Master Thesis

Vaccination coverage for oral polio vaccination and identifying the determinants associated with popular participation in immunization activities of the polio eradication programme in Pakistan

A project proposal

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Abbreviations

AFP	Acute flaccid paralysis
AIDS	Acquired Immunodeficiency Syndrome
AJK	Azad Jumu Kashmir
BHU	Basic Health Unit
CSF	Cerebrospinal fluid
DHO	District Health Officer
EPI	Expanded Program on Immunization
FANA	Federally Administrative Northern Area
FATA	Federally Administered Tribal Area
GAVI	Global Alliance for Vaccines and Immunization
ICT	Islamabad Capital Territory
IgA	Immunoglobulin A
IPV	Inactivated poliovirus vaccine
LHV	Lady Health Visitor
LHW	Lady Health Worker
MCH	Maternity and Child Health Centers
MCP	Malaria Control Program
MO	Medical Officer
NID	National Immunization Day
NWFP	North West Frontier Province
OPV	Oral poliovirus vaccine
PIHS	Pakistan Integrated Household Survey
RHC	Rural Health Center
SNID	Sub National Immunization Days
UN	United Nations
UNICEF	United Nations Children's Fund
VAPP	Vaccine associated paralytic polio
WHO	World Health Organization

Prologue

I am a medical doctor from Pakistan. I joined a Basic Health Unit as a medical officer after my graduation in 2002. My first job experience was in a rural area, which really enriched my knowledge of public health. It also cultivated in me an interest in the field of public health. My present master thesis covers a public health problem that needs attention at the national and international level but also at the local and district levels. If I will be given a chance to carry out my proposed study, it would be a help for the neglected people and for the public health in the Pakistan and my share towards an eradication of an encrippling disease.

1. General background

Wild poliovirus is now only endemic in six countries – Nigeria, India, Pakistan, Niger, Afghanistan and Egypt. Five states and provinces within Nigeria, India and Pakistan are linked to more than 75 percent of all new cases of polio worldwide and thus constitute the key to the global eradication of the disease. The world's few remaining reservoirs of poliovirus continue to pose a significant risk due to the threat of migration-imported polio virus, which can spread rapidly and threaten unprotected children (1).

Figure 1. Map of Pakistan.

Pakistan has the third highest number of polio cases globally (99 cases till January 2004), with endemic poliovirus concentrated in two key areas, North West Frontier Province and Sindh. Transmission also exists in Baluchistan and central Punjab (2) (fig 1).

In 2003, a prolonged polio-outbreak in the densely populated area of east/central Punjab demonstrated the need to maintain high coverage throughout the country (2).

Accurate coverage data are important to assess the impact of different vaccination strategies (3). Although reported data might be the only available information for assessment of vaccination coverage, their use for measuring changes in coverage over time is often questionable due to validity problems (4). In order to evaluate the use and effectiveness of disease protection and control measures, up to date information is, however, required (5).

Several socio-economic as well as health care factors have been identified to be influential for vaccine coverage in infants. Surveys in Belgium underline the role parents as well as physicians and nurses play in the infant immunization coverage. Clearly, more than one factor plays a role in determining the infant immunization rate in a region or a country (6,7). The reasons given by mothers for no immunization or incomplete immunization are lack of knowledge, and a belief that disease is better than immunization. Other common reasons given are social problems and lack of time (8).

Pakistan's poliomyelitis eradication activities have significantly reduced the poliomyelitis disease burden but have not had the anticipated effect of eradicating the disease. Possible reasons for continued high poliomyelitis incidence include failure to implement immunization strategies, vaccine failure, or inadequate immunization strategies (9).

2. Introduction

2.1. Polio

The two words “polio” (grey) and “myelon” (marrow) are derived from Greek roots and describe the tissues affected in polio in the spinal cord leading to the classic manifestations of poliomyelitis (10).

2.2. Poliovirus

Poliovirus has an RNA genome and is member of the enterovirus subgroup of the family Picornaviridae. Enteroviruses are transient inhabitants of the gastrointestinal tract, and are stable in an acid environment. There are three poliovirus serotypes (P1, P2, P3) with minimal heterotypic immunity between the three serotypes, i.e., immunity to one serotype does not produce significant immunity to the other serotypes. The poliovirus is rapidly inactivated by heat, formaldehyde, chlorine, and ultraviolet light (10).

2.2.1. Pathogenesis

The polio virus enters through the mouth and primary multiplication occurs at the site of implantation in the pharynx and gastrointestinal tract. The virus is usually present in the throat and in the stool before the onset of illness. One week after onset there are few viruses left in the throat, but virus continues to be excreted in the stool for several weeks. The virus invades local lymphoid tissue, enters the blood stream, and may then infect cells of the central nervous system (fig 2). Replication of poliovirus in motor neurons of the anterior horn and brain stem results in cell destruction (10).

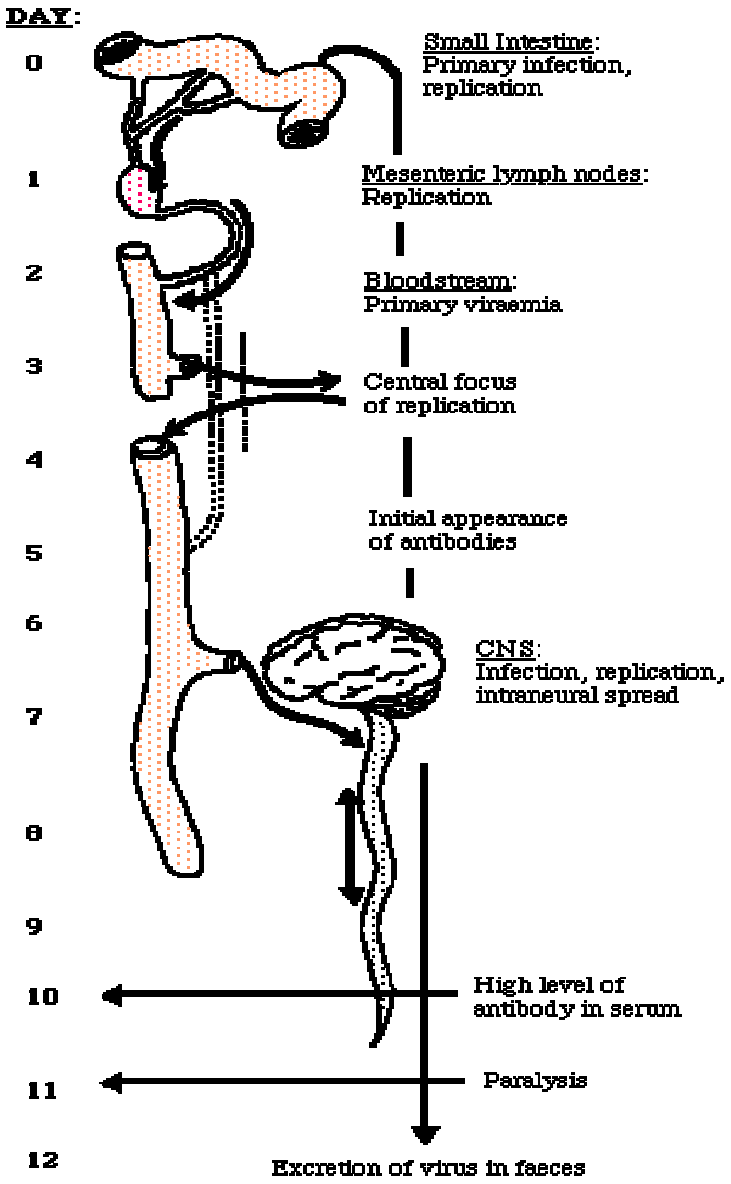

Figure 2. Illustration of the pathogenesis of polio virus according to Siptah's Revenge! Online Tutorials, University of Leicester, UK (11).

2.2.2. Clinical features

The incubation period for poliomyelitis is commonly six to 20 days with a range from three to 35 days. The response to poliovirus infection is highly variable and has been categorized based on the severity of clinical presentation. Up to 95 percent of all polio infections are inapparent or asymptomatic. Estimates of the ratio of inapparent to paralytic illness vary from 50:1 to 1,000:1 (usually 200:1) (10).

Approximately four to eight percent of polio infections consist of a minor, nonspecific illness without clinical or laboratory evidence of central nervous system invasion and known as *abortive poliomyelitis*, characterized by complete recovery in less than a week. *Nonparalytic aseptic meningitis*, usually following several days after a prodrome similar to that of a minor illness, occurs in one to two percent of polio infections. Less than one percent of all polio infections result in flaccid paralysis (fig 2) (10). An acute flaccid paralysis (AFP) case is defined as any child under the age of 15 years with sudden onset of flaccid/floppy paralysis or muscular weakness or any person of any age in whom polio is suspected (12).

Paralytic polio is classified into three types, depending on the level of involvement (10):

1. *Spinal polio* is the most common, and accounted for 79 percent of the paralytic cases in the USA epidemic 1969-1979. It is characterized by an asymmetric paralysis that most often involves the legs.
2. *Bulbar polio* was seen in two percent of the US epidemic cases and gives a weakness of muscles innervated by the cranial nerves.
3. *Bulbospinal polio* is a combination of bulbar and spinal paralysis and accounted for 19 percent of the cases in the above mentioned epidemic.

The case fatality for paralytic polio is generally two to five percent in children and up to 15 to 30 percent in adults depending on age. The death-to-case ratio increases with bulbar involvement (10).

2.2.3. Laboratory diagnosis

a. Viral isolation

Poliovirus may be recovered from the stool or pharynx of a person with poliomyelitis. Isolation of virus from the cerebrospinal fluid (CSF) is diagnostic, but is rarely accomplished. If poliovirus is isolated from a person with AFP, it must be tested further, using oligonucleotide mapping (fingerprinting) or genomic sequencing, to determine if the virus is “wild type” or “vaccine type” (10).

b. Serology

Neutralizing antibodies appear early and may be at high levels by the time the patient is hospitalized (10).

c. Cerebrospinal fluid

CSF in poliovirus infection usually contains an increased number of white blood cells, primarily lymphocytes, and mildly elevated protein from 40 to 50 mg /100ml (10).

d. Compatible case (poliomyelitis compatible case)

A case of AFP in which a diagnosis of poliomyelitis cannot be excluded with confidence based on all available information in the absence of good viral cultures is called a poliomyelitis compatible case. Compatible cases indicate a surveillance failure and should be scrutinized for clustering in space and time.

2.3. Polio vaccine

2.3.1. Inactivated poliovirus vaccine

The Salk-type inactivated poliovirus vaccine (IPV) consists of a mixture of the three poliovirus serotypes grown in monkey kidney cell cultures and made noninfectious by formalin treatment. In USA it is recommended in two intramuscular injections spaced two months apart and requires 6 -18 months and 4-6 year periodic boosters to maintain an adequate serum neutralizing-antibody level. Its effectiveness depends on stimulation of serum neutralizing antibodies that block the spread of poliovirus to the central nervous system. It has some suppressive effect on the replication of wild poliovirus in the highly vascularized oropharyngeal region, but it has no effect on replication in the gut or on viral transmission in feces (13).

IPV is highly effective in producing immunity to poliovirus and protection from paralytic poliomyelitis (table 1). Ninety percent or more of vaccine recipients develop protective antibodies to all three poliovirus types after two doses, and at least 99 percent are immune following three doses. Protection against paralytic disease correlates with the presence of antibodies (10).

2.3.2. Oral poliovirus vaccine

The Sabin-type live attenuated oral poliovirus vaccine (OPV) that is commercially available is also trivalent like IPV. The viruses are attenuated by multiple passages in monkey kidney or human diploid cell cultures. Vaccine potency is stabilized with molar magnesium chloride or sucrose. This vaccine mimics wild poliovirus infections by inducing serum-neutralizing antibodies, as well as interferon and virus-specific IgA antibody in the pharynx and gut. Hence, the vaccine virus not only prevents paralytic poliomyelitis, but also, when given in sufficient numbers of doses, i.e four doses of OPV, can abort a threatening epidemic and has the potential of eradicating poliomyelitis. OPV is highly effective in producing immunity to poliovirus. A single dose of OPV produces immunity to all three serotypes in about 50 percent and three doses in more than 95 percent of the recipients (13). As with other live virus vaccines, immunity from OPV is probably lifelong (10). During an outbreak trivalent OPV is recommended for administration without delay to susceptible individuals in the community to prevent an epidemic (13).

The chief disadvantage of this vaccine is the occurrence of vaccine-associated paralysis (table 1). The risk of paralytic poliomyelitis associated with reversion to neurovirulence is however exceedingly small, estimated as one case of paralysis for every two to four million distributed doses of trivalent OPV (13).

Recently, a vaccination strategy with a combination of IPV and OPV for the control and eradication of poliomyelitis in the Palestine from 1978-1993 has attracted international interest (13).

Table 1. Advantages and disadvantages of all-OPV, all IPV, or mixed vaccination schedules according to Plotkin (14).

	OPV	IPV	IPV+OPV
Vaccine associated paralytic polio (VAPP)	1 case per 790,000 first vaccinations	No cases	Estimated 50-75% reduction in VAPP cases
Safety (other than VAPP)	Excellent	Excellent	Presumably excellent
Systemic immunity	Good	Good	Good
Mucosal immunity	Excellent	Slight to moderate in the intestine, marked in pharynx, overall less than OPV	Excellent
Transmission to contacts and secondary vaccination	Yes	No	Some
Extra injections	No	Yes, if monovalent No, if part of a combination vaccine	Same as for IPV
Reduced compliance	No	Possible, if monovalent vaccine	Possible, if monovalent vaccine
Likelihood of future combination with other program vaccines	Nil	High	High
Cost	Low	Higher, though price difference depends on e.g volume, combination	Intermediate

3. Country profile

Pakistan Islamic Republic lies between Central Asia and the Arabian Sea. Its eastern border runs with India, northern border with China, western border with Afghanistan and Iran (fig1). Pakistan is a federal state, comprising four provinces; Punjab, Sindh, North West Frontier Province (NWFP) and Balochistan, and some federal units which include Islamabad Capital Territory (ICT), Federally Administered Tribal Area (FATA), Northern area (FANA) and Azad Jumu Kashmir (AJK) (15,16). In general, the country's administrative unit is a district, which is further divided into counties known as Tehsils or sub-districts. Urban areas are also known administratively as a town, municipality, city or metropolis depending on their population size, ranging from 5,000 to 30,000. A municipal city has a population up to 250,000. Cities beyond that size and provincial capitals either have a municipal or a metropolitan status. A union council, in a rural setting, is the smallest administrative unit, consisting of a group of villages. A union council varies in the size of its population.

3.1. Health care in Pakistan

The history of health care in Pakistan started before the independence 1946. The Health Survey and Development Committee, popularly known as the Bhore Committee, reported 1946:

> *"The idea that the state should assume full responsibility for all measures, curative and preventive, which are necessary for safeguarding the health of the nation, is developing as a logical sequence. The modern trend is towards the provision of as complete a health service as possible by the state and the inclusion, within its scope, of the largest possible proportion of the community. The need for assuring the distribution of medical benefits to all, irrespective of their ability to pay, has also received recognition* (17).

The report thus declared health care a fundamental right of all people, not a commodity accessible only to those who could afford to pay for it. The Constitution of Islamic Republic of Pakistan in its Article 38 states that the state will secure the wellbeing of people and provide health care to the people of Pakistan (18).

Under the constitution of Pakistan, health is a provincial issue, and most of the implementation takes place in the provinces through the respective health departments. However, the Federal Government deals with the decisions about health policy, formulation of plans and the main primary health care issues such as the expanded program on immunization (EPI), the malaria control program (MCP), acquired immunodeficiency syndrome (AIDS), drug policy, user charges and health insurance. The provincial decision-making hierarchy is the same as the federal level and includes divisional directors, project directors, principals of medical colleges and training schools for medical technicians and of nurses and lady health visitors. In addition, planning and finance departments play an important role in decision-making for provincial health issue (19).

Prior to independence and until the 1960s the health care delivery system in Pakistan consisted only of civil hospitals and district council dispensaries. Most of the rural population had little access to basic health facilities and services. The country's second five-year plan (1960-65) sought the establishment of 150 rural health centers (RHC) in West Pakistan over a period of five years (20). There were 616 RHCs in Pakistan by December 2000.

Basic health units (BHU) started in 1980 and during 1985-86 the government decided to establish one BHU in every union council. During 1991-92, government also decided to provide dispensaries in all larger union councils (table 2), (20).

Table 2. Province-wise distribution of health facilities (December 2000) according to Mursalin and Haque, (21).

Province	DHQ	THQ	Disp	TB	MCH	RHC	BHU	Total
Punjab	28	57	1,006	46	404	307	2,494	4,342
Sindh	11	44	309	1	41	119	781	1,306
*NWFP	15	10	623	24	112	100	1,135	2,019
Balochistan	18	-	652	9	76	58	432	1,227
*AJK	3	6	105	1	10	29	181	335
*FANA	3	21	99	0	1	0	15	139
*ICT	-	-	6	0	1	3	13	23
Total	78	138	2,800	81	645	616	5,051	9,409

NWFP=North West Frontier Province, AJK=Azad Jammu and Kashmir, ICT=Islamabad Capital Territory
DHQ=District Headquarter Hospitals, THQ=Tehsil headquarter hospitals, Disp=Dispensary, TB=Tuberculosis center, MCH=Maternity and Child Health Centers, RHC=Rural Health Center, BHU=Basic Health Unit

The health services delivery system in Pakistan is a mix of public (i.e., government) and private providers. In the public sector, federal, provincial, and some local governments operate tertiary care hospitals for the larger urban areas. In rural areas and smaller towns, the provincial governments (and the governments of FANA, AJK, ICT, and FATA) operate an extensive infrastructure of first-level care facilities and secondary care hospitals, supported by several federal programs. The government is by far the largest provider of hospital care in rural areas, and it is also the main provider of preventive care throughout the country. The majority of curative care is provided through the private for-profit sector.

The public health care delivery system is composed of four tiers:

- outreach and community-based activities that focus on immunization, sanitation, malaria control, maternal and child health, and family planning,
- primary care facilities, mainly for outpatient care,
- Tehsil (i.e., sub district) and district headquarter hospitals for basic inpatient care and outpatient care,
- tertiary care hospitals located in the major cities for more specialized inpatient care.

Primary care facilities are mostly managed by a Medical Officer (MO), except for Maternity and Child Health Centers (MCH) managed by Lady Health Visitors (LHV) and dispensaries which are managed by medical assistants. LHVs are trained midwives and the basic health care worker. Her mandate is primarily to provide outreach services, with a focus on maternal child health care, vaccination, and the provision of basic health advice. Lady Health Workers (LHW) are considered to be an important part of health services in the field of family planning, maternal and child health, immunization, nutrition and treatment of minor ailments.

3.1.1. Public health services

BHUs provide curative and preventive services for a catchment population of about 10,000–20,000 people (table 3).

RHCs provide more extensive outpatient services and some inpatient services, usually limited to short-term observation and treatment of patients who do not require transfer to a higher-level facility. RHCs serve catchment populations of about 25,000 to 50,000 people, and employ about 30 staffs, including several doctors and a number of paramedics**.** They typically have 10–20 beds and X-ray, laboratory, and minor surgery facilities.

Tehsil headquarter hospitals provide basic inpatient and outpatient services. They serve a catchment population of about 100,000–300,000 people with 40 to 50 beds and support services, including X-ray, laboratory and surgery facilities. District Headquarter Hospitals serve catchment populations of about one to two million people and provide a range of specialist care in addition to basic hospital and outpatient services. They typically have about 80-100 beds.

The District Health Officer (DHO) is responsible for all health services in the district. Managers of all Tehsil Headquarter Hospitals and first-level care facilities report to DHO. District Headquarter Hospitals are headed by Civil Surgeons, who, along with the DHOs, report to the Director General of Health at the provincial level. Tertiary care hospitals are directly under the Provincial Secretary of Health.

3.1.2. Private health services

The private health sector is dominated by more than 20,000 "clinics", small, office-based practices of general practitioners (table 3). These practices include more than 300 MCH Centers (also known as maternity homes), about 350 dispensaries, which are outpatient primary health care facilities, and more than 450 small to medium-sized diagnostic laboratories. There are also more than 500 small and medium-sized private hospitals with on average about 30 beds per hospital. They are equipped only for basic surgical, obstetric, and diagnostic procedures, and concentrate on low-risk care. In addition, there are a few large private hospitals, mainly run by non governmental organizations (NGO) and located in major cities. The private health services are concentrated in urban areas (21).

Table 3. A comparison of the public and private sector of the health care system in Pakistan 2003. Source: Ministry of Health (22).

PUBLIC SECTOR		**PRIVATE SECTOR**	
	Number		Number
Hospitals	906	Hospitals	106
Dispensaries	4,590	Small hospital	520
RHCs	550	General practitioners	20,000
BHUs	5,308	Maternity homes	300
MCH Centers	862	Dispensaries	340
TB Clinics	285	Laboratories	450
Total hospital beds	98,264 (1,443 persons / bed)	Health care NGOs	254

HUMAN RESOURSE FOR HEALTH		
	Number	
Doctors	96,248	1,506 persons / doctor
Dentists	4,622	31,371 persons /dentist
Nurses	40,019	3,623 persons / nurse
Lady health visitors	5,669	
Lady health workers	70,000	

3.2. The expanded program on immunization

Following the success of the smallpox eradication program, the World Health Organization (WHO) looked for other activities that could build on what had already been achieved. EPI was created in 1974. "Expanded" because most programs until then had just used smallpox, BCG, diphtheria, tetanus and pertussis (DTP) vaccines. The six diseases now chosen were tuberculosis, diphtheria, neonatal tetanus, whooping cough (pertussis), poliomyelitis and measles. Selection was made on the basis of a high burden of disease and the availability of well-tried vaccines at an affordable price. "Expanded" also meant increased coverage; less than five percent of

children in developing countries were at that time reached by immunization services (12).

3.2.1. The expanded program on immunization in Pakistan

EPI in Pakistan was launched in 1978 and become part of the accelerated health program in 1983. In its first year, the program was successful in achieving a very high immunization coverage of 95 percent in children aged two to five years and of 81 percent in children less than two years of age. The program was evaluated and commended by an international commission in 1984-5. Since then, however, the vaccination coverage has decreased. Presently, it is estimated to 54 percent; the coverage of pregnant women with tetanus toxoid is even lower (23).

A number of steps are being taken to improve EPI services through training of additional staff (e.g. LHWs) in vaccinations, improved surveillance, introduction of new vaccines like hepatitis B, provision of cold chain equipment and training. The government has been able to access funds from the Global Alliance for Vaccines and Immunization (GAVI) for strengthening EPI. The Pakistan EPI has taken up the challenge of eradicating poliomyelitis by reaching every child in the country (23).

Table 4. Pakistan EPI childhood immunization schedule following the WHO recommendation.

	Age				
Antigen	**Birth**	**6 weeks**	**10 weeks**	**14 weeks**	**9 months**
TB	BCG				
Polio		OPV 1	OPV 2	OPV 3	
Diphtheria ,tetanus, pertussis		DTP 1	DTP 2	DTP 3	
Hepatitis B*		Hep B 1	Hep B 2	Hep B 3	
Measles, Mumps, Rubella					MMR

* EPI included Hepatitis B for children born after June 31, 2001.

EPI now includes vaccination for young children against tuberculosis, polio, diphtheria, tetanus, pertussis, measles, mumps, rubella and lastly hepatitis B, which was included in EPI in June 2001 (table 4). It also includes vaccination against tetanus for pregnant women. Vaccination in the public sector is provided through a

combination of vaccination in static and outreach health facilities (operating out of static facilities or in mobile teams). The most recent comprehensive estimates of immunization coverage for children are from the 1995/96 Pakistan integrated household survey (PIHS 95/96). Nationwide, according to this survey, 78 percent of children five years and younger had at least one immunization compared to 70 percent in 1991 (PIHS 91). The percentage of children five years and younger who are fully immunized against the above listed six diseases was only 54 percent in 1995/96, however (25 percent 1991). Immunization coverage against tetanus toxoid in women of childbearing age was only 14 percent in 1995 according to Ministry of Health estimates (24).

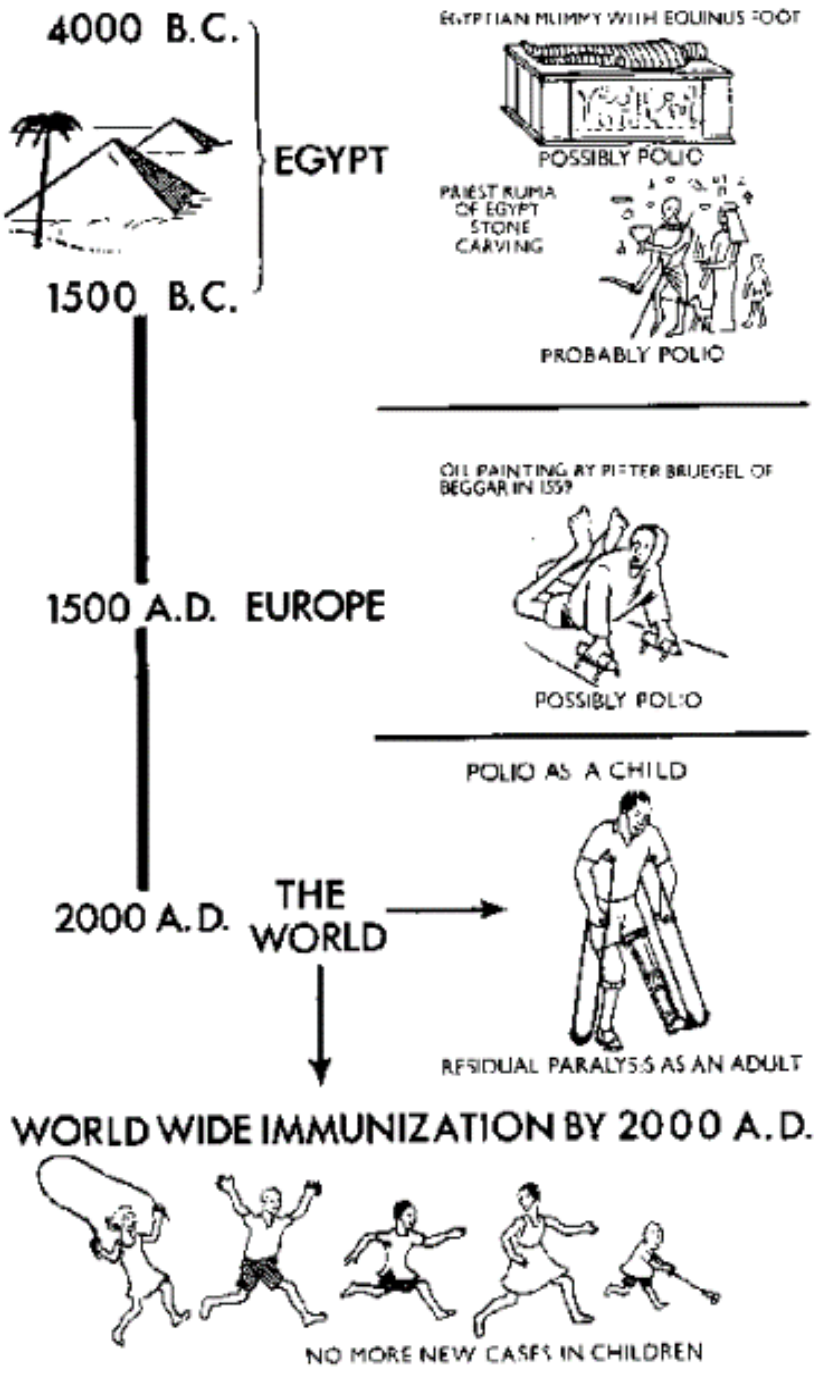

Figure 3. Polio through ages according to Huckstep (25).

3.3. Eradication of polio; general overview

In 1985, Pan American Health Organization (PAHO) joined in 1988 by WHO, initiated a program for the global eradication of polio (26).The Forty-first World Health Assembly (resolution WHA 41.28) established the goal of the global eradication of poliomyelitis. In 1999, the Fifty-second World Health Assembly in a resolution (WHA52.22) called on Member States to accelerate eradication activities (27).

The WHO's USD 3 billion Global Polio Eradication Initiative, launched in 1988, has been successful, lowering the number of polio cases from 350,000 in 1999 in 125 countries to just 235 in seven countries in the year 2003 (27).

At the Global Partners Summit held at United Nations (UN) in September 2000, participants from around the world pledged their commitment and launched the Global Polio Eradication Strategic Plan for 2001-2005 (28). The major components of this global strategy are to

- continue the high level of routine immunization of children under age five,
- intensify National Immunization Days (NIDs) and mop up campaigns (door to door immunization in high risk areas),
- strengthen national immunization programs,
- achieve certification-standard surveillance, for a minimum of three year through a global network of laboratories,
- contain all laboratory, hospital and all other medical stocks of the poliovirus,
- set a consensus of the time when immunization is to stop world wide.

3.4. Polio eradication in Pakistan

Over the past few years, significant progress has been made in implementing polio eradication strategies and reducing the transmission of poliovirus in Pakistan (fig 4) (App II). The Government of Pakistan has invested substantial human and financial resources to meet the global eradication goal. In addition, a large proportion of the total budget of EPI, which includes vaccine, international technical support and partial operational costs, has been provided partner agencies (29).

A study by Hennessey et al found that failure to vaccinate, especially through routine immunization, was the major risk factor for persisting paralytic poliomyelitis in Pakistan (9). Most polio cases had not completed routine immunization and had not received three OPV doses through routine and NID vaccination combined. About 50 percent of the cases had not received any routine immunization at all. Such non immune children are at highest risk for poliomyelitis and are unlikely to be fully protected until reached by two consecutive pairs of NIDs. Thus, because of low routine immunization coverage, a substantial proportion of children in Pakistan remain vulnerable to paralytic polio until two year of age (table 5).

To assure uniformly high routine immunization coverage, routine immunization should be made more widely and regularly available through fixed or mobile immunization posts throughout the country. Long distance to the immunization centers is an important cause of missed vaccinations, particularly in rural areas; although mobile teams are intended to reduce this barrier, teams frequently fail to reach even accessible rural villages. Expanding the system of fixed immunization centers and the number of health workers providing vaccination is now being considered by the Pakistan government. Improving routine immunization coverage will be challenging; efforts however, will have long-term benefits of improved infrastructure for immunization programs and increased immunization against other vaccine-preventable diseases. Results from the study by Hennessey et al did not show parents' literacy and type of health care as risk factors for poliomyelitis; however, since children were matched by neighborhood, the study design limits our ability to value the importance of these factors (9).

Table 5. Different immunization surveys of OPV3 coverage in Pakistan according to a WHO /UNICEF review of national immunization coverage, 1980-2002 (30).

Survey	**Year of Survey**	**Age group** (mo)	**Sample size**	**Card seen** (%)	**Coverage** (%)
Pakistan Integrated Household survey (PIH)	2001/02	12-23			89.0
Assessment of Immunization Coverage	2001/02	12-23	3,664	37.0	58.4
Pakistan Integrated Household survey (PIH)	1998/97	12-23			70.0
Pakistan Fertility and family planning survey	1996/97	12-35	4,421		35.5
Pakistan Integrated Household survey (PIH)	1995/96	12-35			58.0
Multiple Indicators Cluster survey of Pakistan	1995	12-35	2,223	13.0	37.0
EPI Program review in Pakistan	1991	12-35	1,698	91.1	95.6
Pakistan demographic and health surveys	1990/91	12-23	1,215	29.6	42.9
Pakistan demographic and health surveys	1990/91	12-23	1,215	29.6	32.6
EPI/ CDD-Pakistan Interprovincial Immunization coverage Evaluation	1987	12-23			81.0

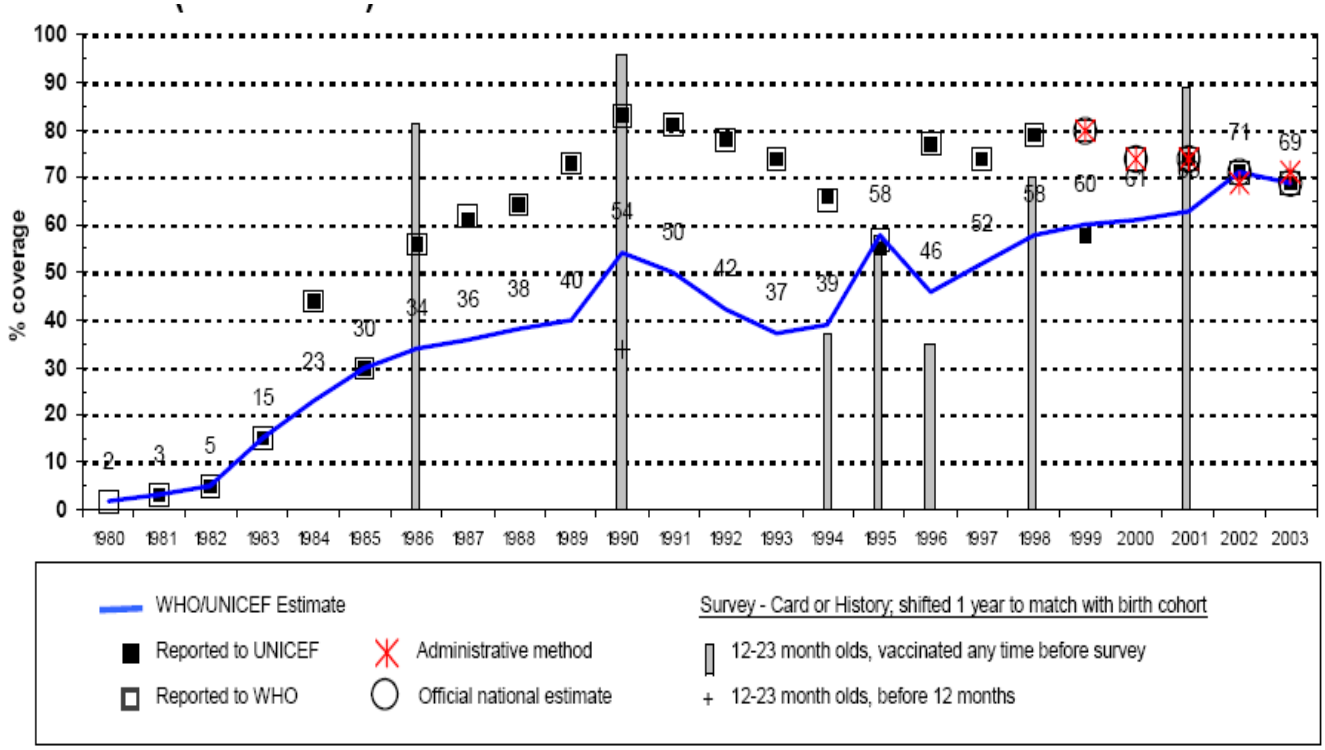

Figure 4. Description of the trend of OPV3 coverage1980-2002 according to the WHO UNICEF review of national immunization coverage, 1980-2002 (30).

Accelerated by UNICEF's Universal Childhood Immunization (UCI) efforts, coverage increased steadily until 1990. Between 1990 and 1993 there was a decline, mostly likely associated with withdrawal of external support. From 1993-95 program performance was compromised by erratic and dwindling supplies of vaccine. In 1994 government plans included full funding of routine immunization. Since 1994, the national government funds all routine immunization activities and coverage has increased to 1990 levels (fig 4). The estimates from 1996 through 2002 are based on DTP3 coverage found in EPI surveys (30).

3.4.1. Surveillance systems

Despite the EPI program staff hard work, several surveys did not find all reported cases (table 5), indicating the difficulties encountered by a polio program (31). Today's 677 cases could result in an epidemic if vigilance is not maintained (32). The key to polio eradication lies in an effective surveillance which finds all cases of AFP in children.

A sensitive surveillance system is one of the globally recommended four key strategies (33). Pakistan has an established and elaborated surveillance system comprising mainly of health managers, pediatricians, field staff and polio laboratories (34).

Polio is difficult to diagnose clinically and AFP is a symptom one could find with different etiologies. Since there are multiple causes of AFP, a laboratory based system is required to identify and report AFP cases. As the country approaches zero cases, it becomes increasingly important that the system is very sensitive and able to detect very low-level virus circulation which otherwise might persist undetected for many months.

To have consistency in the collaborative activity at all level, standard operating procedures are developed. AFP surveillance should proceed according to the following steps (34):

- identification of cases and reporting of all AFP cases less than 15 years old,
- notification of AFP cases by all health care providers, in the public and private sectors,
- visit of a team comprising of the District Surveillance Coordinator, District Supervisors Vaccination (DSV) and/or the vaccinator with in 48 hours of notification to confirm that the case is an AFP,
- collection of two stool samples 24-48 hours apart of the reported AFP case collected immediately after notification. Parents of all AFP cases are

encouraged through treating pediatricians or physicians to be admitted in a hospital till two specimens are collected,

- 60-day follow-up with the objective to find the presence of residual paralysis or weakness.

3.4.2. Campaigns

A NID was launched 1994; two rounds with annual campaigns, since then called Sub National Immunization Days (SNIDs), in 1997 and 1998; two full national campaigns in 2000. A door-to-door approach was adopted during SNIDs and with NIDs in 2000 (35).

These campaigns have been successful, and a survey sponsored by UNICEF in the summer 2001 measured more than 95 percent coverage in the third round in all three provinces checked. However, some critical reservoir districts still did not have coverage adequate to stop transmission. As Pakistan and Afghanistan share virus strains due to the constant movement of people across the border, campaigns are synchronized between the two countries, and vaccination posts are set up at the border crossing points. In 2000, polio eradication activities were intensified and Pakistan began holding an extra campaign each year and switched to a door-to door vaccine delivery strategy as part of a global intensification of activities in the few remaining endemic countries. Routine coverage in the country remains low, at less than 50 percent for fully vaccinated children, necessitating the continuation of special immunization campaigns to boost polio immunity in the population (fig 5) ,(36).

Vaccination should be integrated into the daily routine of health facilities and the vaccination status of mothers and children should be determined at each contact with the health center. Mass vaccination campaigns can dramatically increase coverage but are costly and require detailed planning and coordination between different levels, i.e. the public and government level (37).

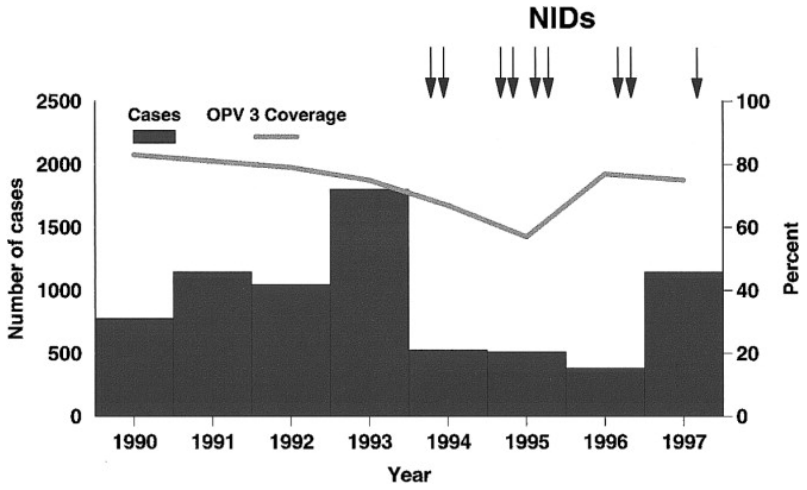

Figure 5. Reported poliomyelitis cases, routine oral poliovirus vaccine coverage (OPV 3), and national immunization days (NIDs) in Pakistan, 1990, according to Hennessey et al (9).

Table 6. Year-wise Acute Flaccid Paralysis (AFP) polio cases and rates according to the AFP surveillance manual (38).

Year	**Total number of AFP cases expected**	**Total number of AFP cases reported**	**Diagnosed**				**Follow up**		**Non polio AFP cases /100,000 < 15 year old§**
			"Compatible" (number)	**Confirmed by virology** (number)	**AFP** (number)	**Non polio AFP** (number)	**2 stools within 14 days** (%)	**60 days follow up** (%)	
1997	606*	1,633	936	219	1,155	478	42	100	0.80
1998	607**	758	185	156	341	417	60	100	0.70
1999	608**	1,329	234	324	558	771	61	100	1.30
2000	647**	1,152	54	199	253	899	67	99	1.50
2001	658**	1,565	37	116	153	1,412	83	98	2.1

***** Based on population figures from the 1981 census. ** Based on population figures from the 1998 census

§ Non-polio AFP per 100,000 children less than 15 years, based on aggregate data. Expected rate is at least 1 per 100,000 children below 15 years of age.

Table 6 presents some indicators of the surveillance system of polio cases in Pakistan for the years 1997 to 2001 and shows improvement in collection of specimens within 14 days and 60 days, around 80 and 100 percent, respectively. Satisfactory surveillance should detect at least one case of non-polio AFP per year per 100 000 children less than 15 years old and in Pakistan it is improved from 0.80 to 2.1 cases per 100,000 children.

4. The proposed study

4.1. Objectives

The objectives of the planned study are to

- determine immunization coverage for OPV,
- asses factors associated with non immunization and non participation in immunization activities of the polio eradication program,
- verify the reported official coverage data of polio immunization,
- give background data for the improvement of the polio vaccination coverage.

4.2. Subjects and methods

4.2.1. Study design

The design is descriptive and based on a community survey. The basic sampling unit (BSU) will be a household defined as consisting of one or more persons who live in the same compound and may or may not be related to one another. To be sampled the household must include a child aged 12-23 months.

4.2.2. Sampling

A modified form of EPI stratified multistage sampling method will be used (5). The administrative districts will be selected strategically by taking two districts from each province. The selection of these districts would be made according to number of new polio confirmed cases during last six months; one district with the highest and one with the lowest number of cases. In the second stage these eight districts will be stratified into urban, rural and slum area localities in cities. In urban areas it can be urban blocks or localities; in rural areas villages where slum areas would be those areas declared to be so by official authorities. Then 24 clusters consisting of urban blocks or villages or slum areas will be selected by probability proportion to size

(PPS), eight clusters each from the urban, rural and slum areas. In each cluster ten children will be interviewed (fig 6). To simplify the study it is assumed that any woman with a child aged 12–23 months who lives in a particular household represent the experience of all the women who lives in that household and have children of the same age. Based on this assumption, only one woman per household is interviewed, in essence making the household the sampling unit. This strategy will avoid redundancy, improve the distribution of the sample and reduce design effects. It will also help in reducing the homogeneity within each cluster as one child per household would be selected, so that the precision of the survey estimates can be increased (5).

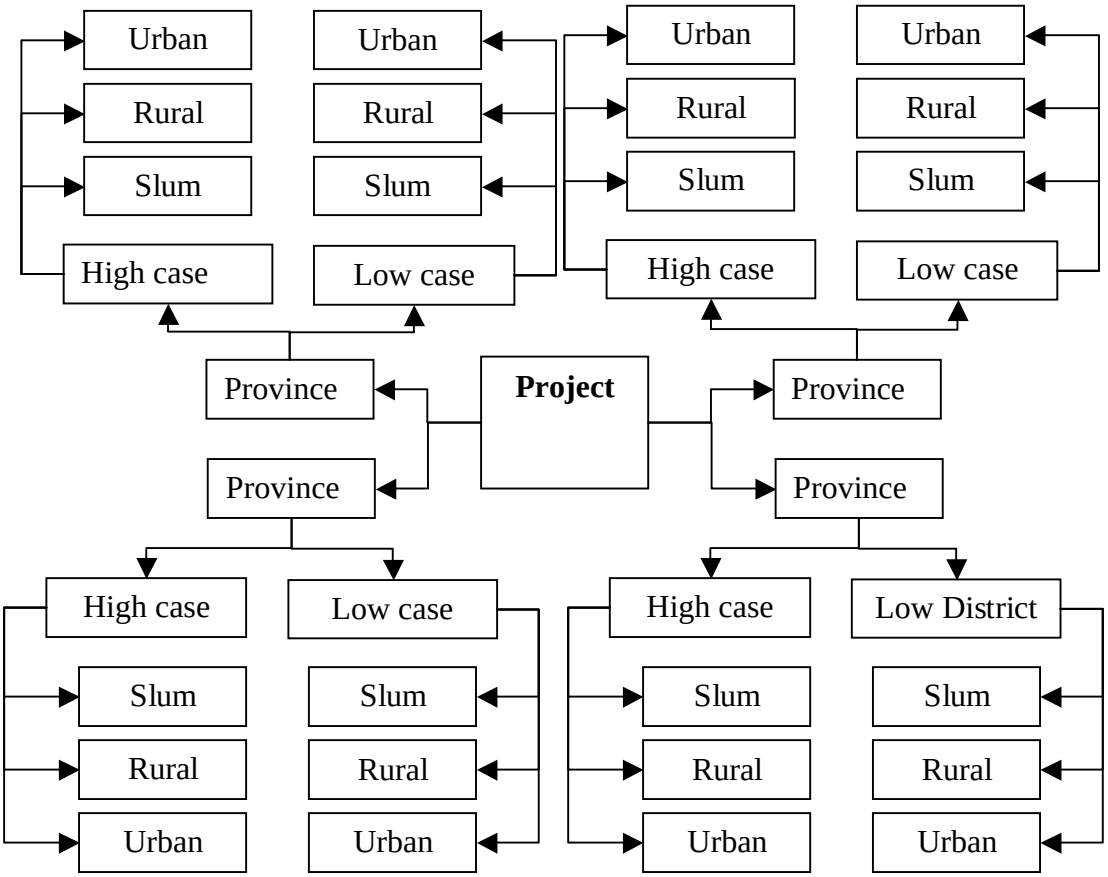

Figure 6. Sampling scheme inspired by the WHO EPI cluster sampling methodology (5).

4.2.3. Sample size

The sample size is the number of individuals to be included in the survey to "represent" the population of interest. If simple random sampling is used to estimate

coverage, the sample size would be 92 children. To correct for the design effect 184 children would be needed (5). In order to increase the precision the sample size is set to 240; 24 clusters with 10 children in each.

4.2.4. Questionnaire

A WHO EPI cluster survey questionnaire will be used where additionally structured questions on socio-economic, demographic and maternal knowledge of immunization are added (5). A printed standard questionnaire into the local language Urdu will be used to collect information from each eligible household by interviewing the mother or female caregiver of a child of the actual age. Each interviewee is asked her children's ages, her own age, occupation and level of education, who in the household decided whether a child would be immunized, how important she consider routine immunization to be, how much she has participated in immunization programs, and where she obtained the relevant information. The vaccination history of the interviewee's child or children aged 12–23 months will be ascertained from the relevant medical cards issued by the area vaccinator or the health center, information recalled by the mothers, or both. Each interview will last for about one hour. If the potential interviewee is temporarily absent, up to two revisits are made. After that, if there still has been no interview in the household selected, the interviewer substitutes the nearest eligible household to the right hand side of the interviewer facing the non-interview household.

The questionnaire will be pretested two weeks before the survey in an urban, a slum area and a rural setting with 10 mothers of children aged 12-23 months and corrections made by the research team before the start of the main study (5).

4.2.5. Selection of households

In urban areas the starting point is selected randomly by creating a list of different localities/urban blocks and one urban block selected randomly. In rural and slum areas the first household is selected by someone standing in the main bazaar/market of area and spinning a bottle. The first visit is made in the house pointed at by the bottle, when it has stopped spinning; a way of ensuring a random choice (5).

4.2.6. Interviewer training

Before conducting the survey a two day training session of interviewers is to be conducted which include field exercise data collection. Interviewers can be LHWs or in case of unavailability, school teachers of same area. The training is conducted by a medical doctor nominated by DHO of the same district, who will also be the superviser for the survey of that district.

4.2.7. Advance notice

A letter will be sent to local religious leaders and politicians, to announce the presence of interviewers in the area. The letter will include a description of the goals and rationale for the survey. Leaders will be asked to inform community members of the survey and encourage their participation.

4.2.8. Data management

All stages of data collection will be carefully supervised and monitored by myself. The data captured in the questionnaire will be later be transferred to computer software, EPI Info by data entry operators, especially hired for the project. To validate the data entry process there will be rechecking of 25 per cent of completed questionnaires taken randomly each day of data entry. This rechecking will be beside the built in feature of EPI Info software.

4.2.9. Data analysis

The survey data will be used for estimates of coverage rendered by point estimates and their respective 95 percent confidence intervals.

The point estimates will be broken down by age in months, sex, numbers of polio vaccinations as well as the other EPI immunizations but also by geographical areas such as districts and regions. Data from the structured questionnaire will be used to

study the determinants of vaccination. Pearson Chi-square test will be used to compare immunization coverage among various groups and difference will be reported to be statistically significant when two tail Pearson chi square p-value will be less than 0.05.Multiple logistic regression will be perform to analyze the factors associated with non immunizations with significance level p=0.05. Administrative data, which is routinely collected at DHO office and used to calculate coverage levels for different health unit catchment areas within the district, will be used for comparisons with our survey point estimates.

4.3. Ethical considerations

Ethical clearance is to be obtained from the Ethics committee of the Medical School in the chosen area. Administrative clearance is to be obtained from provincial and district authorities. Informed verbal consent is to be given by all of the study community i.e. the mother or caretaker of the child bringing it to their notice that results would be available publicly and results may use for further studies. Further more, information about the other outcome like improvement in coverage and prevention activities.

4.4. Time schedule

A timetable of 10 months is estimated for this proposed project and it is planned as follow:

Activity (months)	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**
Start of the project, identifying local conditions and resources										
Convene study team and meeting of team elaboration of the detailed research design										
Identify and involve local counterparts i.e persons, organizations										
Visit and selection of micro regions of districts										
Translation of questionnaire, pre testing and printing										
Recruitment of surveyors and supervisors										
Training										
Survey period field work										
Data entry										
Final analysis and interpretation of the research data										
Report writing										
Report dissemination										

4.5. Budget

The budget of the project is an estimate. For the application for funding the principle investigater will need to identify local resources, since the cost may vary according to local conditions. The costs of conducting the study consists of expenses from the start of the project to the dissemination of the report.

Category	**Description**	**Estimated Cost** (US $)
Study Team	Principal investigater and technical group, remuneration meetings implementing the project	15,000
Staff	Training and study protocol for supervisers and interviewers	2,100
	Doctors (4),supervisers (8), interviewers (24)	7,000
Data Mangement	Data management, entry assistant , statistical analysis	5,000
	Equipment: computer, printer, fax	1,500
	Survey report: printing	1,000
To visiting micro region	Transportation	6,000
	Accommodation	2,500
Main office	Rent, stationary	2,500
	Utility bills, i.e. telephone, internet, electricity	2,000
Subtotal		**44,600**
Incidental expenses (10% of cost)		4,460
Grand Total		**49,060**

5. Discussion

In order to monitor the health status of a population and to evaluate the use and effectiveness of disease protection and control measure, up-to-date information is required (5). Epidemiological methods play an important role in the evaluation of an immunization program. These methods include monitoring vaccine coverage, surveillance of the occurrence of vaccine-preventable diseases and serological surveillance (39).

The EPI of the WHO has popularized the use of a particular cluster sample survey design in developing countries for rapid assessment of vaccination coverage. Even under difficult field conditions, the survey has proved to be affordable and relatively easy to implement and analyze (40).

The result from the survey will give a picture of the EPI program. This result will indicate the flaws and weakness of the vaccination program and lead to formulate recommendations to address the problems. This will help the policy and decisionmakers to take action in time so Pakistan can achieve polio eradication.

All evaluation methods have advantages and limitations. Cluster surveys can provide more accurate measurements of actual coverage for the area surveyed as a whole. However, because of the limited sampling scheme, they do not distinguish which part of the area studied might require additional attention. Because they are also fairly costly, time consuming and require a high level of staff training, they are difficult to implement as a continuous evaluation tool.

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7. Appendices

Appendix I

Polio timeline

Still, there is a general consensus that cases of polio, if not sporadic epidemics, pre-date recorded history. As evidence of the early existence of poliomyelitis, Paul (1971) and other writers offer an Egyptian stele (stone carving) dating between 1580 and 1350 B.C. that shows a young man with an atrophied leg, which looks like a limb deformity that might have been caused by polio (25,41).

Ancient Egypt 3,700 B.C. - An Egyptian mummy with probable polio. If this was polio, cases almost certainly occurred before then.

1,580 - 1,350 B.C. - The Priest Ruma with a withered leg and equinus foot - shown on a plaque and probably poliomyelitis.

1,209 B.C. - Mummy Giptah with an equinus foot.

1559 - Painting by Pieter Bruegel showing a crippled beggar. Not necessarily polio although it probably did occur during this period in England.

1789 - British physician Michael Underwood provides the first clinical description of polio, referring to it as "debility of the lower extremities."

1840 - German physician Jacob von Heine publishes a 78-page monograph in which not only describes the clinical features of the disease, but also notes that its symptoms suggest the involvement of the spinal cord.

1834 - First epidemic of poliomyelitis in the island of St. Helena.

1855 - First description by Duchenne of the pathological process in poliomyelitis with the involvement of the anterior horn cells of the spinal cord

1894 - The first major polio epidemic reported in the United States occurs in Vermont, consisting of 132 total cases, including some adults.

1908- Polio becomes a reportable disease entity as Austrian physicians Karl Landsteiner and E. Popper identify the polio virus.

1909 - Passage of the virus through a monkey by Flexner.

1916 - There is a large outbreak of polio in the United States. Though the total number of affected individuals is unknown, over 9000 cases are reported in New

York City alone. Attempts at controlling the disease largely involve the use of isolation and quarantine, neither of which is successful.

1935 - Physicians Maurice Brodie and John Kollmer compete against each other, with each trying to be the first to develop a successful polio vaccine. Field trials fail with disastrous results as the vaccines are blamed for causing many cases of polio, some of which are fatal.

1948 - Salk's laboratory is one of four awarded research grants for the polio virus typing project. Salk decides to u se the newly developed tissue culture method of cultivating and working with the polio virus that has recently been developed by John Enders at Harvard University. Other researchers, including Albert Sabin, who would later develop the oral polio vaccine, continue to do their work with monkeys infected with the polio virus, a more difficult and time-consuming process.

1954 - Massive field trials of the Salk vaccine are sponsored by the National Foundation for Infantile Paralysis.

1954 - Nobel Peace Prize in Physiology or Medicine awarded to John Franklin Enders, Thomas Huckle Weller and Frederick Chapman Robbins for their discovery of the ability of poliomyelitis viruses to grow in cultures of various types of tissue.

1955 - First inactivated polio vaccine announced by Dr. Jonas Salk. 1.8 million School children participate in trials of the Salk vaccine.

1958 and 1959 - Field trials prove the Sabin oral vaccine, which uses live, attenuated (weakened) virus, to be effective.

1961 - Dr. Albert Sabin's oral polio vaccine approved for use by the American Medical Association.

1962 - The Salk vaccine is replaced by the Sabin oral vaccine, which is not only superior in terms of ease of administration, but also provides longer-lasting immunization.

1974 - The World Health Organization begins its Expanded Program on Immunization to combat measles, diphtheria, pertussis, tetanus, tuberculosis, and polio.

1988 - With approximately 350, 000 cases of polio occurring worldwide, the World Health Organization passes a resolution to eradicate polio by the year 2000.

1993 - The total number of reported polio cases worldwide falls to about 100, 000. Most of these cases occur in Asia and Africa.

1994 - China launches its first National Immunization Days, immunizing 80 million children! The entire Western Hemisphere is certified as "polio free. and The Americas are certified polio-free!

1995 - Nearly 300 million children receive OPV during NIDs conducted in 51 countries including China and India. This represents almost 50 percent of all the world's children under the age of five.

1996 - 26 sub-Saharan African countries hold coordinated NIDs against polio, signaling the beginning of the last push against the crippling disease. Over 50 million children are to be immunized.150 polio-free countries worldwide.

1997 - More than 260 million children are vaccinated in nine countries in Asia.

1999 - More than 450 million children are vaccinated, including nearly 147 million in India. In the 11 years since the World Health Assembly Initiative, the number of reported cases worldwide has fallen to approximately 7,000.

2000 - Wars, natural disasters, and poverty in about 30 Asian and African nations prevent the complete eradication of polio. There is even a polio outbreak in Haiti and the Dominican Republic, which along with the rest of the western hemisphere had been polio free since the early 1990s. A new target date for worldwide eradication of 2005 is now set by the Global Polio Eradication Initiative.

2001 - 575 million children are vaccinated in 94 countries.

2004 - Ministers of Health from the six remaining polio-epidemic countries assured that polio will be eliminated before the year's end.

2005 - Anticipation of a polio-free world (25, 41).

Appendix II

District and yearwise confirmed polio cases. Data as of March 2004 by the courtesy of Dr Tahir Mir, National Surveillance Coordinator, World Health Organization Pakistan.

District and year wise confirmed polio cases								
DISTRICT	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
ABOTABAD	3	1	1	0	1	0	0	0
ATTOCK	4	0	0	0	0	0	0	0
AWARAN	0	1	0	0	0	0	0	0
BADIN	18	20	6	1	2	0	2	0
BAGH	1	0	0	0	0	0	0	0
BAHAWALPUR	35	4	5	1	1	0	0	0
BAHWLNAGAR	23	1	7	1	0	0	0	0
BAJOUR	9	0	19	5	0	2	1	0
BANNU	36	1	6	6	3	1	1	0
BATAGRAM	1	0	0	0	0	0	0	0
BHAKKAR	8	0	0	0	0	0	0	0
BOLAN	3	1	5	0	0	0	0	0
BUNIR	13	6	3	2	0	0	2	0
CDA	0	0	12	2	0	0	0	0
CHAGHAI	4	1	2	0	1	0	0	0
CHAKWAL	0	1	1	0	0	0	0	0
CHARSADA	7	5	6	5	0	1	1	0
DADU	21	11	2	2	1	3	3	0
DBUGTI	0	0	0	0	0	0	1	0
DGKHAN	34	9	21	0	14	5	0	0
DIAMIR	1	4	0	0	0	0	0	0
DIKHAN	10	3	3	2	0	15	0	0
DIR	17	0	0	0	0	0	0	0
DIRLOWER	0	0	0	0	1	0	1	0
DIRUPPER	0	0	0	0	0	0	1	0
FAISALABAD	57	6	25	7	2	0	2	1
GHOTKI	4	2	6	1	1	11	0	0
GILGIT	2	0	0	0	0	0	0	0
GUJRANWALA	14	0	9	3	2	1	0	0
GUJRAT	5	0	2	0	0	0	0	0
GWADUR	1	0	0	0	1	0	0	0

HAFIZABAD	5	0	4	5	0	0	0	0
HANGU	0	0	0	0	0	1	0	0
HARIPUR	0	0	2	0	0	0	0	0
HYDERABAD	24	23	13	7	8	1	0	0
ISLAMABAD	0	5	0	0	0	0	0	0
JACOBABAD	11	9	3	9	6	1	3	0
JAFARABAD	8	4	4	0	0	0	0	0
JHALMAGSI	0	1	0	0	0	0	0	0
JHANG	30	0	8	5	0	0	0	0
JHELUM	1	1	0	0	0	0	0	0
KABDULAH	5	1	3	4	1	2	6	0
KALAT	5	0	1	0	0	0	2	0
KARACHICEN	7	6	6	3	0	1	0	0
KARACHIEST	17	3	5	5	0	0	0	0
KARACHIMLR	15	12	7	5	5	2	0	0
KARACHIS	10	4	2	2	0	0	0	0
KARACHIW	46	27	12	7	2	0	0	0
KARAK	6	0	1	0	0	0	0	0
KASUR	38	2	19	4	1	0	2	0
KECH	5	2	0	0	0	0	0	0
KHAIRPUR	4	6	1	6	0	8	2	0
KHANEWAL	17	3	6	1	0	0	1	0
KHIGIQBAL	0	0	0	0	0	0	1	0
KHISITE	0	0	0	0	0	0	1	0
KHUSHAB	7	1	2	2	0	0	0	0
KHUZDAR	0	2	0	0	0	0	0	0
KHYBER	1	1	11	2	4	1	7	0
KOHAT	11	5	11	0	0	0	0	0
KOHISTAN	2	0	2	0	0	0	0	0
KOHLU	0	2	2	0	0	0	0	0
KOTLI	0	0	0	1	0	0	0	0
KSAIFULAH	0	0	1	0	0	0	1	0
KURRAM	1	0	0	0	0	0	0	0
LAHORE	31	2	10	3	0	1	1	0
LAKKIMRWT	35	1	5	3	2	0	5	0
LARKANA	11	9	6	6	1	10	5	0
LASBELA	1	0	2	0	0	0	0	0
LAYYAH	3	1	0	0	1	0	0	0
LODHRAN	3	7	4	5	0	0	2	0

LORALAI	0	0	5	0	0	1	1	0
MALAKAND	0	0	2	2	0	1	0	0
MANSEHRA	6	1	5	1	0	0	0	0
MARDAN	2	5	7	5	3	1	2	0
MASTUNG	1	2	1	0	0	0	0	0
MBDIN	5	0	0	0	0	0	0	0
MIANWALI	5	2	3	0	0	0	0	0
MIRPUR	0	1	2	1	0	0	0	0
MIRPURKHAS	10	4	4	0	1	0	1	0
MOHMAND	0	0	3	1	3	2	1	0
MULTAN	12	2	7	2	0	0	2	0
MUSAKHEL	0	0	1	0	0	0	0	0
MUZAFFARABAD	0	1	1	0	0	0	0	0
MUZFARGARH	49	7	16	1	3	1	3	2
NAROWAL	9	1	6	3	0	0	1	0
NAWABSHAH	9	4	2	0	0	1	1	0
NFEROZ	10	3	8	2	0	0	2	0
NOWSHERA	10	3	3	0	1	3	0	1
NSIRABAD	4	1	4	6	4	1	1	0
OKARA	7	0	4	0	0	0	3	0
ORAKZAI	2	0	0	0	1	0	0	0
PAKPATTEN	9	0	0	1	0	0	2	0
PANJGOUR	0	2	1	0	0	0	0	0
PESHAWAR	10	17	31	19	7	4	1	1
PISHIN	2	0	2	3	0	0	1	0
POONCH	0	0	1	0	0	0	0	0
QUETTA	35	10	31	4	7	2	0	0
RAJANPUR	15	0	12	1	16	2	0	0
RAWALPINDI	11	2	4	3	1	0	0	0
RYKHAN	18	4	13	0	4	1	0	0
SAHIWAL	3	0	2	1	0	0	1	0
SANGHAR	9	13	5	4	0	0	0	0
SARGODHA	12	2	8	2	0	0	0	0
SHANGLA	0	0	0	0	0	0	1	0
SHEIKUPURA	51	3	13	3	0	0	3	0
SHIKARPUR	6	6	4	1	0	0	1	0
SIALKOT	29	2	10	0	0	0	0	0
SIBI	0	0	1	1	1	0	0	0
SUKKUR	12	3	2	2	0	1	0	0

SWABI	5	1	1	0	1	0	0	0
SWAT	40	2	4	4	1	0	5	0
TANK	2	0	4	0	0	0	0	0
THARPARKAR	1	1	1	0	0	0	0	0
THATTA	13	11	7	2	1	0	7	0
TTSINGH	4	0	4	0	0	0	0	0
UMERKOT	16	8	1	0	0	0	0	0
VEHARI	11	0	6	1	0	0	1	0
WAZIR-N	7	0	5	0	3	1	4	0
WAZIR-S	0	0	1	0	0	0	0	0
ZHOB	1	0	6	0	0	1	2	0
ZIARAT	1	0	0	0	0	0	0	0
Total	**1155**	**341**	**558**	**199**	**119**	**90**	**101**	**5**

*** Upto 99 Polio cases include both clinical & virological diagnoses & from 2000 virological confirmed only**