

Table 1. Key definitions

Term	Definition
Fully Immunized Child* ¹	A child who has received the complete schedule of BCG, IPV, MCV, OPV (including OPV-0), and three doses each of Pentavalent and PCV vaccines before the age of 12 months
Cluster	A limited subgroup consisting of at least seven eligible children (12-23 m) within the specified age range under evaluation
Primary vaccines	BCG, Penta 1-3, MCV-1
Zero Dose	Any child who has not received any vaccine till the age of 12 months.

*1 As per the National EPI childhood Immunization Schedule [18] [20] (Razaq 2016), which will be verified by the presence of a BCG scar and EPI card records

BCG: Bacillus Calmette–Gue´rin (BCG) is an antituberculosis vaccine.

Penta: Pentavalent vaccine for diphtheria, tetanus, acellular pertussis, poliomyelitis, and Haemophilus influenzae type b

PCV: Pneumococcal Conjugate Vaccine

*The schedule in 2019 included Hepatitis B0 too, but that is omitted from this table owing due to non-availability and limited supply from government side to EPI centers.

Table 2. Demographic characteristics of study participants children under 2 years of age and their caregivers (n=1,316) in district Shikarpur.

Characteristics	n	%
Taluka		
Shikarpur	419	31.8
Garhi Yasin	364	27.6
Lakhi	308	23.4
Khanpur	225	17.1
Locality		
Urban	496	37.7
Rural	470	35.7
Peri-urban	350	26.6
Gender		
Male	747	56.7
Female	569	43.3
Child Age at Enrolment (months) (mean, SD)	18.1	3.6
12 - 15	411	31.2
16 - 18	300	22.8
19 - 21	245	18.6
22 - 24	360	27.4
Birthplace		
Home	595	45.2
Tertiary care facility	554	42.1
Primary care facility	167	12.7
Father's Occupation		
Farmer	439	33.4
Daily wages	349	26.5
Houseman	188	14.3
Self-employed	113	8.6
Government employee	66	5.0
Private employee	66	5.0
Student	2	0.1
Unemployed	62	4.7
Retire	3	0.2
Other	28	2.1
Mother's Occupation		
Housewife	750	57.0
Farmer	372	28.3
Government employee	27	2.0
Private employee	25	1.9
Daily wages	52	4.0
Self-employee	12	0.9
Student	6	0.5
Unemployed	62	4.7
Other	10	0.8
Father's Education (years)		
No education (0)	697	53.0
Less than primary (1-4)	135	10.3

Primary (5)	115	8.8
Middle (6-8)	68	5.2
Matric (10)	123	9.4
Intermediate (12)	103	7.8
Graduate (16)	50	3.8
Higher than graduation (>16)	25	1.9
Mother's Education (years)		
No education (0)	749	56.9
Less than primary (1-4)	335	25.5
Primary (5)	100	7.6
Secondary (6-8)	43	3.3
Matric (10)	45	3.4
Intermediate (12)	30	2.3
Graduate (16)	8	0.6
Higher than graduation (>16)	6	0.5
Issues in accessing health facilities		
Yes	365	27.7
No	883	67.1
BCG scar (yes)	930	70.7
Fully immunized children (FIC)**	560	42.5

*Calculated using Principal Component Analysis

**Children who have received BCG, Penta1-3, PCV 1-3, OPV0-3, Measles-1

Table 3. LQAS outcomes by Union Council (n=1,316)*

Union Council	Fully immunized		Partially & Unimmunized		LQAS	Priority
					(Pass/Fail)^	(Low/Medium/High)**
	n	%	n	%		
1	16	57.1	12	42.9	Fail	High
2	22	78.6	6	21.4	Pass	Low
3	17	60.7	11	39.3	Fail	High
4	13	46.4	15	53.6	Fail	High
5	13	46.4	15	53.6	Fail	High
6	13	46.4	15	56.6	Fail	High
7	22	78.6	6	21.4	Pass	Low
8	15	53.6	13	46.4	Fail	High
Abdu	17	60.7	11	39.3	Fail	High
Amrote Shareef	11	39.3	17	60.7	Fail	High
Bambhiarh	7	25	21	75	Fail	High
Bhirkan	8	28.6	20	71.4	Fail	High
Chak	20	71.4	8	28.6	Pass	Medium
Chatto Mangi	10	35.7	18	64.3	Fail	High
Dhakan	15	53.6	13	46.4	Fail	High
Gaheja	12	42.9	16	57.1	Fail	High
Garhi Dakho	2	7.1	26	92.9	Fail	High
Garhi Yaseen	13	46.4	15	53.6	Fail	High
Humayoon	9	32.1	19	67.9	Fail	High
Jagan	15	53.6	13	46.4	Fail	High
Jahan Wah	-	-	28	100	Fail	High
Jano	12	42.9	16	57.1	Fail	High
Jindo Dero	6	21.4	22	78.6	Fail	High
Karan	4	14.3	24	85.7	Fail	High
Khanpur	16	57.1	12	42.9	Fail	High
Lakhi	25	89.3	3	10.7	Pass	Low
Lodra	9	32.1	19	67.8	Fail	High
Madeji	26	92.9	2	7.1	Pass	Low
Mian Sahab	2	7.1	26	92.9	Fail	High
Mirzapur	22	78.6	6	21.4	Pass	Low
Mungrani	8	28.6	20	71.4	Fail	High
Naushero Abro	7	25	21	75	Fail	High
Nim	6	21.4	22	78.6	Fail	High
Panah Odho	-	-	28	100	Fail	High

Pir Bux Shujrah	6	21.4	22	78.6	Fail	High
Rahimabad	5	17.9	23	82.1	Fail	High
Ruk	11	39.3	17	60.7	Fail	High
Rustam	17	60.7	11	39.3	Fail	High
Sehwani	13	46.4	15	53.6	Fail	High
Shabirabad	3	10.7	25	89.3	Fail	High
Sherkot	20	71.4	8	28.6	Pass	Medium
Sultan Kot	3	10.7	25	89.3	Fail	High
Taib	25	89.3	3	10.7	Pass	Low
Thanhiro	12	42.9	16	57.1	Fail	High
Waryaso	16	57.1	12	42.9	Fail	High
Wazirabad	10	35.7	18	64.3	Fail	High
Zarkhail	6	21.4	22	78.6	Fail	High
Total	560	43%	756	57%	8	

*28 children per union council

^Criteria: Pass - ≥19 fully immunized children, Fail - <19 fully immunized children

**UCs having 'Pass' status are on low priority if above 20, medium priority if on 19 or 20 successes, while UCs having 'Fail' status are on high priority

Table 4. Point estimate coverage with 95% confidence interval at district level (n=1,316)*

Method applied: Direct Adjustment Method

Supervision Area (SA)	SA Sample Size	Number $\hat{C}_1$ Correct	$p = C/n$	Relative Total Population (2020)	Weights	Weighted Average Coverage	95 CI ($1.96 \times \sqrt{\sum w_i^2 \times p_i q_i / n}$)		
	n	C	mini %	N	$w_i = N_i / \sum N_i$	$w_i \times p_i$ (mini %)	w_i^2 (Squared Weights)	$p_i \times q_i$ [1-p]	$(w_i^2 \times p_i q_i) / n$
1	28	16	0.57	25,574	0.020	0.012	0.0004	0.245	0.000004
2	28	22	0.79	24,834	0.020	0.016	0.0004	0.168	0.000002
3	28	17	0.61	26,207	0.021	0.013	0.0004	0.239	0.000004
4	28	13	0.46	24,128	0.019	0.009	0.0004	0.249	0.000003
5	28	13	0.46	24,500	0.020	0.009	0.0004	0.249	0.000003
6	28	13	0.46	24,575	0.020	0.009	0.0004	0.249	0.000003
7	28	22	0.79	25,188	0.020	0.016	0.0004	0.168	0.000002
8	28	15	0.54	26,533	0.021	0.011	0.0005	0.249	0.000004
Abdu	28	17	0.61	29,994	0.024	0.015	0.0006	0.239	0.000005
Amrote Shareef	28	11	0.39	28,841	0.023	0.009	0.0005	0.239	0.000005
Bambhiarh	28	7	0.25	22,172	0.018	0.004	0.0003	0.188	0.000002
Bhirkan	28	8	0.29	28,269	0.023	0.006	0.0005	0.204	0.000004
Chak	28	20	0.71	28,997	0.023	0.017	0.0005	0.204	0.000004
Chatto Mangi	28	10	0.36	28,664	0.023	0.008	0.0005	0.230	0.000004
Dhakan	28	15	0.54	31,032	0.025	0.013	0.0006	0.249	0.000005
Gaheja	28	12	0.43	25,695	0.021	0.009	0.0004	0.245	0.000004
Garhi Dakho	28	2	0.07	31,661	0.025	0.002	0.0006	0.066	0.000002

Garhi Yaseen	28	13	0.46	22,212	0.018	0.008	0.0003	0.24 9	0.00000 3
Humayoon	28	9	0.32	30,404	0.024	0.008	0.0006	0.21 8	0.00000 5
Jagan	28	15	0.54	32,367	0.026	0.014	0.0007	0.24 9	0.00000 6
Jahan Wah	28	0	0.00	23,749	0.019	0.000	0.0004	0.00 0	0.00000 0
Jano	28	12	0.43	23,445	0.019	0.008	0.0004	0.24 5	0.00000 3
Jindo Dero	28	6	0.21	22,274	0.018	0.004	0.0003	0.16 8	0.00000 2
Karan	28	4	0.14	30,443	0.024	0.003	0.0006	0.12 2	0.00000 3
Khanpur	28	16	0.57	27,784	0.022	0.013	0.0005	0.24 5	0.00000 4
Lakhi	28	25	0.89	16,645	0.013	0.012	0.0002	0.09 6	0.00000 1
Lodra	28	9	0.32	33,033	0.026	0.009	0.0007	0.21 8	0.00000 5
Madeji	28	26	0.93	31,667	0.025	0.024	0.0006	0.06 6	0.00000 2
Mian Sahab	28	2	0.07	26,910	0.022	0.002	0.0005	0.06 6	0.00000 1
Mirzapur	28	22	0.79	27,246	0.022	0.017	0.0005	0.16 8	0.00000 3
Mungrani	28	8	0.29	26,032	0.021	0.006	0.0004	0.20 4	0.00000 3
Naushero Abro	28	7	0.25	28,939	0.023	0.006	0.0005	0.18 8	0.00000 4
Nim	28	6	0.21	27,886	0.022	0.005	0.0005	0.16 8	0.00000 3
Panah Odho	28	0	0.00	13,974	0.011	0.000	0.0001	0.00 0	0.00000 0
Pir Bux Shujrah	28	6	0.21	30,053	0.024	0.005	0.0006	0.16 8	0.00000 3
Rahimabad	28	5	0.18	27,807	0.022	0.004	0.0005	0.14 7	0.00000 3
Ruk	28	11	0.39	24,812	0.020	0.008	0.0004	0.23 9	0.00000 3
Rustam	28	17	0.61	31,529	0.025	0.015	0.0006	0.23 9	0.00000 5
Sehwani	28	13	0.46	24,628	0.020	0.009	0.0004	0.24 9	0.00000 3
Shabirabad	28	3	0.11	29,325	0.023	0.003	0.0006	0.09 6	0.00000 2

Sherkot	28	20	0.71	19,324	0.015	0.011	0.0002	0.20 4	0.00000 2
Sultan Kot	28	3	0.11	28,331	0.023	0.002	0.0005	0.09 6	0.00000 2
Taib	28	25	0.89	28,957	0.023	0.021	0.0005	0.09 6	0.00000 2
Thanhiro	28	12	0.43	26,585	0.021	0.009	0.0005	0.24 5	0.00000 4
Waryaso	28	16	0.57	21,980	0.018	0.010	0.0003	0.24 5	0.00000 3
Wazirabad	28	10	0.36	28,208	0.023	0.008	0.0005	0.23 0	0.00000 4
Zarkhail	28	6	0.21	25,530	0.020	0.004	0.0004	0.16 8	0.00000 3
Total		560		1,248,943		42.47%			0.0001

*28 children per union council

^Criteria: Pass - ≥ 19 fully immunized children, Fail - < 19 fully immunized children

^1Number Correct is defined as the number of children found vaccinated through recall/EPI home based records

95% CI: $(1.96 \times \sqrt{0.0001}) = \pm 0.019$, $\pm 0.019 \times 100 = \pm 1.9$

We are 95% confident that the true coverage lies within the range of 40.5% ----- 42.4%-----44.3%

**UCs having 'Pass' status are on low priority if above 20, medium priority if on 19 or 20 successes, while UCs having 'Fail' status are on high priority

Table 5. Immunization status of children (n= 1,316) according to the areas of their residence

Type of Areas	Fully Immunized		Partially Immunized		Unimmunized	
	n	%	n	%	n	%
Urban Areas	298	53.2	164	32.4	34	13.6
Rural Areas	161	28.8	190	37.5	119	47.6
Peri-Rural Areas*	101	18.0	152	30.0	97	38.8
Grand Total	560	42.6	506	38.4	250	19

*Peri-rural areas are those areas which are considered as areas with the worst roads infrastructure (also known as Katcha Areas)

Table 6. Univariable and multivariable analysis showing factors associated with full immunization coverage among children under 2 years of age in district Shikarpur.

Characteristics	Univariable			Multivariable		
	Odds Ratio	95% Confidence Interval	p-value	Odds Ratio	95% Confidence Interval	p-value
Taluka						
Garhi Yasin	1 (base)					
Lakhi	1.83	1.34 – 2.48	<0.001	1.41	0.95 – 2.10	0.087
Khanpur	0.42	0.29 – 0.61	<0.001	0.38	0.24 – 0.61	<0.001
Shikarpur	1.09	0.82 – 1.45	0.536	0.51	0.33 – 0.79	0.003
Locality						
Urban	1 (base)					
Rural	0.34	0.26 – 0.44	<0.001	0.64	0.43 – 0.94	0.026
Peri-rural	0.26	0.20 – 0.36	<0.001	0.56	0.36 – 0.85	0.007
Gender						
Male	1 (base)					
Female	0.94	0.76 – 1.18	0.642			
Child Age at Enrolment (months)						
12 – 15	1 (base)					
16 - 18	0.75	0.55 – 1.02	0.073			
19 - 21	1.24	0.90 – 1.71	0.177			
22 - 24	1.11	0.83 – 1.48	0.457			
Birthplace						
Home	1 (base)					
Primary care facility	1.99	1.40 – 2.82	<0.001	0.73	0.46 – 1.14	0.173
Tertiary care facility	2.29	1.80 – 2.91	<0.001	1.31	0.96 – 1.79	0.082
Father's Occupation						
Unemployed	1 (base)					
Daily wages	0.76	0.44 – 1.31	0.332	0.75	0.37 – 1.50	0.420
Houseman	0.78	0.44 – 1.40	0.421	1.09	0.49 – 2.46	0.820
Self-employed	1.39	0.74 – 2.61	0.303	0.80	0.36 – 1.78	0.586
Government employee	1.64	0.80 – 3.36	0.172	0.58	0.22 - 1.47	0.253
Private employee	1.05	0.52 – 2.11	0.889	0.68	0.27 – 1.66	0.400
Student	-	-	-	-	-	-
Farmer	0.27	0.16 – 0.48	<0.001	0.61	0.29 – 1.28	0.195
Retire	0.41	0.03 – 4.78	0.478	0.13	0.00 – 2.06	0.152
Other	0.06	0.01 – 0.29	<0.001	0.22	0.03 – 1.34	0.102
Mother's Occupation						

Unemployed	1 (base)					
Farmer	0.49	0.28 – 0.87	0.015	0.52	0.23 – 1.17	0.118
Government employee	3.16	1.22 – 8.18	0.017	0.99	0.30 – 3.31	0.999
Private employee	2.01	0.78 – 5.16	0.144	0.64	0.20 – 2.04	0.458
Daily wages	0.83	0.38 – 1.80	0.652	0.97	0.33 – 2.84	0.966
Self-employee	0.52	0.12 – 2.14	0.372	0.41	0.08 – 2.06	0.283
Student	0.31	0.03 – 2.87	0.307	0.08	0.00 – 0.86	0.037
Housewife	1.70	1.00 – 2.90	0.049	0.52	0.24 – 1.11	0.093
Other	1.05	0.26 – 4.13	0.938	1.66	0.28 – 9.74	0.574

Father's Education (years)

No education (0)	1 (base)					
Less than primary (1-4)	1.79	1.22 – 2.61	0.003	1.13	0.68 – 1.87	0.625
Primary (5)	2.49	1.67 – 3.72	<0.001	1.30	0.78 – 2.16	0.312
Middle (6-8)	2.05	1.23 – 3.40	0.005	1.21	0.64 – 2.29	0.539
Matric (10)	4.72	3.14 – 7.09	<0.001	2.20	1.28 – 3.76	0.004
Intermediate (12)	5.19	3.33 – 8.11	<0.001	2.24	1.20 – 4.18	0.011
Graduate (16)	6.97	3.63 – 13.39	<0.001	2.63	1.14 – 6.04	0.023
Higher than graduation (>16)	58.8	7.90 – 437.6	<0.001	21.5	2.51 – 184.4	0.005

Mother's Education (years)

No education (0)	1 (base)					
Less than primary (1-4)	1.38	1.06 – 1.79	0.016	0.56	0.36 – 0.89	0.015
Primary (5)	1.52	1.00 – 2.32	0.048	0.69	0.38 – 1.25	0.225
Secondary (6-8)	1.80	0.97 – 3.34	0.060	0.50	0.22 – 1.14	0.101
Matric (10)	3.44	1.82 – 6.52	<0.001	1.23	0.50 – 3.02	0.640
Intermediate (12)	6.89	2.78 – 17.07	<0.001	1.79	0.59 – 5.40	0.298
Graduate (16)	12.06	1.47 – 98.58	0.020	1.15	0.11 – 11.8	0.900
Higher than graduation (>16)	-	-	-	-	-	

Issues in accessing health facilities

No	1 (base)					
Yes	0.45	0.35 – 0.58	<0.001	0.87	0.59 – 1.29	0.509

Wealth quintiles

Lower	1 (base)					
Lower middle	1.85	1.23 – 2.78	0.003	1.30	0.77 – 2.20	0.315
Middle	2.90	1.95 – 4.30	<0.001	1.34	0.75 – 2.39	0.310
Upper middle	5.36	3.62 – 7.94	<0.001	2.40	1.29 – 4.47	0.005
Upper	9.16	6.12 – 13.70	<0.001	2.59	1.22 – 5.50	0.013

BCG scar

No	1 (base)					
Yes	10.29	7.28 – 14.54	<0.001	7.6	5.13 – 11.22	<0.001

