in 1970 and 1971, respectively

In 1971, 8 "contact vaccine-associated" cases were reported, the highest annual figure reported to CDC since live, attenuated vaccine became widely used in 1962 (Table 8). Five of these cases occurred in parents of children who were receiving routine

oral poliovirus vaccinations. Three cases were in children under 4 years of age who had a playmate or sibling who recently ingested vaccine. Six cases had no prior polio immunization; 1 had 1 IPV and 1 had 1 MOPV. Trivalent oral poliovirus vaccine (TOPV) was the vaccine given to the recipient in the 7 cases where the vaccine type was reported. Since over 97% of the OPV distributed in the United States in 1970 and 1971 was TOPV, it was presumably the vaccine given the recipient in the 8th case as well.

The experience of recipients and their contacts with respect to developing vaccine-associated paralytic disease can be expressed in terms of rates of cases per million doses of vaccine distributed (Table 9). These statistics give a useful basis for comparing trends. Such rates are not so useful for describing the risks to recipients and their contacts because there are no satisfactory estimates of the number of doses actually received and the number of susceptible people who contact vaccine recipients. These rates are given for 1961-4 and 1965-71 because following 1964 there was a general curtailing of routine immunizations for adults as recommended by the Advisory Committee on Immunization Practices, there was a shift in emphasis from mass immunization campaigns and community wide programs to routine immunization of infants, and TOPV became the most widely used oral poliovirus vaccine.

Table 9

RATES OF VACCINE-ASSOCIATED PARALYTIC POLIO IN OPV RECIPIENTS AND THEIR CONTACTS, UNITED STATES, 1961-71

Vaccine	Period	Est. Doses Distributed in Millions	Recipient Cases	Recipient Rate/Million	Contact Cases	Contact Rate/Million
MOPV-1	1961-64	109*	16	0.147	0	0
	1965-71	8.69	1	0.115	2	0.230
MOPV-2	1961-64	104*	2	0.019	0	0
	1965-71	6.89	0	0	2	0.290
MOPV-3	1961-64	105*	39	0.371	3	0.029
	1965-71	7.40	6	0.811	0	0
ALL MOPV	1961-64	318*	57	0.179	3	0.009
	1965-71	23.0	7	0.304	4	0.174
TOPV	1961-64	28.2	5	0.177	0	0
	1965-71	157	4	0.025	28	0.178
ALL OPV	1961-64	346	62	0.179	3	0.009
	1965-71	180	11	0.061	34**	0.189

*Sources of distribution data: State health departments and PHS regional offices prior to June 1962 and the Biologic Surveillance Unit CDC subsequently
**Includes 2 cases for which type of vaccine administered to recipient is unknown

In relation to all OPV, there has been a statistically significant decrease in the rate after 1964 for vaccine recipients, $p<.0001$, and a statistically significant increase in this rate after 1964 for contacts of vaccine recipients, $p<.0001$. A theory to explain the significant increase in the "contact vaccine-associated" cases after 1964 should be consistent with the facts that both before and after January 1, 1965, the rate of "contact vaccine-associated" cases with all MOPV has been similar to the rate of "contact vaccine-associated" cases with TOPV. Further, the theory should be consistent with the fact that the increase in contact cases has been marked for both

children and adults. Accordingly the theory proposed in this report contends that the significant increase in contact cases is due to both the shift in emphasis from mass immunization campaigns to routine immunization of infants, and to a presumed improvement in recognition of contact cases, an improvement which would be facilitated by the reduction in total poliomyelitis cases following the 1961-64 polio immunization campaigns. The shift from mass campaigns would increase the number of susceptibles in contact with each case. During mass campaigns, for instance, many contacts of a given recipient would themselves have received vaccine. This would either protect them from becoming infected with another poliovirus, or if not, and paralysis occurred, would lead to their being classified as "recipient" rather than as "contact vaccine-associated" cases.

The shift to routine immunization of infants has been reflected in progressive increases in the percentage of infants under one year of age who have received at least one dose of OPV. According to the Annual United States Immunization Surveys conducted since 1962 by the Bureau of the Census, the percentage of such infants has steadily risen: 11.0%, 1962; 32.3%, 1964; 36.6%, 1965; 45.0%, 1967; 52.4%, 1969; and 60.2%, 1971. Since there is evidence that children under 2 years of age spread poliovirus to their contacts more readily than older individuals,* the increase in the percentage of infants receiving OPV might also have contributed to the greater rate of "contact vaccine-associated" cases after 1964. In 1971, seven of the eight "contact vaccine-associated" cases were in contact with a recipient under 1 year of age. The single older recipient was 1½ years of age.

The decrease in the rate of "recipient vaccine-associated" cases with all OPV appears to be largely due to the general curtailing in late 1964 of routine vaccinations of adults. This is supported by the fact that 47 of the 62 (75.8%) recipient cases before 1965 were adults compared to none of 11 recipient cases reported 1965-71. Against the contention that the switch to TOPV played the major role in reducing the rate of "recipient vaccine-associated" cases is the absence before 1965 of a significantly different rate of "recipient vaccine-associated" cases with TOPV compared to this rate with all MOPV. However, that the switch to TOPV played at least some important role in reducing the rate of "recipient vaccine-associated" cases is supported first by, the significantly lower recipient rate after January 1, 1965 with TOPV compared with all MOPV ($p<.02$); and second, the evidence presented in Table 10 suggesting that the effect of type 3 vaccine poliovirus is significantly modified by the simultaneous administration of poliovirus type 1 and 2 in the trivalent vaccine.

Table 10

"CONTACT AND RECIPIENT VACCINE-ASSOCIATED" CASES, BY ASSOCIATION WITH THE TYPE 3 POLIOVIRUS IN TOPV AND MOPV-3, UNITED STATES 1965-71

	TOPV	MOPV-3	TOTAL
"Contact Vaccine-Associated" Cases with Type 3 poliovirus infection	13*	0	13
"Recipient Vaccine-Associated" Cases with Type 3 poliovirus infection	0**	6***	6

*Vaccine-like poliovirus type 3 was isolated from all 13; vaccine-like poliovirus type 1 was also isolated from 1 case

**There were 4 "TOPV recipient vaccine-associated" cases, 1965-71;
1 was associated with vaccine-like poliovirus 2,
1 with "intermediate" strain poliovirus 2, and
2 were not associated with any poliovirus type

***Vaccine-like poliovirus type 3 was isolated from 4 cases

*Gard, S. in Poliomyelitis 5th International Poliomyelitis Conference, Copenhagen, Denmark, July 26-28, 1960. International Poliomyelitis Congress Philadelphia, J.B. Lippincott Co., p. 413, 1961

The greater association of recipient cases with MOPV-3 in Table 10 is statistically significant (p=.0004). It is in instructive to note that in Table 10 a total of 127 "recipient vaccine-associated" cases due to the type 3 virus in TOPV would be expected if this recipient rate were to equal 0.811 cases/million doses, the rate for "recipient vaccine-associated" cases with MOPV-3 in 1965-71.

3. "Vaccine Failures". A "vaccine failure" is presently defined as paralytic disease attributed to poliovirus infection occurring in an individual having previously received an "adequate immunization series." As defined by the Advisory Committee on Immunization Practices (ACIP), an "adequate" series consists of 4 or more doses of IPV, 3 doses of MOPV plus one TOPV, or 3 doses of TOPV at appropriate intervals (See ACIP Recommendations in appendix). Five of the 17 reported paralytic cases for 1971 had previously received OPV prior to onset of illness (Table 11). These 5 cases bring to 74 the total number of persons, since 1963, reported to have received at least 1 dose of OPV prior to onset of paralytic poliomyelitis. Poliovirus type 1 (21 cases) and 3 (16 cases) have been more frequently implicated in these patients than poliovirus 2 (8 cases); the etiologic poliovirus type for the others is unknown. Twenty patients received at least one dose of TOPV, but only one of these had received 3 or more doses. As noted in the 1969 surveillance report, this child had been shown to be hypogammaglobulinemic.

Table 11

PARALYTIC POLIOMYELITIS BY IMMUNIZATION STATUS OF ALL WITH HISTORY OF AT LEAST ONE IMMUNIZATION, 1971

State	Age	Sex	Prior OPV Doses	Prior OPV Type	Year of Last OPV Dose	Prior IPV Doses	Year of Last IPV Dose	Virus Type Implicated	Residual Disability
Colo.	26	F	1	MOPV	1962	0		2	Significant
Mont.	3	M	2	UNK	1/69	0		2	Minor
Ohio	5 mos.	M	1	MOPV-1	4/71	0		3	Minor
Texas	27	F	1	UNK	2/69	0		1	Severe
Texas	4 mos.	M	1	TOPV	5/71	0		3	Minor
Wash.	36	M	0			1	1957	2	UNK

III. LABORATORY STUDIES OF POLIOMYELITIS, 1971

A. Characterization of Poliovirus Isolations, 1971

Laboratory techniques have been employed to differentiate "vaccine-like" from "nonvaccine-like" strains of virus isolates. One of these tests, the modified Wecker intratypic serodifferentiation test, is based upon certain antigenic characteristics of the virus strains. Another test, the "temperature marker" ("T" marker), is based upon comparison of viral replication at different temperatures. In general, strains of poliovirus types 1 and 2 that are antigenically "vaccine-like" are usually associated with negative "T" markers, while this association is seen less frequently with poliovirus type 3. These tests almost always establish with high probability the origin of the virus isolated. However, because certain wild type 3 viruses are antigenically "vaccine-like" and because of the known antigenic and "T" marker changes

which can occur, especially with vaccine type 1 virus, these tests do not definitely establish the origin of the virus isolated. Furthermore, these tests do not in any way indicate the neurovirulance of the isolated virus.

Laboratory characterization studies were performed by Enteric Virology Unit, Laboratory Division, CDC, on 13 of the 14 poliovirus isolates from the patients with paralytic poliomyelitis reported in 1971. The characterizations of the viral isolates on the vaccine-associated cases were shown in section IIC; 7 of the 8 were antigenically "vaccine-like." Studies on 5 of the 6 viral isolates from the nonvaccine-associated cases of paralytic poliomyelitis in 1971 revealed 2 antigenically "vaccine-like" viruses (Table 12).

Table 12

CHARACTERIZATION OF VIRAL ISOLATES FROM NONVACCINE-ASSOCIATED CASES OF PARALYTIC POLIOMYELITIS, 1971

State	Age	Sex	Polio Type Isolated	Characterization Antigenic & RCT 39.5°/40.1°		4-fold AB Change	Residual Disability
Calif.	37	M	1	Nonvaccine-like	+/+	No	Death
Nevada	7 mos	F	1	Untested		Presumptive*	Significant
N.Y.	38	M	1	Nonvaccine-like	+/+	Yes	Severe
Texas	4 mos	M	3	Vaccine-like	+/±	No	Significant
Texas	3 mos	F	3	Vaccine-like	+/+	Yes	Significant
Texas	27	F	1	Nonvaccine-like	+/+	No	Severe

*Only a late convalescent serum with titers of 1:32, <1:8, and <1:8 for polio types 1, 2, and 3, respectively was available

B. Poliovirus Isolations 1971

Reports of 130 poliovirus isolations were received from reporting laboratories in 29 states for 1971. Nine (47.4%) of the characterized type 1 polioviruses were antigenically wild (Table 13); 4 of these were isolated from New York, 3 from Texas, 1 from California and 1 from Montana. Though antigenicity does not definitely establish the origin of the virus isolated, it may be significant that, except for Montana, these states constitute major ports of entry into the United States from areas where wild poliovirus type 1 is endemic. Only 4 (14.3%) of the characterized type 2 viruses and none of the studied type 3 viruses were antigenically wild. The association of the poliovirus isolation and the disease syndrome as shown in Table 13 may not be etiologically important. Many of these isolations were made from patients who were known to have recently ingested poliovirus vaccine. Except for almost all the paralytic cases, none of the other cases from whom a poliovirus was isolated were officially reported as poliomyelitis disease.

Table 13

POLIOVIRUS ISOLATIONS, BY TYPE AND CLINICAL HISTORY
UNITED STATES, 1971*

Clinical History	Type 1 Antigenic Char. Vaccine	Wild	Untested	Type 2 Antigenic Char. Vaccine	Wild	Untested	Type 3 Antigenic Char. Vaccine	Wild	Untested	Total
Associated with Paralytic Disease	0	4	2**	4	0	0	6	0	0	16
Associated with Aseptic Meningitis and/or Encephalitis	1	2	1	2	0	7	2	0	2	17
Other	9	3	10	19	4	15	9	0	18	87
Unknown	0	0	2	1	0	4	0	0	3	10
Total	10	9***	15	26	4****	26	17	0	23	130

*Compilation of polio, aseptic meningitis, enterovirus surveillance and CDC Laboratory Records
**Includes a 1970 case with a polio isolation in 1971
***From New York (4), Texas (3), California (1) and Montana (1)
****From Arizona (1), Maine (1) and North Carolina (2)

IV. VACCINE DISTRIBUTION AND VACCINATION STATUS OF THE POPULATION

A. Vaccine Distribution

Two kinds of information indicative of the vaccination status of the United States population are available. One is the number of doses of polio vaccine distributed annually in the United States. These data, as summarized for 1962-71 in Table 14, present not the number of doses administered, but the maximum possible utilization. More importantly, these data show quite clearly certain trends in immunization practice.

Table 14

POLIOMYELITIS VACCINES, NET DOSES (MILLIONS)
DISTRIBUTED ANNUALLY, UNITED STATES, 1962-71

Poliomyelitis Vaccine	1962*	1963	1964	1965	1966	1967	1968	1969	1970	1971
Inactivated (IPV)	15.3	19.0	8.8	7.5	5.5	4.0	2.7	***	***	***
Live, Oral (OPV)										
Monovalent (MOPV)										
Type 1	33.1	38.7	24.9	4.7	1.4	1.3	0.5	0.4	.3	.2
Type 2	37.0	34.2	29.8	3.4	1.3	0.9	0.5	0.4	.2	.1
Type 3	13.7	54.2	28.4	3.7	1.4	1.0	0.6	0.4	.3	.2
Trivalent (TOPV)	----	4.2**	24.0	17.4	24.0	18.0	23.9	22.5	25.8	25.5
Total	99.1	150.3	115.9	36.7	33.6	25.2	28.2	23.7	26.6	25.9

*July-December (Biologics Surveillance Program began July 1962)
**Production began in mid-1962
***Not shown since fewer than 3 distributors reported

After 1963 the distribution of IPV steadily declined to the low 1968 level of 2.7 million doses. Essentially no IPV was available for use in the United States in 1969. With the introduction of TOPV in 1963, use of MOPV diminished to the 1971 level of less than 1/3 of a million doses of each of the 3 types. It should be noted, of course, that the raw data on doses are not adjusted for the number of doses in each category required for a primary immunization series. Nevertheless, TOPV is now clearly the most widely used vaccine. The overall decrease in total doses of vaccine distributed yearly since 1963 reflects a shift in emphasis from mass immunization campaigns and community-wide programs to routine immunization of infants.

B. The 1971 Immunization Survey

A second approach to estimating immunization levels in the population involves a sample survey of the history of types and doses of vaccine received.* While this questionnaire method is not as accurate as serologic surveillance, it has proved useful in assessing the proportion of the population that can be expected to exhibit immunity to poliovirus infection. Table 15 shows the percentages of the population by age group that had received at least 3 doses of OPV or at least 3 doses of IPV and the percentage with no poliovaccine whatsoever for 1965-1971.

Table 15

POLIOVACCINE IMMUNIZATION STATUS BY AGE GROUP (UNDER 15 YEARS)
UNITED STATES 1965-1971

	Percentage with ≥ 3 doses of OPV or ≥ 3 doses of IPV			Percentage with no OPV or IPV Immunization		
	Age Group			Age Group		
Year	1-4	5-9	10-14	1-4	5-9	10-14
1965	73.9	89.9	92.1	9.9	3.0	2.1
1966	70.2	88.2	90.0	11.3	2.9	2.3
1967	70.9	88.3	89.7	11.7	3.1	2.2
1968	68.3	84.9	87.8	10.5	3.3	2.2
1969	67.7	83.6	85.7	10.2	3.2	2.5
1970	65.9	82.3	85.3	10.8	3.6	2.3
1971	67.3	81.2	83.9	8.6	3.3	2.6

The decline from 1965-1970 in pre-school age children who received at least 3 doses of OPV or at least 3 doses of IPV appears to have leveled off in 1971. The downward trend continues in the 5-9 and 10-14 year age groups. The immunization history, by economic status and age group under 10, for the United States Central Cities with population greater than 250,000 is shown in Table 16. In the poverty areas of the Central Cities, 45.7% of the 1-4 year age group have received less than 3 doses of either OPV or IPV. Even after reaching school age, 26.2% in these areas received fewer than 3 doses of either OPV or IPV, and 4.4% have received no polio immunization. These figures illustrate where greater immunization efforts are needed.

*United States Immunization Survey-September 1971

Table 16

POLIOVACCINE IMMUNIZATION STATUS
IMMUNIZATION HISTORY BY ECONOMIC STATUS AND AGE GROUP
(UNDER 10) FOR U.S. CENTRAL CITIES WITH POPULATION
GREATER THAN 250,000, 1971*

	Age Group	Population (thousands)	Percentage** "Inadequately" Immunized	Percentage with No IPV or OPV Immunization
Poverty Areas	1-4	871	45.7	14.0
	5-9	1091	26.2	4.4
Non-Poverty Areas	1-4	2286	34.5	7.7
	5-9	2893	18.4	2.7

*Source - United States Immunization Survey, September 1971
**<3 doses of OPV or <3 doses of IPV in acceptable primary series

RECOMMENDATION OF THE PUBLIC HEALTH SERVICE ADVISORY COMMITTEE ON IMMUNIZATION PRACTICES

POLIOMYELITIS VACCINE

INTRODUCTION

Widespread use of poliovirus vaccines since 1955 has resulted in the virtual elimination of paralytic poliomyelitis in the United States. To ensure continued freedom from the disease, it is necessary to pursue regular immunization of all children from early infancy.

Paralytic poliomyelitis declined from 18,308 cases in 1954 to 32 cases in 1970 and 19 cases in 1971. A national survey in 1971 showed that 77 percent of individuals 1-19 years old had received at least 3 doses of oral poliovirus vaccine*(OPV), inactivated poliovirus vaccine**(IPV), or both.

Nevertheless, low immunization rates still prevail in certain disadvantaged urban and rural groups, particularly for infants and young children born since the mass immunization campaigns conducted between 1958 and 1962. Most of the cases of paralytic poliomyelitis in recent years occurred in these populations.

With widespread use of poliovirus vaccine, laboratory surveillance of enteroviruses indicates that circulation of wild polioviruses has diminished markedly. It can be assumed that inapparent infections with wild strains will no longer contribute significantly to maintaining immunity; therefore, it is essential not only to continue active immunization programs for infants and children but also to make special efforts to raise the low immunization rates existing in certain other segments of the population.

POLIOVIRUS VACCINES

Between 1955, when IPV was introduced, and 1962, when live, attenuated vaccines became widely used, more than 400 million doses of IPV were distributed in the United States. Primary immunization with IPV plus regular booster doses provided a high degree of protection against paralytic disease.

OPV has almost completely replaced IPV in this country because it is easier to administer and produces an immune response like that induced by natural poliovirus infection.

Monovalent OPV types 1, 2, and 3 were widely used in the United States beginning in 1961, but they have generally been supplanted by trivalent OPV because of greater simplicity in scheduling and recordkeeping.

A primary series of 3 adequately spaced doses of trivalent OPV will produce an immune response to the 3 poliovirus types in well over 90 percent of recipients.

Very rarely, paralysis has occurred in recipients of OPV or in their close contacts within 2 months of its administration. During 1963-70, about 147 million doses of trivalent OPV were distributed in the United States. In the same 8-year period, 9 cases of "vaccine-associated" paralysis in recipients (0.06/million doses distributed) and 21 in contacts of recipients (0.14/million doses distributed) were reported.

In 1972, OPV produced in the WI-38 strain of human diploid cells was licensed in the United States. This vaccine is considered to be equivalent in safety and effectiveness to vaccine produced in primary rhesus monkey kidney cell culture.

VACCINE USAGE

Trivalent OPV—Primary Immunization

Infants: The 3-dose immunization series should be started at 6-12 weeks of age, commonly with the first dose of DTP. The second dose should be given not less than 6 and preferably 8 weeks later. The third dose is an integral part of primary immunization and should be administered 8-12 months after the second dose.

Children and adolescents: For unimmunized children and adolescents through high school age, the primary series is 3 doses. The first 2 should be given 6-8 weeks apart, and the third, 8-12 months after the second. If circumstances do not permit the optimal interval between the second and third doses, the third may be given as early as 6 weeks after the second.

Adults: Routine poliomyelitis immunization for adults residing in the continental United States is not necessary because of the extreme unlikelihood of exposure. However, an unimmunized adult at increased risk through contact with a known case or travel to areas where polio is epidemic or occurs regularly should receive trivalent OPV as indicated for children and adolescents. Persons employed in hospitals, medical laboratories, and sanitation facilities might also be at increased risk, especially if poliomyelitis is occurring in the area.

Pregnancy is not an indication for vaccine administration, nor is it a contraindication when protection is required.

Monovalent OPV—Primary Immunization

An alternative primary immunization is 1 dose of each of the 3 types of **monovalent** OPV given at 6-8 week intervals. A dose of **trivalent** OPV should be given

*Official names: (1) Poliovirus Vaccine, Live, Oral, Type 1, (2) Poliovirus Vaccine, Live, Oral, Type 2, (3) Poliovirus Vaccine, Live, Oral, Type 3, (4) Poliovirus Vaccine, Live, Oral, Trivalent.

**Official name: Poliomyelitis Vaccine.

8-12 months after the third dose of monovalent OPV to ensure adequate responses to all poliovirus types.

OPV–Booster Doses

Entering school: On entering kindergarten or first grade, all children who have completed the primary series of OPV should be given a single dose of trivalent OPV; others should complete the primary series.

There is no indication for routine booster doses of OPV beyond that given at the time of entering school.

Increased risk: A single dose of trivalent OPV can be administered to anyone who has completed the full primary series because of travel or occupational hazard as described above. The need for such an additional dose has not been established, but if there is uncertainty about the adequacy of existing protection, a single dose of trivalent OPV should be given.

Contraindications

Altered immune states: Infection with live, attenuated polioviruses might be potentiated by severe underlying diseases, such as leukemia, lymphoma, or generalized malignancy, or by lowered resistance, such as from therapy with steroids, alkylating drugs, antimetabolites, or radiation; therefore, vaccination of such patients should be avoided.

EPIDEMIC CONTROL

For operational purposes in the United States, an "epidemic" of poliomyelitis is defined as 2 or more cases caused by the same poliovirus type and occurring within a 4-week period in a circumscribed population, such as that of a city, county, or a metropolitan area. An epidemic can be controlled with either trivalent OPV, or, after identification of the responsible type of poliovirus, homotypic monovalent OPV. Within the epidemic area, all persons over 6 weeks of age who have not been completely immunized or whose immunization status is unknown should promptly receive OPV.

SIMULTANEOUS ADMINISTRATION OF LIVE VIRUS VACCINES

There are obvious practical advantages to administering 2 or more live virus vaccines simultaneously. Data from specific investigations are not yet sufficient to develop comprehensive recommendations on simultaneous use, but a summary of current experience, attitudes, and practices provides useful guidance.

It has been generally recommended that live virus vaccines be given at least 1 month apart whenever possible–the rationale for this being that more frequent and severe adverse reactions as well as diminished antibody responses otherwise might result. Field observations indicate, however, that with simultaneous administration of certain live virus vaccines, results of this type have been minimal or absent.

If the theoretically desirable 1-month interval is not feasible, as with the threat of concurrent exposures or disruption of immunization programs, the vaccines should preferably be given on the same day–at different sites for parenteral products. An interval of about 2 days to 2 weeks should be avoided because interference between the vaccine viruses is most likely then.

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STATE EPIDEMIOLOGISTS

Key to all disease surveillance activities are those in each State who serve the function as State epidemiologists. Responsible for the collection, interpretation and transmission of data and epidemiologic information from their individual States, the State epidemiologists perform a most vital role. Their major contributions to the evolution of this report are gratefully acknowledged.

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