ESTIMATING ORAL POLIO VACCINE COVERAGE DROPOUTS FOR EQUITABILITY: EVIDENCE FROM PAKISTAN

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ABSTRACT

Objective: To analyze the effectiveness of expanded program on immunization (EPI) in Pakistan by finding proportion of children who have received at least one dose of oral polio vaccine (OPV) to prevent poliomyelitis but failed to receive 2nd & 3rd dose before the end of their 1st year of life.

Study Design: Retrospective study.

Place and Duration of Study: The study was carried out at Sustainable Development Institute, COMSATS Institute of Information Technology and National Defense University Islamabad, from Jan 2015 to Mar 2016.

Material and Methods: Method of multivariate regression and odds ratio were used on Pakistan demographic and house hold survey micro-datasets to analyze the effectiveness of expanded program on immunization (EPI) in Pakistan by finding the proportion of children who have received at least one dose of oral polio vaccine (OPV) to prevent poliomyelitis. Drop-out (DO) rate was calculated in order to assess effectiveness of coverage-breadth.

Results: Gaps in service delivery, ineffective communication with mothers and entwined poverty dimensions are contributors to low coverage statistics and Drop-out (DO) rate of children in context of polio vaccination. Female children do not benefit to the same extent from polio vaccination efforts as male counterparts. Empowered mothers with good health seeking behavior care better for their children. Education is another key factor with major impact on health system service utilization and acceptability.

Conclusion: Gaps in service delivery, ineffective communication with mothers and entwined poverty dimensions are contributors to low coverage statistics. Education is the key factor with major impact on health system service utilization and acceptability. Due to cultural norms in society gender discrimination is observed in all provinces which shows that girls are more likely to be vulnerable as compare to their male counterparts.

Keywords: Equitable delivery, Polio, Program evaluation, Systems research.

INTRODUCTION

Vaccination is a cost effective inter-vention to prevent humans from viral disease morbidity[1]. World Health Organization targets 12-23 month children for 8 doses[1] of vaccines against Tuberculosis, Diphtheria, Pertussis, Neonatal tetanus, Hepatitis-B, Hemophilic influenzae Type B [Hib], Poliomyelitis, and Measles. Pakistan is fighting against these diseases since 1978. On average 40 polio cases are reported in Pakistan annually for the period (2008-12) (figure). In recent years, international pressure on Pakistan has mounted being the one of only two nations in the world to not have eradicated polio[2].

Initially expanded program on immuni-zation (EPI) in Pakistan aimed to eradicate Polio by 2012, measles and tetanus by 2015[3]. In 2002, vaccine against Hepatitis was included, then Hib meningitis & pneumonia added in 2008 and pneumococcal was added in 2012 to the program to meet the standard 8 dose full immunization against 9 preventable diseases i.e. poliomyelitis, neonatal tetanus, measles, diphtheria, pertussis (whooping cough), hepatitis-B, Hib pneumonia, meningitis and childhood tuberculosis among 12-23 month children[2]. EPI in Pakistan is focusing polio through a schedule presented in table-I.

The rationale of this study was to assess the effectiveness of service delivery by EPIP through estimation of trend of the proportion of children who have received at least one dose of oral polio

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vaccine (OPV) to prevent poliomyelitis, but failed to receive their second and third dose to complete the schedule before the end of the first year of life.

MATERIAL AND METHODS

This study was conducted at COMSATS

months of age. A total of 4811 children were selected using stratified random sampling technique from all three rounds (1215 from 1990-91, 1522 from 2006-07 and 2074 from 2012-13 round respectively). The sample size was selected on the availability of subjects in the relevant cohort. PDHS collects extensive information on

Table-I: Expanded program on immunization in Pakistan immunization schedule.

Disease	Causes of infection	Vaccine	Doses	Age of administration
Childhood Tuberculosis	Bacteria	BCG	1	0 age or at birth
Poliomyelitis	Virus	OPV	4	OPV-0 : At birth
Diphtheria Tetanus Pertussis	Bacteria Bacteria Bacteria	Pentavalent vaccine (DPT + Hep. B + Hib)	3	Penta-1 : 6 weeks Penta-2 : 10 weeks Penta-3 : 14 weeks
Pneumoniae and Meningitis due to S. Pneumonia	Bacteria	PCV10	3	Pneumo-1 : 6 weeks Pneumo-2 : 10 weeks Pneumo-3 : 14 weeks
Measles	Virus	MMRV[3]	2	Measles-1 : 9 months Measles-2 : 15months

Institute of Information Technology and National Defense University Islamabad from January 2015 to March 2016. This is a retrospective study that utilizes data from three rounds 1990-91, 2006-07,

basic health indicators of children under 5 and women of reproductive age i.e. 15 years-49 years. Information about children 12-23 months of age on immunization status; viz, health attributes
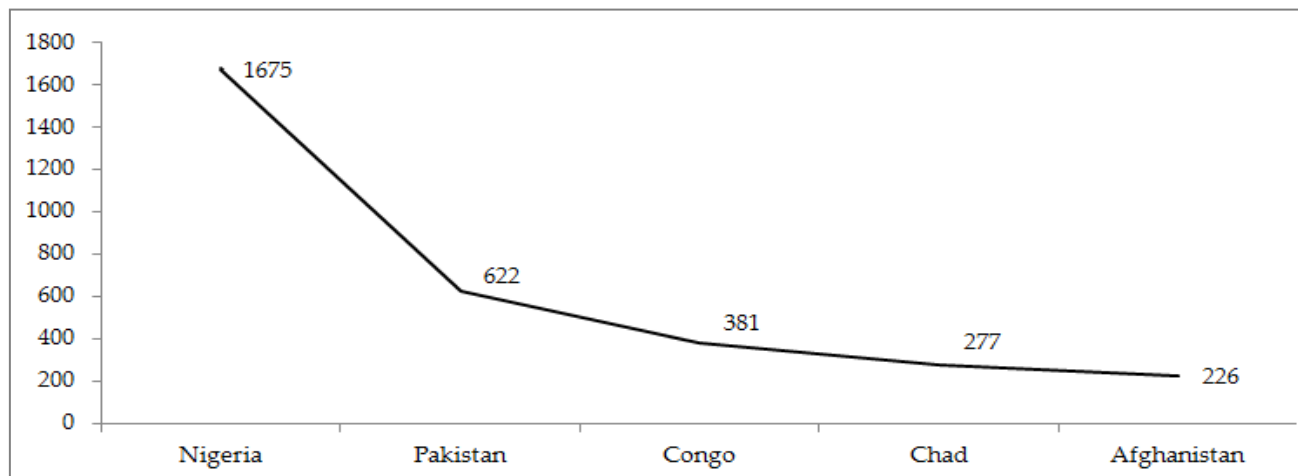
Figure: Top five countries endemic to Polio virus in five years (2008-12).
Source: Annual WHO/UNICEF Joint Reporting Form and WHO; Regional offices report, Update October 2013.

2012-13 of Pakistan demographic health survey (PDHS) to analyze polio dropout incidences. Observation unit comprised of children 12-23

and vaccine uptake is available from "Child vaccination, health and nutrition" section of "Women Questionnaire".

Response indicator was defined as whether the child (12m-23m) has been dropped out (coded '1') or not (coded '0'). Drop-out (DO) rate was calculated in order to assess effectivity of coverage breadth. The DO formula was and confounded as failure of planning objective. Difference of ratio between incidences of initial vaccine dose OPV1 and final vaccine dose OPV3 was calculated using the formula; $DO = $ Rate of dropout $= \left[\frac{OPV1 - OPV3}{OPV1}\right]$. DO may range

Table-II: Percent distribution of children age 12-23 months by their status of vaccination against Polio virus (OPV1-OPV3) and Socio-Demographic characteristics in Pakistan.

Variables	Levels	PDHS 1990-91 Full doses Yes (%)	No (%)	N	Never Yes (%)	No (%)	N	Drop-outs Yes (%)	No (%)	N	PDHS 2006-07 Full doses Yes (%)	No (%)	N	Never Yes (%)	No (%)	N	Drop-outs Yes (%)	No (%)	N	PDHS 2012-13 Full doses Yes (%)	No (%)	N	Never Yes (%)	No (%)	N	Drop-outs Yes (%)	No (%)	N
Mother's age at 1st marriage	>19	38.4	61.6	726	37.2	62.8	726	80.1	19.9	221	82.7	17.3	871	8.5	91.5	871	17.1	82.9	444	82.1	17.9	1044	9.6	90.4	1044	18.3	81.7	469
	19-24	48.8	51.2	406	23.9	76.1	406	72.4	27.6	152	83.7	16.3	510	4.5	95.5	510	29.3	70.7	198	88.9	11.1	844	5.8	94.2	844	14.1	85.9	284
	<25	53.7	46.3	83	28.9	71.1	83	60	40	25	83	17	341	5.7	94.3	341	35.7	64.3	43	86.6	13.4	186	5.9	94.1	186	32.6	67.4	43
Birth order	1-2	40.3	59.7	409	27.4	72.6	409	81	19	164	84	16	619	6.6	93.4	619	22.6	77.4	252	86.1	13.9	964	8	92	964	18.3	81.7	295
	3-4	43.9	56.1	358	31.3	68.7	358	75.4	24.6	118	80.8	19.2	407	7.1	92.9	407	26.8	73.2	179	86.6	13.4	575	7.3	92.7	575	13.1	86.9	246
	<5	44.6	55.4	448	37.3	62.7	448	69.8	30.2	116	83.7	16.3	496	7.1	92.9	496	17	83	253	82.4	17.6	535	7.5	92.5	535	20.8	79.2	255
Gender of child	Male	45.8	54.2	586	29.7	70.3	586	78.7	21.3	184	84.4	15.6	816	6.5	93.5	816	20.5	79.5	351	86.1	13.9	1050	7	93	1050	17.4	82.6	385
	Female	40.2	59.8	629	34.6	65.4	629	73.8	26.2	214	81.6	18.4	706	7.4	92.6	706	23.1	76.9	334	84.5	15.5	1024	8.3	91.7	1024	17.8	82.2	411
Mother education	Uneducated	38.2	61.8	929	39.5	60.5	929	76.7	23.3	271	79.9	20.1	948	9.1	90.9	948	20.3	79.7	498	81.9	18.1	1118	9.4	90.6	1118	16.3	83.7	565
	Primary to Secondary	58.2	41.8	189	11.1	88.9	189	69.9	30.1	83	87.6	12.4	346	3.8	96.2	346	23.8	76.2	126	87.8	12.2	517	6.4	93.6	517	20.1	79.9	139
	Secondary and above	58.8	41.2	97	4.1	95.9	97	84	16	44	89.5	10.5	228	2.6	97.4	228	29.5	70.5	61	90.7	9.3	439	5	95	439	22	78	92
N (Total)		522	693	1215	392	823	1215	302	96	398	1264	258	1522	107	1415	1522	150	535	685	1769	305	2074	160	1914	2074	139	657	796

"N" sample size for respective category.

consistent under assumption that it pertains to those children (12m-23m) who (a) 'Missed' i.e. did not receive OPV1, OPV2, OPV3 (b) 'Discontinued' i.e. did not receive OPV1 through OPV3 sequentially according to schedule. Hence, coverage for target population remains partial from 0% to 100%. A decreasing dropout rate would implicate stronger coverage for outcome. Multinomial Logit model was used to find odd ratios that helped to draw comparison across different groups of the sample. As OPV is part of polio campaign yet in Pakistani context it covers

a substantial part of this activity and hence considered an appropriate measure for polio.

SPSS software (version 18) was used to analyze data.

RESULTS

Total number of subjects in the study is 4811 selected from three rounds of PDHS based on the availability of subjects in the relevant cohort.

Across 1991 to 2013 mother's age at first marriage was a relevant factor in determination of dropout percentage. Reproductive health care service is significant across the years but father's education is significant for 1991 and 2013. It insignificantly measures vertical equity for OPV. In 2013, household wealth was a significant characteristic in relation to vaccination intake (table-II). The significance level is based on standard T and F

Table-III: Odds ratio of immunization status among children 12m-23m by their Background Characteristics.

Predictors	PDHS 1990-91			PDHS 2006-07			PDHS 2012-13		
	Full doses	Never	Drop outs	Full doses	Never	Drop outs	Full doses	Never	Drop outs
Regions	**PUNJAB (Reference)**								
Sindh	0.432	2.619	1.359	1.075	1.422	0.520	0.295	5.590	1.168
KPK	0.836	1.388	1.420	0.791	1.862	0.891	0.304	6.537	1.456
Baluchistan	0.415	2.693	1.501	0.302	9.673	0.665	0.151	9.915	
GENDER OF CHILD (Male[Ref])									
Female	0.748	1.413	0.860	0.536	1.130	1.209	0.875	1.177	1.225
FATHER'S EDUCATION (Secondary and above[Ref])									
Uneducated	0.897	0.721	2.215	0.536	3.081	1.004	0.721	1.457	1.143
Primary to Middle	0.975	0.726	1.313	0.566	2.489	1.225	1.027	1.212	0.683
MOTHER'S EDUCATION (Secondary and above[Ref])									
Uneducated	1.004	8.447	0.259	0.511	1.853	1.308	0.837	0.986	0.742
Primary to Middle	1.439	2.337	0.315	0.811	1.188	1.111	0.841	1.066	1.112
GENDER OF HH'HEAD (Male[Ref])									
Female	1.982	0.800	0.336	1.553	0.304	0.926	0.775	1.871	0.788
WEALTH STATUS (Rich[Ref])									
Poor	0.309	3.351	2.057	1.291	0.902	0.553	0.706	1.504	0.806
Middle	0.533	2.155	0.703	1.707	0.432	0.432	0.891	0.897	1.068
Sample size	1215	1215	398	1522	1522	685	2074	2074	796

N=4811 (Punjab:700, 865,1224) (Sindh: 215, 372, 437) (KPK: 168, 222, 309) (Baluchistan: 132, 63, 104)

First, percented distribution of children age 12-23 months by their status of vaccination against polio virus (OPV1-OPV3) and socio-demographic characteristics in Pakistan were present in table-II. Then, deterministic probabilities were calculated of maternal variables and marital age, level of reproductive health care, health seeking behavior, education level, household size in nuclear family, and household wealth were found significant (p=0.03). In 2007 and 2013, reported drop outs are more for children delivered at health facility. Same year, 11% never vaccinated against polio and 66% dropped out.

statistics.

A significant difference in polio immunization was found among the regions of Pakistan with Baluchistan performing poorest of all. From 1991 to 2013, probability of polio dropouts increased. The highest one was observed in 2007 where children were nearly 10 times more likely to dropout (OR 9.673; 95% CI: 4.758-19.664) as compared to Punjab (table-III).

DISCUSSION

Poor parental knowledge about child health preventive measures, poor geographical access

to health services, lack of technical skill of health staff, lack of resources/logistics, misconceptions in population, fear of side effects, conflicting priorities, socio-cultural norms, missed opportunities and unreliable services can be considered responsible for under coverage of vaccination[4]. Previously the education of mother had been proved as a significant factor affecting immunization status of children[5]. Inversely speaking the dropout percentage is increasing as level of mother's education decreasing. This finding is in line with previous studies on the subject[6]. Households headed by female were less likely to remain unvaccinated during Polio campaigns[7] (table-III).

Different trends among full and no vaccination coverage categories were observed in contrast to drop out cases. This shows that determinants of full, partial and no immunization are different. Increased dropout rates for births at health facilities indicate unsatisfactory service delivery status. Improved probability to vaccination exists for highly educated parents, male children and male head of households. Gender discrimination is due to cultural norms in society. Among all indicators mother's age at marriage, reproductive health care behavior of mothers, parental education, household size and wealth status of mothers were statistically significant and most influential variables. Results of multivariate analysis suggest that improvement in socioeconomic status of women will decrease the chance of polio dropout cases hence improving service delivery and implementation of vaccination program.

Behavior change modification and family planning are the most important strategies to improve outcomes of immunization drive against polio virus. Mismanagement within tall structure health system, misallocations and inappropriate utilization of available resource for access to immunization services, irregular monitoring and evaluation, lack of literacy or awareness, incapacity of stewardship and deteriorated security situation especially in north-western regions are hampering performance by health departments in Pakistan[8-10].

CONCLUSION

Gaps in service delivery, ineffective communication with mothers and entwined poverty dimensions are contributors to low coverage statistics. Education is the key factor with major impact on health system service utilization and acceptability. Due to cultural norms in society gender discrimination is observed in all provinces which shows that girls are more likely to be vulnerable as compare to their male counterparts.

CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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