Evaluation of Oral Poliovirus Vaccine Delivery during the 1994 National Immunization Days in Pakistan

M. R. Reichler, R. Aslanian, Z. H. Lodhi, I. Latif, M. Alam Khan, R. Chaudhry, A. A. Idris, and M. A. Barzgar

Pakistan conducted national immunization days (NIDs) for the first time in 1994. To estimate coverage, to evaluate risk factors for failure to be immunized, and to determine the effectiveness of mass media, parents of 1288 children in 714 households in four districts were surveyed after the first NID round. In each district, a high proportion of children (93%–96%) received oral poliovirus vaccine (OPV) during the NID. In three districts, unimmunized or partially immunized children were less likely to receive NID OPV than were fully immunized children (Kohistan, $P < .001$; Quetta, $P < .001$; and Sibi, $P = .05$). Although a high proportion of children in each age cohort received NID OPV, in three districts children 0–11 months of age were less likely to receive NID OPV than were older children. Television and radio reached a high proportion of survey households, but other mass media were less effectively utilized. Risk factor and media effectiveness surveys provide important information that is useful for planning future NIDs.

Until recently, vaccination strategies for poliomyelitis control in regions other than the Americas have consisted primarily of routine immunization. It is now widely recognized that routine immunization alone is unlikely to be sufficient to interrupt wild poliovirus transmission in most tropical and subtropical regions and that supplementary immunization activities, including national immunization days (NIDs), are necessary in countries where polio remains endemic [1].

From 1991 to 1993, Pakistan reported >1000 cases of poliomyelitis each year. In 1993, the 1803 poliomyelitis cases reported by Pakistan represented 76% of all cases reported in the Eastern Mediterranean Region of the World Health Organization and 23% of all cases reported globally [2–4]. To improve poliomyelitis control and reduce transmission of wild poliovirus, the government of Pakistan conducted NIDs with oral poliovirus vaccine (OPV) in April and May 1994, demonstrating its commitment to the goal of global polio eradication by the year 2000 [5].

Controlling poliomyelitis in Pakistan is critically important to the global polio eradication initiative [3, 4, 6]. In this report, we present the results of a coverage and risk factor survey conducted to evaluate vaccine delivery during the first round of the 1994 NIDs in Pakistan. This study provides important information regarding risk factors for failure to be immunized during the NID, evaluates the effectiveness of information sources used to publicize the NID, and provides rough estimates of coverage achieved during the NID among children in several districts in three provinces in Pakistan.

Background

Vaccination schedule. Children in Pakistan are scheduled to receive four doses of OPV during the first year of life: at birth, 6 weeks, 10 weeks, and 14 weeks of age. A booster dose of OPV is recommended at 9 months of age for children who did not receive a birth dose.

Vaccination coverage. Whereas a cluster sample survey conducted in 1991 estimated coverage with three doses of OPV (OPV3) for children between 12 and 23 months of age to be 95%, a similar survey conducted in April 1993 found OPV3 coverage in the same age group to be 73%.

Surveillance and disease incidence. Between 1982 and 1992, the number of poliomyelitis cases reported in Pakistan decreased from 3506 to 1046. However, reported cases increased to 1803 in 1993, an epidemic year.

NIDs. NIDs were conducted for the first time ever in Pakistan in 1994, in two rounds (27–30 April and 28–31 May). The target population for each round of the 1994 Pakistan NID included all 20,679,222 children <5 years of age estimated to be living in Pakistan’s four provinces and three federally administered areas, regardless of prior immunization history.

Methods

Survey design. To estimate the coverage achieved during the first round of the 1994 NIDs, to evaluate risk factors for failure to be immunized, and to determine the effectiveness of mass media in promoting community awareness about the NIDs, a survey was conducted 4–14 days after the first NID round in selected districts in three of four provinces (Baluchistan, Punjab, and Northwest Frontier) in Pakistan, using a modification of the standard Expanded Programme on Immunization cluster survey [7]. The survey could not be conducted in the fourth province, Sindh, due to intercurrent civil disturbances.

The districts selected for the survey represented a convenience sample, with consideration given to selecting districts in all provinces, predominantly urban as well as predominantly rural districts, and districts with NID vaccine delivery predominantly at fixed immunization sites as well as those with vaccine delivery predominantly door-to-door via mobile teams. Quetta and Lahore were selected because they are the largest urban areas in their respective provinces; vaccine delivery in these districts was mainly at fixed sites. Sibi was randomly selected from the 26 predominantly rural districts in Baluchistan; vaccine delivery in this district was through a combination of fixed sites and mobile team strategies. Kohistan was selected because it is the Pakistan district that relied most heavily on mobile teams for vaccine delivery during the NID; this district was predominantly rural.

The targeted sample size was 210 households per study district (targeted precision, ±10%). In each study district, 30 sites were selected randomly with probability proportional to estimated size, where the measure of size was the total population. At each site, 1 household was randomly selected as the starting point, and 7 consecutive households containing at least 1 child 0–59 months of age were selected for interview. A standard questionnaire providing information about NID OPV receipt, NID center location, sources of information for the NID, and routine OPV coverage was administered to a parent in each selected household for all children 0–59 months of age (born between 27 April 1989 and 26 April 1994). Information was collected for 379 children in 198 households in Quetta, 301 children in 186 households in Lahore, 259 children in 124 households in Kohistan, and 349 children in 206 households in Sibi. Because of difficult road access and severe weather conditions, households were surveyed at only 18 of 30 sites in Kohistan. Because some interviewers collected information on children ≥60 months of age in certain households, the total number of households included in analysis was <210 in each of the study districts.

Statistical analysis. For each study district, statistically significant differences in risk variable responses among children and households were assessed with Mantel-Haenszel chi-squared tests, using Epi Info software [8]. Analyses of NID OPV receipt overall, by routine vaccination status, and by age cohort were performed using all survey children. To address the possibility of confounding, these analyses were also performed per household, using 1 randomly selected child in each household; in the few instances in which results per household differed substantially from those per child, both results are presented. All other analyses were performed per household.

Results

Population characteristics and immunization coverage. Table 1 presents the characteristics, routine immunization cover-

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Quetta</th>
<th>Lahore</th>
<th>Kohistan</th>
<th>Sibi</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of households</td>
<td>198</td>
<td>186</td>
<td>124</td>
<td>206</td>
</tr>
<tr>
<td>No. of children</td>
<td>379</td>
<td>301</td>
<td>259</td>
<td>349</td>
</tr>
<tr>
<td>Age distribution, months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0–11</td>
<td>79 (21)</td>
<td>77 (26)</td>
<td>54 (21)</td>
<td>91 (26)</td>
</tr>
<tr>
<td>12–23</td>
<td>78 (21)</td>
<td>82 (27)</td>
<td>69 (27)</td>
<td>87 (25)</td>
</tr>
<tr>
<td>24–35</td>
<td>85 (22)</td>
<td>42 (14)</td>
<td>39 (15)</td>
<td>57 (16)</td>
</tr>
<tr>
<td>36–47</td>
<td>77 (39)</td>
<td>60 (20)</td>
<td>47 (18)</td>
<td>58 (17)</td>
</tr>
<tr>
<td>48–59</td>
<td>58 (15)</td>
<td>37 (12)</td>
<td>49 (19)</td>
<td>47 (13)</td>
</tr>
<tr>
<td>No. receiving ≥3 routine doses of OPV</td>
<td>241 (80)</td>
<td>187 (86)</td>
<td>132 (64)</td>
<td>44 (30)</td>
</tr>
<tr>
<td>No. receiving NID OPV dose</td>
<td>360 (95)</td>
<td>290 (96)</td>
<td>236 (91)</td>
<td>323 (93)</td>
</tr>
</tbody>
</table>

NOTE. Unless otherwise indicated, data are no. (%).
In all study districts except Lahore, children 0–11 months of age were less likely to receive NID OPV than were older children (figure 2). The association of younger age with failure to receive NID OPV was statistically significant in Kohistan (odds ratio, 3.6; 95% confidence interval, 1.4–9.4; P < .01) but not in Quetta or Sibi. Results of analysis per household rather than per child were similar for Kohistan, Sibi, and Lahore but differed for Quetta (NID OPV receipt among children 0–11 months, 12–23 months, 24–35 months, 36–47 months, and 48–59 months of age in Quetta was 88%, 83%, 96%, 98%, and 100%, respectively; χ² for trend = 8.1, P < .005).

Risk factors for failure to be immunized during the NID. As illustrated in table 2, five risk factors for failure to receive OPV during round one of the 1994 NID in Pakistan were identified: younger age (all four districts; statistically significant in Kohistan [per-household analysis only; P < .01] and Quetta), receipt of fewer than three routine doses of OPV before the campaign (all four districts; statistically significant in Quetta, Lahore [per-child analysis only], and Kohistan), distance from residence to the nearest NID immunization center estimated to be > 10 min walk (Quetta, Lahore, and Sibi; statistically significant in Quetta and Lahore), not being informed about the campaign at least 1 day in advance (all four districts; statistically significant for Sibi), and absence of a television or radio in the household (statistically significant in Quetta and Lahore, [per-child analysis only], and Kohistan), distance from residence to the nearest NID immunization center (all four districts; statistically significant in Quetta and Lahore), not being informed about the campaign at least 1 day in advance (all four districts; statistically significant for Sibi), and absence of a television or radio in the household (statistically significant for all four districts). Because the number of study children who did not receive NID OPV was quite small, it was not possible to determine whether these risk factors were independent.

Reasons given for failure to be immunized during the NID. Among the 79 study children not immunized during round one of the 1994 NID, 14 different reasons were given by parents. Overall, the most frequent reasons given were that the parents were too busy to go to the NID immunization site (23; 29%), parents did not take the child to be immunized because the child was sick (14; 18%), parents were not informed about the NID (10; 13%), mobile team did not come to the household (10; 13%), and parents brought the child but vaccine was unavailable at that time (8; 10%). Overall, 60 (76%) of the 79 study children who did not receive NID OPV were not immunized because of parents not bringing their children to the NID immunization center, 10 (13%) because mobile teams did not visit the household (in an area served by mobile teams), and 15 (19%) because vaccinators did not immunize children brought by parents to the immunization center. Since several parents listed more than one reason, the total number of reasons is greater than the number of children.

Effectiveness of information sources. As illustrated in table 3, information about the NID was received through a wide variety of media sources. The major source of information differed between study districts. Television was the information source that informed the greatest number of households in Quetta (90%) and Lahore (85%), whereas radio was the greatest source of information in Kohistan (65%) and Sibi (47%). Considerably fewer households were informed by newspaper, with great variation between study sites: 69% in Quetta, 28% in Lahore, 20% in Sibi, and 9% in Kohistan. Although posters were an important source of NID information, only about half of study households in Quetta and Kohistan, one-third in Sibi, and fewer than a quarter of households in Lahore were informed via this medium. Mosque announcements were a source of information for relatively few households in Quetta (40%), Kohistan (44%), and Sibi (34%) and only a moderate number in Lahore (66%). In all study districts, relatively few households received NID information from schools.

The potential to utilize television or radio as a source of information was measured by evaluating the frequency that these media were present in survey households (table 3). Either a television or a radio was present in nearly all study households

![Figure 1](image1.png)

**Figure 1.** Receipt of oral poliovirus vaccine (OPV) during first round of 1994 NID in Pakistan by number of routine OPV doses received before campaign. In 3 of 4 study sites, previously unimmunized or partially immunized children were less likely to receive OPV during NID than were fully immunized children.

![Figure 2](image2.png)

**Figure 2.** Receipt of oral poliovirus vaccine (OPV) during first round of 1994 NID in Pakistan according to age group. At all 4 study sites, high proportion of children in each age cohort targeted during campaign received NID OPV; however, in 3 study sites, children 0–11 months of age were less likely to receive NID OPV than were older children.
Table 2. Characteristics of survey children who were or were not immunized with oral poliovirus vaccine (OPV) during round one of 1994 NID and their households in 4 districts in Pakistan.

<table>
<thead>
<tr>
<th>Characteristic for child or child's household</th>
<th>Quetta</th>
<th>Lahore</th>
<th>Kohistan</th>
<th>Sibi</th>
</tr>
</thead>
<tbody>
<tr>
<td>NID dose Yes</td>
<td>No</td>
<td>Odds ratio (95% CI)</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>1.9</td>
<td>1.2*</td>
<td>1.7</td>
<td>1.0</td>
</tr>
<tr>
<td>No. receiving ≥3 routine OPV doses</td>
<td>275 (76)</td>
<td>8 (42)</td>
<td>224 (79)</td>
<td>5 (50)</td>
</tr>
<tr>
<td>Household</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Center within 10 min walk from residence</td>
<td>141 (77)</td>
<td>3 (23)</td>
<td>134 (76)</td>
<td>2 (29)</td>
</tr>
<tr>
<td>Informed ≥1 day before NID</td>
<td>155 (84)</td>
<td>10 (77)</td>
<td>166 (88)</td>
<td>6 (75)</td>
</tr>
<tr>
<td>Television or radio in house</td>
<td>171 (96)</td>
<td>11 (85)</td>
<td>159 (89)</td>
<td>5 (63)</td>
</tr>
</tbody>
</table>

NOTE: Unless otherwise indicated, data are no. (%). CI = confidence interval.

P < * .05, † .001, ‡ .01.

in Quetta (96%) and Lahore (88%) and in about two-thirds of households in Kohistan (65%) and Sibi (68%). Nearly all households with a television were informed about the NID via television in Quetta and Sibi, demonstrating very effective utilization of this medium in these districts. Utilization of television was somewhat less complete in Lahore (85% of households were informed in this way whereas 90% had a television). No households had a television in Kohistan. Nearly all households with a radio were informed about the NID via radio in Sibi and Kohistan, indicating very effective utilization of this medium in these districts. By contrast, a significant number of study households in Lahore and Quetta with a radio were not informed via this medium.

Discussion

NIDs are a key strategy for global eradication of poliomyelitis. Experience has shown that NIDs that are associated with high coverage, that reach previously unimmunized as well as previously immunized children, that achieve high coverage in all target population age groups, and that are conducted in the lowest season for enterovirus transmission are most likely to interrupt wild poliovirus transmission [9]. Experience in the many countries where NIDs have already been conducted has demonstrated that this activity requires extensive planning to achieve high coverage in all community subpopulations [9–11].

Pakistan conducted NIDs for the first time in 1994. Since then, the incidence of paralytic poliomyelitis in Pakistan has declined dramatically, with only 391 cases reported from April 1994 through March 1995 compared with 1500 cases reported during the same time period in 1993–1994, a decrease of 78% [3, 12]. During 1996, it was expected that as many as 90 countries in all regions of the world would implement NIDs, many for the first time. Our evaluation of the very successful 1994 NIDs in Pakistan provides information that will be useful to other countries as they prepare to conduct NIDs.

In our study, children who were unimmunized or only partially immunized through the routine program were less likely to receive NID OPV doses than were fully immunized children. Nevertheless, high coverage was achieved during the NID in Pakistan even in these subgroups. Other studies have shown that children not reached by the routine program are often not reached during NIDs (unpublished data). The fact that a high proportion of previously unimmunized children were immunized during Pakistan’s NID is likely a major contributing factor to the great success of this activity. A recent study demonstrating that the effectiveness of mass campaigns is at least in part due to greater immunogenicity of campaign OPV doses compared with routine OPV doses highlights the importance of immunizing all children in the target age group during NIDs [13]. Thus, even greater efforts
should be made in future campaigns in Pakistan and other countries to reach all previously unimmunized and partially immunized children.

During Pakistan’s first NID, children <1 year of age were less likely to receive NID OPV than were children 1–4 years of age. Despite this, relatively high coverage was achieved during the NID among children <1 year of age, which undoubtedly contributed to the success of this activity in Pakistan. Although maternal antibody may provide some protection, many young infants remain susceptible to poliovirus infection, as evidenced by the not infrequent occurrence of paralytic poliomyelitis in infants <6 months of age [14]. Although infants are probably less likely to transmit wild poliovirus to other children since they are not ambulatory, transmission can occur, particularly in settings with poor sanitation and crowding. Thus, achieving high coverage among children <1 year of age as well as among older children is important to provide adequate individual and population immunity to poliovirus infection.

Pakistan launched a very effective media campaign for the first round of the 1994 NIDs. A high proportion of households in most study sites surveyed were informed about the NID by mass media of one type or more. Nevertheless, some children were not immunized during the NID because of lack of information—theyir parents were not informed, were not informed well enough in advance, were unaware that sick, fully immunized, and recently immunized children should still receive NID OPV doses, or did not receive a message that convinced them to make NID immunization a priority activity for their children.

Although television and radio were the media through which the greatest number of households in our study were informed, small subsets of the population were informed only through newspapers, posters, mosque announcements, or schools, demonstrating that the use of multiple media is necessary to reach all segments of the population. Publicizing NIDs through a wide variety of media may be particularly important to inform households that do not have a radio or a television and households in rural settings.

In our study, radio and television were very effectively utilized, reaching nearly every study household where these appliances were present. By contrast, other media sources were underutilized for the NID. In Lahore, a large city and cultural center, fewer than one-third of study households were informed by newspaper. Furthermore, in a country where announcements in the mosque have the potential to reach nearly every household, fewer than one-half of study households learned about the NID through the mosque. To improve publicity for future NIDs, greater use of a wide variety of media sources (in addition to radio and television) should be considered, as well as more complete and timely dissemination of information about the NID.

Since NIDs are an important strategy for polio eradication, finding ways to maximize their effectiveness is important. Risk factor and media effectiveness surveys such as the one presented in this report can provide important information about characteristics of children not reached in the campaign, as well as insights into ways to more effectively use the mass media during future campaigns. In addition, coverage data from surveys such as the one conducted in Pakistan can be useful to supplement information provided by administrative method estimates of coverage, the usual method of estimating coverage achieved during NIDs. Such surveys can be conducted rapidly and at relatively little expense, using teams composed of Expanded Programme on Immunization personnel paired with other health workers or teachers. Conducting risk factor and media effectiveness surveys may be particularly important to evaluate NIDs when they are a country’s first, in high-risk areas within a country, or in countries in which NIDs have not had the anticipated impact on the incidence of poliomyelitis.

References