Expanded Program on Immunization
Government of Pakistan

Supplementary Immunization Coverage Survey in Super High-Risk Union Councils of Pakistan (TPVICS-SHRUCs)

Survey Report

Centre of Excellence in Women and Child Health
The Aga Khan University

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THE AGA KHAN UNIVERSITY

BIOSTAT GLOBAL CONSULTING

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Abbreviations

AKU	Aga Khan University
BCG	Bacille Calmette-Guérin
BMGF	Bill and Melinda Gates Foundation
CAPI	Computer Assisted Personal Interviews
CES	Coverage Evaluation Survey
CI	Confidence Interval
cVDPV2	Circulating Vaccine-derived Poliovirus Type 2
DMU	Data Management Unit
EB	Enumeration Block
EPI	Expanded Program on Immunization
ERC	Ethical Review Committee
HH	Household
IPV	Inactivated Polio Vaccine
KP	Khyber Pakhtunkhwa
MCV	Measles-Containing-Vaccine
MDGs	Millennium Development Goals
MoNHSRC	Ministry of National Health Services Regulation & Coordination
MOSV	Missed opportunities for simultaneous vaccination
NBC	National Bioethics Committee
NEAP	National Emergency Action Plan
NEOC	National Emergency Operations Center
NISP	National Immunization Support Project
NOCs	No Objection Certificates
OPV	Oral Polio Vaccine
PBS	Pakistan Bureau of Statistics
PCV	Pneumococcal Conjugate Vaccine
PENTA	Pentavalent vaccine to protect against: Diphtheria, Pertussis, Tetanus, Haemophilus influenza type b & Hepatitis B
PEOC	Provincial Emergency Operations Center
PSU	Primary Sampling Unit
ROTA	Rotavirus Vaccine
RV	Rotavirus Vaccine
SHRUC	Super High-Risk Union Council
SOP	Standard Operating Procedure
SSU	Secondary Sampling Unit
TAG	Technical Advisory Group
TPVICS	Third-party Verification Immunization Coverage Survey
ToR	Terms of Reference
ToT	Training of Trainers
UC	Union Council
VPD	Vaccine-preventable Diseases
VCQI	Vaccination Coverage Quality Indicator
WB	World Bank
WHO	World Health Organization
WPV1	Wild Poliovirus Type 1

Key definitions

Fully Vaccinated: Fully vaccinated is defined as a child who has completed their vaccinations through the first dose of measles-containing-vaccine (MCV1; given at 9 months of age) per the schedule of the Expanded Program on Immunization (EPI; i.e., BCG, OPV0, OPV1, OPV2, OPV3, Penta1, Penta2, Penta3, PCV1, PCV2, PCV3, IPV, and MCV1). ROTA1 and ROTA2 are excluded from this analysis because they are the doses introduced into the EPI schedule most recently.

Partially Vaccinated: A child who has received at least one, but also missed any of the vaccines given under the national immunization program until one year of age is classified as partially vaccinated [1].

Mother's/Father's Education Level: The parental education level is classified into four categories: None (has not attended formal schooling), Primary education (1-5 years of formal education), Middle (6-8 years of formal education), Secondary (9-10 years of formal education), Higher (formal education of 11 years and above).

Literate: Those who have attended one or more years of formal education.

Formal Education: Formal education means schooling of one or more years at a public or a recognized private institution.

Household: A household is either one person living alone or a group of people, who may or may not be related, living at the same address, with common housekeeping, who either share at least one meal a day or share common living accommodations (i.e. a living room or sitting room) [2].

Wealth Quintiles: Households are divided into five equal categories (poorest, poor, middle, rich, and richest), each with 20% of the population, based on the number and kinds of consumer goods they own, ranging from a television to a bicycle or car, and housing characteristics such as source of drinking water, toilet facilities, and flooring materials [3,4].

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or

https://www.aku.edu/coe-wch/pk/Documents/TPVICS_SHRUCS_Survey_2021_Report.pdf

Executive summary

Vaccination programs are key to averting vaccine-preventable diseases. The Expanded Program on Immunization (EPI) was launched in 1994 in Pakistan. Since that time, the Program has been delivering services extensively to reduce the burden of vaccine-preventable disease in the country. To augment this effort, Pakistan started its National Immunization Support Project (NISP) in 2016 to coordinate efforts for vaccination and reduce vaccine-preventable diseases. Additionally, to address the recurring endemic poliovirus in the country, the National and Provincial Emergency Operations Centers (NEOC and PEOCs) for polio eradication identified 40 union councils as Super-High Risk Union Councils (SHRUCs) for targeted interventions. The national EPI and the co-financing partners of NISP (the World Bank; the United States Agency for International Development (USAID); Gavi, the Vaccine Alliance; and the Bill and Melinda Gates Foundation) agreed to carry out a Union Council (UC)-specific vaccination survey in these SHRUCs.

To obtain more granular information on vaccine coverage and vaccination service delivery, a team from Aga Khan University (AKU), supported by EPI Pakistan, implemented a supplementary vaccination coverage survey. One of the key survey indicators was the assessment of full vaccination among children ages 12-23 months in the target SHRUCs. For the purposes of the survey, a fully vaccinated child was a child who had completed all of their vaccinations through Measles dose 1 (given at 9 months of age) per the EPI schedule (i.e., BCG, OPV0, OPV1, OPV2, OPV3, Penta1, Penta2, Penta3, PCV1, PCV2, PCV3, IPV, and MCV1[1]). The team conducted the survey in 39 SHRUCs from eight districts in three provinces: eight SHRUCs from four districts in Sindh, 17 SHRUCs from one district in Khyber Pakhtunkhwa (KP), and 14 SHRUCs from three districts in Balochistan. The timeframe for survey data collection was July 2021 to October 2021.

Overall, 610 clusters, 7,549 households (HHs), and 6,976 children born between September 2018 and January 2019 were enrolled in the survey. Of the children enrolled, 3,694 (53%) were male, while 3,282 (47%) were female.

The survey sample was allocated in a fashion to power for detecting change over the next few years not at the union council level, but at the level of districts that hold SHRUCs. Results in this report are aggregated up to the district level. SHRUCs survey results are portrayed beside the corresponding

[1] Rotavirus doses 1 and 2 are excluded from the analysis of fully-vaccinated children because they are the newest vaccine in the national schedule and may not have been available when these children were scheduled to receive them.

outcome from the recent TPVICS survey, for context. Note that the SHRUCs constitute a subset of these districts, so the SHRUCs results are not meant to represent the entire district.

Of the SHRUCs covered, those from district Peshawar recorded higher rates of vaccination coverage indicators and the SHRUCs from the districts in Balochistan recorded comparatively low rates of home-based record (HBR or vaccination card) availability and low rates for the vaccination indicators.

The proportion of respondents who showed HBRs and the proportion who were fully vaccinated tended to be lower in the SHRUCs survey than in the TPVICS survey. Vaccination coverage of OPV doses tended to be higher in SHRUCs than in the surrounding district as estimated in TPVICS. Coverage of all other antigens tended to be (with a few exceptions) lower in the SHRUCs than in the district as a whole. The proportion of unvaccinated, or zero-dose children in Balochistan SHRUC districts was much lower in the SHRUCs than in the TPVICS survey, expressly because OPV coverage is much higher in the SHRUCs than in the remainder of those districts.

Timeliness of vaccination in SHRUCs showed similar patterns as TPVICS, with a notable portion of children with HBRs indicating that they received the EPI doses more than two months after the age when they were scheduled. And a larger portion of respondents receives the later doses more than two months late than the early doses. There is room for improvement in the timeliness of vaccination in the SHRUCs and in these districts as a whole.

Encouragingly, the EPI doses are given in most cases in the groupings reflected in the national immunization schedule, with most children who showed HBRs showing evidence of receiving most doses at the first vaccination visit when they were eligible for the dose. Missed opportunities for simultaneous vaccination (MOSVs) were rare for most doses. For three-dose antigens, MOSVs were more common for the first dose than the later two doses, and most of the MOSVs were corrected when the child received the dose at a later visit. IPV showed a noticeably high rate of MOSVs and a concerningly high proportion of those MOSVs had not been corrected by the time of the survey. IPV is scheduled to be delivered at age 14 weeks with OPV3, Penta3, and PCV3. Because of poor timeliness and delayed vaccination visits, many children with HBRs show evidence of receiving their ten-week doses (OPV2, Penta2, PCV2 and Rota2) after age 14 weeks. Some even receive the six-week doses, OPV1, Penta1, PCV1 and Rota1 after age 14 weeks. If the child is 14 weeks old, they could also receive IPV with those 6- or 10-week doses, but that is not the practice, so the child experiences a MOSV for IPV and spends more time under-protected against polio than would be the case if every child received IPV at the earliest visit after age 14 weeks.

The consistently high delivery of OPV in the SHRUCs is commendable. Some work is warranted to increase OPV coverage elsewhere in those districts up to the SHRUC levels. Work inside the SHRUCs is warranted to bring the delivery of other doses up to the level of OPV and to deliver doses in a more timely fashion – as near as possible to the ages in the national immunization schedule, to minimize the time children spend under-protected. The EPI staff are doing a good job administering all the doses that are scheduled to be delivered together. In cases where the 6-week or 10-week doses are given to children who are 14 or more weeks old, it may be worthwhile to consider guidance to also deliver the IPV dose at that time.

1. Background and objectives

Pakistan has posted substantial progress in curtailing the transmission of poliovirus in the recent past. Efforts including the National Emergency Action Plan (NEAP) for Polio Eradication resulted in a significant reduction in polio incidence. The country recorded an all-time low number of polio cases, eight cases in 2017 and 12 cases in 2018 [5], after witnessing an outbreak in 2014 when 304 polio cases were recorded [6]. Despite continuous efforts, the persistence of polio in Pakistan poses a significant challenge for global eradication, as the country is affected by ongoing endemic Wild Poliovirus type 1 (WPV1) transmission and circulating vaccine-derived poliovirus type 2 (cVDPV2) [7]. In 2020, a total of 84 WPV1 and 135 cVDPV2 cases were reported in the country [5]. With these recurring incidences, Pakistan is still one of the two polio-endemic countries in the world, a position it holds alongside neighboring Afghanistan [8].

The National and Provincial Emergency Operations Centers (NEOC and PEOCs) for polio eradication have identified 40 union councils in the country as Super-High Risk Union Councils (SHRUCs) because they are significant poliovirus reservoirs [9]. There are 8 UCs from Sindh, 18 from KP, and 14 UCs from Balochistan. Together, these areas have an estimated population of around 3 million, including 574,000 children under five years of age [9].

Though Pakistan has made considerable progress, vaccination indicators have yet to reach the expected benchmarks. The key goals of polio and measles eradication have not been achieved [10], and the country continues to experience endemic polio transmission and periodic measles outbreaks and all districts remain vulnerable. A variety of factors are responsible for failing to reach all children with sufficient doses of vaccines, including weak governance and accountability mechanisms [11]. Further, the lack of quality data collection and management [12] have impeded the assessment of EPI performance in the country.

AKU with the support of EPI Pakistan conducted a district-specific Third-party Verification Immunization Coverage Survey (TPVICS)[2] from September 2020 to January 2021. The survey was meant to assess the progress of four out of the ten DLIs under the NISP. TPVICS covered all four provinces i.e. Sindh, Punjab, Khyber Pakhtunkhwa (KP), Balochistan and three federal regions i.e. Islamabad, Azad Jammu and Kashmir (AJK) and Gilgit-Baltistan (GB). After reviewing the results of the TPVICS, the National Immunization

[2] https://www.aku.edu/coe-wch/Documents/TPVICS%20Survey%20Report.pdf

Program Pakistan, and the key partners supporting NISP, enlisted AKU to conduct a supplementary survey targeting 39 out of the 40 SHRUCs[3]. The three objectives of this supplementary survey were:

- To assess vaccination coverage precisely in the target SHRUCs.
- To compare coverage in SHRUCs with coverage in the districts that contain the SHRUC, as estimated in the 2021 TPVICS survey (hereafter simply called TPVICS).
- To create a baseline for the SHRUCs to assess the impact of interventions over time.

[3] One HRUC in Peshawar located in the Cantonment area has been dropped from the scope of survey, as the Cantonment areas do not allow private organizations to carry out such surveys due to security concerns.

2. Survey design and methods

This section describes the survey sampling methods, development of the survey instrument, manuals, and standard operating procedures (SOPs), along with approval processes, hiring of field teams for data collection and supervision, and training and fieldwork. Furthermore, pilot testing of the survey instruments and protocol, and the data collection process and timeline are also discussed in this section.

2.1. Sampling

The team employed a two-stage, stratified cluster, cross-sectional survey. Additional details about the survey and sampling design are provided in table 1.

Table 1. Summary of survey design

Survey design	Two-stage stratified cluster, cross-sectional survey
Target age group	The primary target group was all children of age 12-23 months. Data were also collected on the convenience sample of younger children aged 6-11 months in the households that had children aged 12-23 months. It is not common for a couple to have two children born in a span of 18 months, so the sample of younger children is comparatively small.
Unit/domain of analysis (strata)	Samples from all Primary Sampling Units (PSUs) (also known as clusters) were aggregated at the UC level and analysis was conducted on UCs and then on upper administrative levels i.e. District level.
Sampling design and strategy	Maps developed and finalized during the provincial workshops organized by BMGF for the operationalization of Essential Immunization (EI) work plans in SHRUCs were used for demarcation and selection of sample areas and clusters.
Selection of primary sampling units, households, and respondents	A two-stage cluster sampling technique was adopted for the implementation of the supplementary TPVICS. ***Stage I:*** The required number of the PSUs from each SHRUC were selected randomly with necessary identification information and boundary demarcations using the maps developed by BMGF for SHRUCs. ***Stage II:*** All households in each selected PSU were visited to screen for the presence of children of age 12-23 months. Households with children in that age range were treated as Secondary Sampling Units (SSUs). In every PSU, 13 households with eligible children were selected using systematic random sampling. Those households were visited to collect data for the survey. ***Stage III:*** Vaccination status data were collected for all children aged 12-23 months, and all children aged 6-11 months in the selected households.

2.1.1 Selection of primary sampling units:

To demarcate and select sample areas/clusters, the survey team used the maps developed and finalized during the provincial workshops organized by BMGF for the operationalization of essential vaccination work plans in SHRUCs. A total of 2,447 clusters containing 100 to 150 households were demarcated in all 39 SHRUCs. Of the demarcated clusters, 612 PSUs were selected randomly by the team from Biostat Global Consulting from the 39 SHRUCs.

2.1.2 Sample size calculation and estimated vaccination coverage

The sample size estimates were finalized after a series of meetings with key technical stockholders. WHO 2018 Vaccination Coverage Surveys Reference Manual was also consulted for sample size estimation[16].

The inferential goal is to have 80% statistical power to detect a 15% improvement in coverage outcomes in the SHRUCS within each district comparing outcomes in two surveys: this one conducted in 2021 and another comparable survey envisioned for perhaps two years later. The WHO 2018 manual's Table B-4 indicates that an effective sample size of 183 respondents per district should yield 80% power with 95% confidence. Table 2 lists the number of SHRUCs per district and the target number of PSUs per SHRUC. With 90 PSUs per district and a target of at least ten eligible respondents per cluster, the achieved sample size will be over 900 children, so the inferential goal should be achievable even if the observed design effect is as high as four or five. Recall that the effective sample size is the actual sample size divided by the design effect; 915 / 5 = 183. To be quite likely of finding at least ten respondents aged 12-23 months per cluster, the team targeted visiting 13 households per cluster.

Following cluster selection, trained listing teams visited each cluster. Cluster boundaries were identified using cluster maps and local guides/knowledgeable persons. The teams visited all structures and dwellings in the cluster and identified households with children aged 12-23 months. To further increase the probability of achieving the target sample size, a central team at the district level randomly selected 13 households in each cluster that were known to hold at least one child aged 12-23 months. A total of 7,956 households were targeted for visitation by survey interview teams.

Table 2. Number of PSUs per SHRUC by province and district

Province	District	Number of SHRUCs	PSUs per SHRUC
Sindh	Karachi East	1	45[a]
	Karachi West	5	18
	Malir	2	37[b] & 45
Balochistan	Quetta	6	15
	Killa Abdullah	5	18
	Pishin	3	15[c]
KP	Peshawar	17	10[d]

[a] It was considered that the design effect in Karachi East would probably be small enough for 45 PSUs to yield an effective sample size of 183.

[b] Fewer than 45 PSUs were selected in one SHRUC due to a small number of PSUs there.

[c] Due to small numbers of PSUs

[d] Ten PSUs may be too small to characterize the heterogeneity of coverage across a SHRUC; the WHO 2018 reference manual recommends a minimum of 15 PSUs per stratum, but to strike a balance between precision and budget, a maximum of 170 PSUs were allocated to Peshawar district. More emphasis should be placed on estimates combined across SHRUCs in Peshawar than on outcomes in individual SHRUCs.

2.2. Survey instrument development

This survey used the same tools developed and employed to implement the primary TPVICS conducted previously. Three sets of questionnaires were used in the survey: **1)** a household line listing questionnaire to collect household information about key demographic indicators to generate a sampling frame for the selection of target households; **2)** a household questionnaire which was used to collect basic demographic information on all de jure household members (usual residents), the household, and the dwelling; and **3)** a questionnaire for eligible children to assess vaccination coverage in each targeted household. Questionnaires were adopted from the WHO Vaccination Coverage Cluster Surveys Reference Manual 2018 [16] and modified in accordance with the objectives of the survey. To ensure that question meaning was consistent in both English and the local language (Urdu), questionnaires were translated into Urdu and translated back to English.

2.3. Survey manuals and standard operating procedures (SOPs)

This survey used the SOPs for data collection and manuals developed to conduct the TPVICS line listing and household survey.

2.4. Approval processes

The AKU team prepared and submitted applications to the National Bioethics Committee (NBC) and AKU Ethical Review Committee (ERC) for approval to implement proposed survey activities in target areas of Pakistan. Both committees approved the survey activities.

No objection certificates (NOCs) and approvals were obtained from the provincial authorities with the support of provincial program leadership. The National EPI Program Manager and Ministry of National Health Services Regulation & Coordination (MoNHSRC), Islamabad issued the support letters to respective

provincial authorities for their support and facilitation of supplementary TPVICS activities. Following that each province granted NOCs and approvals to carry out the survey operations.

2.5. Field teams for data collection and supervision

All field team staff hired for the project had the requisite qualifications, including field-based data collection experience, fluency in the local language, and willingness to travel. District-specific networks were used to identify experienced data collectors and supervisors who had worked with AKU in past. Preference was given to candidates who were locals, were well versed with local languages and culture, had the experience of working in similar large-scale surveys, and could operate handheld data collection devices.

The hiring of the survey implementation team was initiated in two phases. In phase one, the core team including data supervisors, programmers, master trainers, district supervisors, and provincial managers were hired. In phase two, a district-specific team responsible for data collection and line listing was hired. In each district, three teams were hired for the household survey. Each team consisted of one team leader, two data collectors (one male, one female), and one data entry operator/logistics assistant.

Provincial managers were responsible for district-specific hiring with the support of district supervisors. They were also responsible for conducting quality checks by revisiting a portion of randomly selected households already surveyed to verify that the household listing and interviews were conducted properly, that all eligible respondents in those households completed questionnaires, and that vaccination dates (and possibly other responses) were recorded correctly in HHs where cards were available.

District supervisors were responsible for coordination with the provincial managers for day-to-day progress and plans. District supervisors reported daily to the provincial managers.

Team leaders were responsible for day-to-day supervision, monitoring, coordination, and providing logistical support to the team. Team leaders were also responsible for revisiting a set of households to ensure data accuracy.

Data collectors were responsible for visiting sampled/selected households for interviews and completing the filling of forms. Also, the data collectors were responsible for checking the completed forms and, where required, revisited the households to correct any discrepancies or obtain missing information.

The data entry operator (DEO) was responsible for data entry when data collectors were not able to

directly enter the data on handheld devices due to the reluctance of respondents or other issues. In cases where data collectors gathered data on paper-based forms, the DEOs were responsible for data entry on the same day with the support of the corresponding data collector.

For the line listing/mapping of households, three teams were hired in each district, with each team consisting of three-line listers. The supervisors in their respective jurisdiction did the identification of the boundaries of the clusters a day before HH line listing. The line listers did the household listing and completed the household listing questionnaires. The three teams of line listers (nine in total) were able to cover all selected PSUs in a district in four weeks. District supervisors oversaw the household listing teams to ensure the household listing had been done correctly and tallied eligible respondents in each home. Line listers also accompanied the data collection teams to assist and guide them in the identification of areas and target households.

2.6. Training and fieldwork

Team leaders, data collectors, and line listers were trained using the survey questionnaires on handheld devices and were encouraged to give comments and suggestions to improve the clarity of the data collection instruments. An important additional benefit of this exercise was to provide an environment where the data collectors understood the deliverable and the reasons behind each question. This exercise also enabled field staff to probe more effectively while conducting the interviews in the field. On the last day of the training, teams were sent to a nearby location and the questionnaire was tested in the field. This exercise ensured field staff comprehension of the survey questionnaires and field protocols. A feedback session with the data collectors was also conducted to address their comments and issues. To measure the impact of training on the knowledge and skills of participants, pre and post-tests were conducted. Capable data collectors who passed the final test were deployed for the actual survey. In addition, each data collector was observed during the data collection process to assess their performance, and feedback was provided accordingly.

2.7. Pilot testing of survey instruments and protocol

The survey instruments were pilot tested for during TPVICS. Approximately 1,000 interviews were conducted in different locations of Pakistan in households with eligible children to identify potential problems with the survey instruments and protocol. The final version of the questionnaires was shared with the representatives of key project stakeholders for their review and feedback and was shared with members of the Technical Committee for their review and endorsement.

Before starting survey field activities, the team conducted a pilot survey in 20 different locations of the country. This exercise was done only in non-targeted PSUs. All steps of the survey data collection and quality analysis protocol were conducted, and revisions were made based on the lessons learned.

2.8. Data collection and timeline

Data collection of the supplementary TPVICS was implemented in two stages in each district. In the first stage, household line listing was conducted in the selected PSUs. The household listing was used to select 13 eligible households for the survey to target in each PSU.

Stage two was dedicated to the collection of information on household socio-economic status and information about routine vaccination of children 12-23 months of age from the 13 sampled households in each PSU. Two custom-made data collection applications were designed using native Java language for the interface/front end with SQL Lite running at the backend. The data collection applications were Android compatible. The data stored in the handheld devices were transmitted to the AKU data centre using the internet. At the AKU data centre, a dedicated database hosted on a Microsoft SQL Server was used to store and retrieve the data received from the handheld devices. For error checking, cleaning, data analysis, and final storage, data were transferred into Stata version 16.1 [17]. Data backups were conducted in accordance with the shared Data Management Unit (DMU) Data Back-up SOP.

During the data collection process, Pakistan faced a fourth wave of COVID-19. AKU staff continued to conduct field activities during this period and adhered to guidelines for reducing risk and exposure to COVID-19. Field activities, including identifying travel routes to and from field locations, were developed to either circumvent the areas of high COVID risk or minimize encounters with the public and local authorities while in the area. All field staff were trained on the precautionary methods to avoid COVID and necessary personal protective equipment (PPE) such as gloves, masks, and sanitizers were provided to the entire field staff. The timeline for survey implementation is summarized in table 3**.**

Table 3. Timelines for survey implementation

Districts	Start date of HH data collection	End date of HH data collection
Peshawar	5 July 2021	24 August 2021
Korangi	7 July 2021	20 August 2021
Karachi West	10 July 2021	3 August 2021
Karachi East	25 August 2021	27 August 2021
Malir	30 August 2021	31 August 2021
Killa Abdullah	20 September 2021	20 October 2021
Quetta	13 July 2021	8 September 2021
Pishin	10 August 2021	26 August 2021

2.9. Data collection monitoring and quality control procedures

A dedicated "TPVICS dashboard" was also developed on the PHP programming language. The PHP version used in this dashboard was 8.1.2. The "*CodeIgniter*" framework was used for backend, and the HTML, CSS, JQUERY, Bootstrap were used for front-end development. The database used in this dashboard was "SQL Server".

TPVICS dashboard provided live information on the progress of data collection activities and offered other features including facility for the survey managers to carry out randomization of the households, access soft copy or print the list of randomized households for each PSU. The access of dashboard was also provided to key partners to check the day to day progress of the field activities.

There were four main user roles for dashboard, which were "Super Admin", "Admin", "Supervisor", and "User".

- The Super Admin group had all the rights of dashboard, including adding, editing, and deleting. It is mostly for Senior Managers, PI, etc.
- The admin group had also almost all rights. They were mostly DMU staff, and coordinators.
- Supervisors had limited rights only to add or edit the data but not the right to delete the data. They were site staff supervisors.
- The user group had very limited rights. They could only view the data of their respective PSU.

Survey activities were regularly and rigorously monitored through the dashboard and in-field by the supervisors/managers. The district-level data collection was supervised by the district supervisors and monitored by the provincial manager, who was specially trained to supervise this task. All filled-in data was checked by the team leader/supervisor for completeness before leaving the field. After completing their work, they returned to the office and checked their collected data on the dashboard. The team leader checked the entire filled questionnaires for completeness, accuracy, and vaccination card visibility. The regional manager and district supervisors were responsible for reviewing vaccination cards on the dashboard to ensure the quality of data transcription by data collectors. The district supervisors were also responsible for timely syncing of line listing data and acquisition of randomization sheets as well as syncing of the household data along with the vaccination cards.

The following steps were ensured during monitoring and quality control in the field:

- Each data collector was expected to submit/sync only completed and accurate questionnaires. Every day, the supervisor checked data for completeness and timely syncing. The supervisor checked the household list indicating that questionnaires had been completed for all eligible children, and if not,

the reasons for missing questionnaires were recorded (for example, caretaker not available after two visits or refused to participate). All forms were checked and corrected before leaving the cluster area and syncing data. The district supervisor/team leader gave feedback immediately to interviewers. Any discrepancy or missing data was resolved through discussions with the interviewers, a review of photographs of the vaccination card (if available), or revisits to households if necessary.

- To ensure the quality of the data collected, the team leader/district supervisor validated household listing activities to check that the household lists had been done correctly, cluster or segment boundaries were correctly identified, and that field workers did not skip (either intentionally or by mistake) interviews for eligible children, and to tally eligible respondents in each home. The selection of clusters was based on data indicators related to the number of listed households and eligible children. Clusters with a smaller number of reported households and eligible children than expected were selected for validation.

- A dedicated quality control associate at the data management unit reviewed pictures of vaccination cards taken by survey teams and compared them with the data entered from the card to validate the quality of data transcription by data collectors. This exercise was very helpful for notifying teams about possible errors in a timely fashion.

2.10. Data processing and analysis

2.10.1 Data cleaning

In addition to human-initiated review in the field, an automated data quality script was run regularly to evaluate relationships between vaccination dates, the child's date of birth, and the date of the interview. Discrepancies were identified and initiated another round of review of the photos of children's home-based records. 952 cards were corrected. In some cases, logical discrepancies remained because they accurately reflect what was recorded on the home-based record. Those discrepancies were handled downstream in the WHO Vaccination Coverage Quality Indicator (VCQI) software, described below.

Every home-based record was reviewed at least twice, once by the primary data collector in the home and a second time by their supervisor using the dashboard. All records that contained logical discrepancies were reviewed a third time using the dashboard.

2.10.2 Weighting

Survey weights were calculated in accordance with Annex J of the 2018 WHO Vaccination Coverage Cluster Survey Reference Manual [16]. Base weights were calculated as the inverse probability of respondent selection:

$$BaseWt = \frac{1}{P1\ x\ P2\ x\ P3\ x\ P4}$$

Where:

- ***P1*** is the probability the PSU was selected = number of PSUs selected in the UC / total number of PSUs in the UC
- ***P2*** is the probability the household has at least one child aged 12-23 months = # of HH found to hold a child 12-23m / # of HHs listed
- ***P3*** is the probability of selecting a specific HH = Number of HH selected (usually 13) / Number of HH found to hold at least one child age 12-23 months
- ***P4*** is the probability of selecting an eligible child in the household = 100% (because the teams collected data on all eligible children)

The base weights were inflated to represent a contribution for a small number of PSUs that contained only commercial buildings and a small number of households where residents were not at home when visited.

$$AdjWt1 = BaseWt\ x\ \frac{\#\ of\ clusters\ targeted\ for\ interview\ data\ collection\ in\ this\ UC}{\#\ of\ clusters\ where\ interviews\ were\ conducted\ in\ this\ UC}$$

$$AdjWt2 = AdjWt1x\ \frac{\#\ of\ HHs\ targeted\ for\ data\ collection\ in\ this\ cluster}{\#\ of\ HHs\ from\ which\ data\ were\ collected\ in\ this\ cluster}$$

Because data are to be combined across UCs to estimate SHRUC coverage at the district level, the weights were post-stratified so the sum of weights in each UC would be proportional to the estimated population of eligible children there. Administrative estimates of the population of children under 5 years of age in each SHRUC were obtained from the BMGF polio program. The number of children aged 12-23 months was assumed to be proportional to the number of children under 5 years of age, so the post-stratified weights were calculated thus:

$$PsWt1 = AdjWt2\ x\ \frac{(Population\ under\ age\ 5\ in\ this\ UC/5)}{Sum\ of\ AdjWt2\ for\ children\ age\ 12\ to\ 23\ months\ in\ this\ UC}$$

The values of PsWt1 may be used to estimate the number of children aged 12-23 months in the UCs and to estimate the number of those children who received the various vaccine doses. The values are less programmatically meaningful for the younger siblings aged 6-11 months in this dataset. Their relative values are meaningful, representing the probability of household selection, but their absolute values do not correspond to anything that should be interpreted as a count of children aged 6-11 months in the UCs.

The weights for children aged 12-23 months were rescaled in a final step so the overall sum of weights is equal to the number of children in the survey sample.

$$PsWt2 = PsWt1\ x\ \frac{Total\ number\ of\ children\ 12-23m}{Sum\ of\ PsWt1\ for\ children\ 12-23m}$$

The values of PsWt2 were used in the analysis of vaccination coverage among children aged 12-23 months. Identical estimated proportions (coverage results) would be obtained if the analysis used PsWt1. A similar set of weights were calculated for children aged 6-11 months.

2.10.3 Data analysis – pre-processing

The survey dataset was designed to provide estimates of key indicators at UC level. Analyses were performed after data cleaning and satisfactory quality assurance. The SHRUC data were combined with TPVICS data from the SHRUC districts and analyzed in a way to show TPVICS district results alongside results from the SHRUCS within those districts. Vaccination coverage and its associated indicators were calculated using the freely available software known as Vaccination Coverage Quality Indicators (VCQI) [18]. VCQI analyses were conducted using Stata version 17 [17]. The primary analysis examined coverage for children aged 12-23 months to compare directly with TPVICS.

VCQI employs its own data cleaning process that makes edits to the data. Vaccination evidence can take the form of date from an HBR, a tick mark from an HBR (indicating that there was a pen or pencil mark or signature to indicate that the child received the dose, but no date, or that the date was illegible), or yes/no caregiver recollection concerning whether the child received for each dose. In several well-defined circumstances, VCQI converts a date to a tick mark before estimating coverage indicators. Dates are converted to a simple yes/no tick marks under these conditions:

- If the date is only partially specified
- If the date is nonsensical (e.g., Feb 30 or Sep 31)
- If the date falls outside the possible period for eligible respondents (in this case, dates of birth

should fall between 12 and 24 months before the survey interview and dates of vaccination should fall between the child's date of birth and the date of the survey interview)

- If doses in a series have dates that are equal (e.g., Penta1 date is the same as Penta2)
- If doses in a series have dates that are out of order (e.g., Penta2 date is before Penta1)

2.10.4 Data analysis – indicators

After the data are cleaned in that manner, coverage indicators are calculated. Indicators reported here include:

- Card availability - proportion of children for whom a home-based record (HBR or *vaccination card*) was seen.
- Crude coverage – What proportion of children had any evidence of receiving the dose, either via the home-based record (HBR) or via the recollections of the child's caregiver?
- Drop-out – What portion of children who began a dose series, did not complete the series?

Date-based analyses – For children with vaccination dates on HBRs, several other indicators may be calculated.

- Timeliness – What portion of children have documented evidence of receiving the dose too early? Within 28 days of the appropriate age? 1-2 months late? Or more than two months late?
- Dose interval assessment – What portion of dose pairs in a series is given with an interval that is < 28 days? An interval of 28-56 days? What portion of intervals exceeds 56 days?

Missed opportunities for simultaneous vaccination (MOSVs) – An MOSV occurs when a child receives one or more doses on a particular day but does not receive all the doses that s/he was eligible for.

- Visits with MOSVs – What portion of vaccination visits include one or more MOSVs?
- Children with MOSVs – What portion of children experience one or more MOSVs? Overall? By dose?
    - Corrected MOSVs – What portion of those doses that were missed at the first eligible visit were received at a later visit? What portion of MOSVs were still uncorrected at the time of the survey?
    - Time-to-MOSV correction – Among children who missed a dose at their first eligible visit and received it later, what was the median time to correction, in days?

3. Survey results

The survey results are presented in eight sections. Section 3.1 presents findings related to survey coverage, and household demographic characteristics for each district. Section 3.2 provides survey findings regarding vaccination card availability and reasons associated with the non-availability of vaccination cards. Section 3.3 presents findings regarding vaccination coverage and timeliness among children ages 12-23 months; Section 3.4 describes antigen coverage status in districts and SHRUCs; Section 3.5 presents drop-outs between vaccination visits; Section 3.6 reports results on dose intervals, and Section 3.7 presents findings related to MOSV, and Section 3.8 reflects on reasons associated with not vaccinating the children.

3.1. Survey coverage and household demographic characteristics

The survey targets and demographic characteristics of the target districts are presented in this section.

3.1.1 Survey target and coverage

The survey covered a total number of 610 clusters from 39 target SHRUCs spreading over eight districts. Seventeen SHRUCs were located in district Peshawar in KP, eight SHRUCs in four districts in Sindh, and fourteen SHRUCs in three districts of Balochistan. In total, interviews were completed at 7,549 HHs in the SHRUCs against the target of 7,956: a 99.3% response rate. The household response rate was 100% in the SHRUCs in districts Killa Abdullah and Quetta in Balochistan and in the SHRUCs in four districts of Sindh. In Peshawar, the response rate was 99.8%, and in Pishin, where two PSUs in strictly commercial districts were dropped, the response rate was 92%. District-wise survey targets, coverage, and number of SHRUCs are summarized in table 4.

Table 4. Survey targets and coverage by district

Districts	Number of SHRUCs	Clusters			Households			
		Sampled	Randomized	Surveyed	Target	Randomized	Completed	Response rate
Overall	**39**	**612**	**610**	**610**	**7,956**	**7,904**	**7,549**	**99.3%**
Peshawar	17	170	170	170	2,210	2,205	2,049	99.8%
Korangi	2	82	82	82	1,066	1,066	1,066	100%
Karachi East	1	45	45	45	585	585	585	100%
Karachi West	4	72	72	72	936	936	935	100%
Malir	1	18	18	18	234	234	234	100%
Killa Abdullah	5	90	90	90	1,170	1,170	1,163	100%
Pishin	3	45	43	43	585	538	466	92%*
Quetta	6	90	90	90	1,170	1,170	1,051	100%

* Two PSUs in Pishin were dropped because they were commercial neighborhoods with no residents.

3.1.2 Demographic characteristics of target districts

Overall, the survey covered 6,976 children ages 12 to 23 months from the 8 districts of the target SHRUCs. Of the children covered, 53.0% were male and 47.0% were female. In all districts, there were more male children in the sample than females.

Concerning parental education in the districts, the survey found the highest literacy[4] rate among mothers of eligible children in SHRUCs district Korangi (44.7%). It was followed by districts Karachi West (39.1%), Peshawar (32.7%), Malir (30.2%), and Karachi East (21.3%). In the districts of Balochistan, the literacy of mothers of eligible children was relatively low: 9.2% in district Quetta, 11.0% in Pishin and only 1.6% in Killa Abdullah. (Table 5)

Regarding the education level of the fathers of eligible children , the survey found that more than 50% of fathers were literate in two districts: Peshawar, and Korangi. For districts Karachi West, Malir, Karachi East, Quetta, and Pishin, the paternal literacy rates were 48.5%, 30.2%, 27%, 22.1%, and 20.4% respectively. District Killa Abdullah recorded the lowest percentage at 1.7%. Overall, parental education level was low in the target districts of Balochistan. (Table 5)

Table 5. Demographic characteristics of target districts, TPVICS & SHRUCs survey

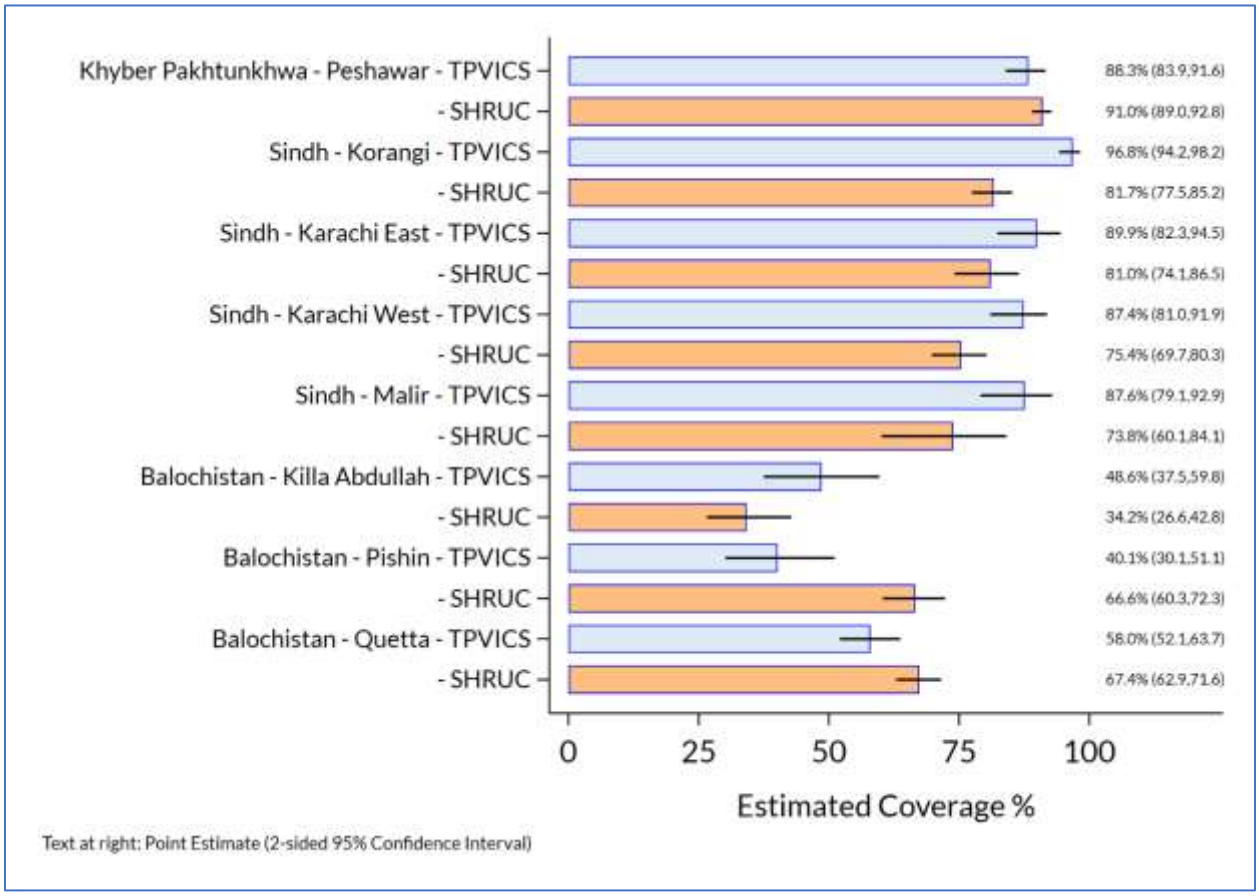
Districts	Children 12-23 months			Education (% literate)	
	TPVICS (N)=6,267 SHRUC (N)= 6,976	Age in months (mean ± sd)	% male children	Mothers	Fathers
Khyber Pakhtunkhwa – Peshawar – TPVICS	646	17.5 ± 3.3	52.2	36	59.2
- SHRUC	2,007	17.6 ± 3.4	51.1	32.7	52
Sindh - Korangi - TPVICS	839	17.4 ± 3.4	55.4	86.1	87.9
- SHRUC	1,036	17.2 ± 3.5	53.9	44.7	54.7
Sindh - Karachi East - TPVICS	819	17.4 ± 3.6	59.7	79.3	83.5
- SHRUC	571	17.0 ± 3.4	55.2	21.3	27
Sindh - Karachi West - TPVICS	832	17.6 ± 3.2	49	62	66.3
- SHRUC	924	17.5 ± 3.5	53	39.1	48.5
Sindh - Malir - TPVICS	837	17.4 ± 3.6	51.4	56.3	67.4
- SHRUC	226	16.8 ± 3.4	53.6	30.2	30.2
Balochistan - Killa Abdullah - TPVICS	728	18.3 ± 2.7	65.4	8.5	6.5
- SHRUC	896	15.8 ± 2.5	52.7	1.6	1.7
Balochistan - Pishin - TPVICS	745	17.5 ± 2.6	44.7	9.3	46.2
- SHRUC	420	17.2 ± 3.3	55.7	11	20.4
Balochistan - Quetta - TPVICS	821	17.6 ± 3.1	52.7	25.9	29.1
- SHRUC	896	16.8 ± 3.2	56.2	9.2	22.1

[4] In this report, literacy is defined as having received one or more years of formal education.

3.2. Vaccination home-based record (card) availability

Vaccination cards are considered a quality measure in vaccination services and one of the reliable sources of information about vaccination history. Information about vaccination card availability in the target districts of TPVICS and SHRUCs are presented in Figures 1 and 2. SHRUC survey detail at the UC level is available in an electronic annex[5].

Figure 1. Proportion of children aged 12-23 months who ever had a card, TPVICS & SHRUCs



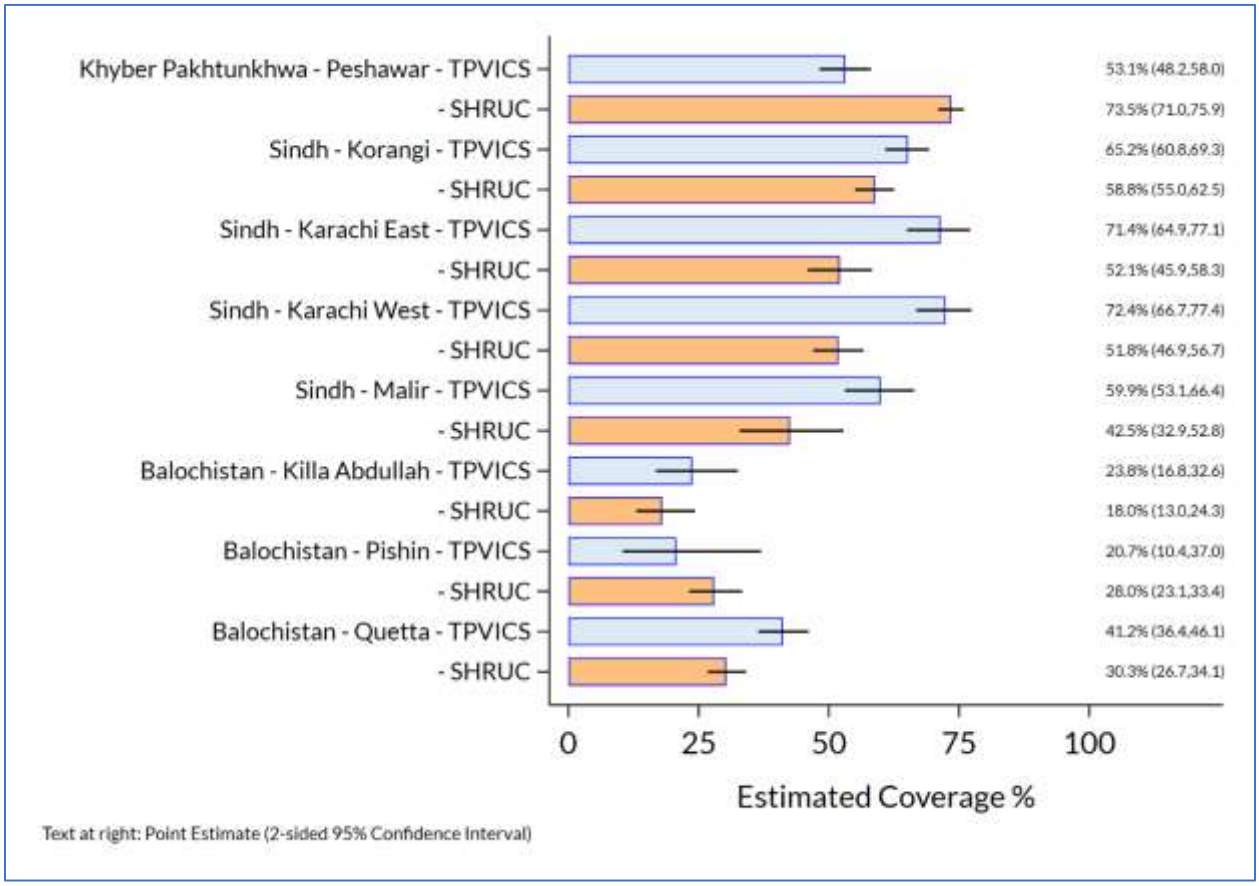
Three-quarters or more of the children in Sindh and KP SHRUCs received a card whereas only one- to two-thirds of the children in the Balochistan SHRUCs did so. In Peshawar, about 90% of respondents in both TPVICS and SHRUCs surveys had received a card. In Sindh, the TPVICS results were higher than the SHRUC results, whereas, in Balochistan, the portion of children who ever received a card was higher for the SHRUC respondents than TPVICS respondents in both Pishin and Quetta districts, but lower than TPVICS in Killa Abdullah.

[5] https://www.dropbox.com/sh/wkb5nenf8tx1dot/AAAojoSVtR_SWiG7jlDI1WHSa?dl=0

The report does not include p-values for a formal statistical hypothesis test of whether outcomes are higher in the TPVICS or SHRUC datasets (one blue bar vs. the following orange bar) but in many cases an informal eyeball test is sufficient. If two 2-sided 95% confidence intervals do not overlap, as is the case for Pishin district in figure 1, then we can confidently say that the difference would be statistically significant with 95% confidence. If the intervals overlap substantially (i.e., the 95% confidence interval from one survey includes the point estimate from the other survey) then we can say that the difference would not be statistically significant. If the two intervals overlap sightly, then it is not possible to tell by eye, and a formal test would be required to draw a confident conclusion. In figure 1, we might use an eyeball test to say the following:

- Peshawar - inconclusive
- Korangi – significant – The TPVICS estimate is significantly higher than the SHRUC estimate.
- Karachi East - inconclusive
- Karachi West – significant – Again, TPVICS is higher.
- Malir - inconclusive
- Killa Abdullah - inconclusive
- Pishin – significant – The SHRUC estimate is significantly higher than the TPVICS estimate.
- Quetta – significant – Again, the SHRUC estimate is higher.

Figure 2. Proportion of children aged 12-23 months whose card was seen by the survey interviewer, TPVICS & SHRUCs



Note that every bar in Figure 2 is shorter than the corresponding bar in 1 so for every district and every set of SHRUCs, a substantial portion of caregivers who reported having received a card for the child were not able to show it to the survey interviewer. District Peshawar recorded the highest percentage of cards observed in the SHRUC survey, where for 73.5% of the children, the vaccination cards were seen by the survey team at the time of the interview. That figure is significantly higher than the 53.1% of TPVICS respondents in the same district. Killa Abdullah had the lowest availability; Figure 1 indicates that 34.2% of children in SHRUCs ever received a card, but Figure 2 shows that interview teams only saw cards for 18% of respondents aged 12-23 months in the SHRUC survey.

3.2.1 Reasons for non-availability of vaccination cards

Reasons for never having received a vaccination card are summarized in Table 6. In the target districts, a primary reason for the non-availability of vaccination cards was unawareness of the importance of the card. Another important reason was that family members of the children never visited a health facility to obtain a vaccination card for their children.

Table 6. Reasons for never having received a vaccination card, by district, TPVICS & SHRUCs

Districts	Don't think it's important (%)	Never visited a facility (%)	Card was not available with the health provider (%)	The vaccinator/ facility didn't provide the card (%)	Not aware of such cards (%)	Other specify (%)	Total (%)	N
Khyber Pakhtunkhwa – Peshawar – TPVICS	2.9	2.4	0.6	0.1	2	3.6	11.7	646
- SHRUC	2.4	2.7	3	0.3	0	0.5	8.9	2,007
Sindh - Korangi - TPVICS	0.8	1	0	0	0.1	1.3	3.2	839
- SHRUC	7.4	8.2	0.2	0	0.3	2.3	18.3	1,036
Sindh - Karachi East - TPVICS	1	0.6	6.5	0.6	0.2	1.1	10.1	819
- SHRUC	10.1	7.3	0.3	0	0.3	0.9	19	571
Sindh - Karachi West - TPVICS	2.7	1.5	4.2	0.4	2.2	1.6	12.6	832
- SHRUC	10	8.7	0	0.2	0.4	5.4	24.6	924
Sindh - Malir - TPVICS	2.5	6.2	0.2	0.3	0.4	2.8	12.4	837
- SHRUC	3.2	19.2	1.5	0	0	2.2	26.2	226
Balochistan - Killa Abdullah - TPVICS	20.7	12.3	9.7	2.6	4.2	1.9	51.4	728
- SHRUC	38.3	2.4	0.5	0.5	18.8	5.1	65.7	896
Balochistan - Pishin - TPVICS	23.1	8.8	0.5	7.2	3.1	17.1	59.9	745
- SHRUC	18.9	13	0.2	0	0.2	0.9	33.1	420
Balochistan - Quetta - TPVICS	5.7	18.3	7.7	0.3	4.6	5.4	42	821
- SHRUC	6.2	25.5	0.3	0.1	0.2	0.1	32.5	896
Each row sums to the % of children who never received a card.								

The SHRUC survey asked respondents who had received a card but couldn't show it, why not. This question was not asked in the TPVICS survey. The responses are summarized in Table 7.

Table 7. Reasons for not showing a vaccination card, by district, SHRUCs

Districts	Card not found at this time (%)	Card misplaced (%)	Card is with the vaccinator (%)	Other (%)	Total (%)	N
Khyber Pakhtunkhwa Peshawar	7	8.6	1.4	0.5	17.6	2,007
Sindh - Korangi	7.3	13.1	0.3	2.2	22.9	1,036
Sindh - Karachi East	8.9	15.6	2.2	2.2	29	571
Sindh - Karachi West	6.1	13.5	0.7	3.2	23.5	924
Sindh - Malir	10	18.2	2.3	0.9	31.3	226
Balochistan - Killa Abdullah	7.7	6.8	1.7	0.1	16.2	896
Balochistan - Pishin	12.3	20.3	4	2	38.6	420
Balochistan - Quetta	12.2	23.2	0.8	1.1	37.3	896

3.3. Vaccination coverage and timeliness

Vaccination coverage among children ages 12-23 months is summarized at the district level in figures 3-18. Each district is summarized in two figures – one showing results from TPVICS and the other showing results for the SHRUCs within that district. Each dose is represented by a single bar. The proportion of respondents who showed a home-based record (HBR) is indicated in the figure. The saturated colors starting at the left side of the bar summarize the timeliness with which the doses were administered. Timeliness is calculated using the child's date of birth and the date when the vaccine was given. The lightest portion of the bar at the far right represents children for whom timeliness is unknown, perhaps due to an illegible date on the card or because the vaccination evidence is from the caregiver's recall instead of a documented date.

These figures help visualize several characteristics of coverage:

- The proportion of children for whom HBRs were seen is indicated with a dashed vertical line that passes behind the dose coverage bars.
- Most doses use the same colors to code timeliness, but BCG has two unique colors in the legend: the BCG dose is considered to be timely if it is given within five days of birth. This is indicated with a darker shade of green than the timely category for other doses. And BCG is sometimes considered to be egregiously late if it is given after the age of one year; those children are indicated with a black segment in the BCG bar.
- Crude coverage (based on either card or recall) is indicated by the overall length of each bar and listed on the right side of the figure.
- Uncertainty due to sampling variability is indicated with the two-sided Wilson type confidence interval, at the tip of the bar, and listed at the right side of the figure.
- The number of children in the sample who were age-eligible to have received the dose is listed at the right side of the figure.
- The estimated proportion of children who were fully vaccinated and who were zero-dose are listed in footnotes.
- Drop-out within a dose series is evident from the fact that the bars for later doses are generally shorter than those for earlier doses.
- Generally speaking, a higher proportion of children receive the later doses more than 2 months late than the earlier doses. Note that the dark pink portion of the bar for dose 3 of each series is often much longer than the dark pink segment for dose 1 in the same series.
- The length of each segment of each bar is listed in the table below each figure.

Figure 3. Vaccination coverage among children aged 12-23 months, Peshawar District, TPVICS

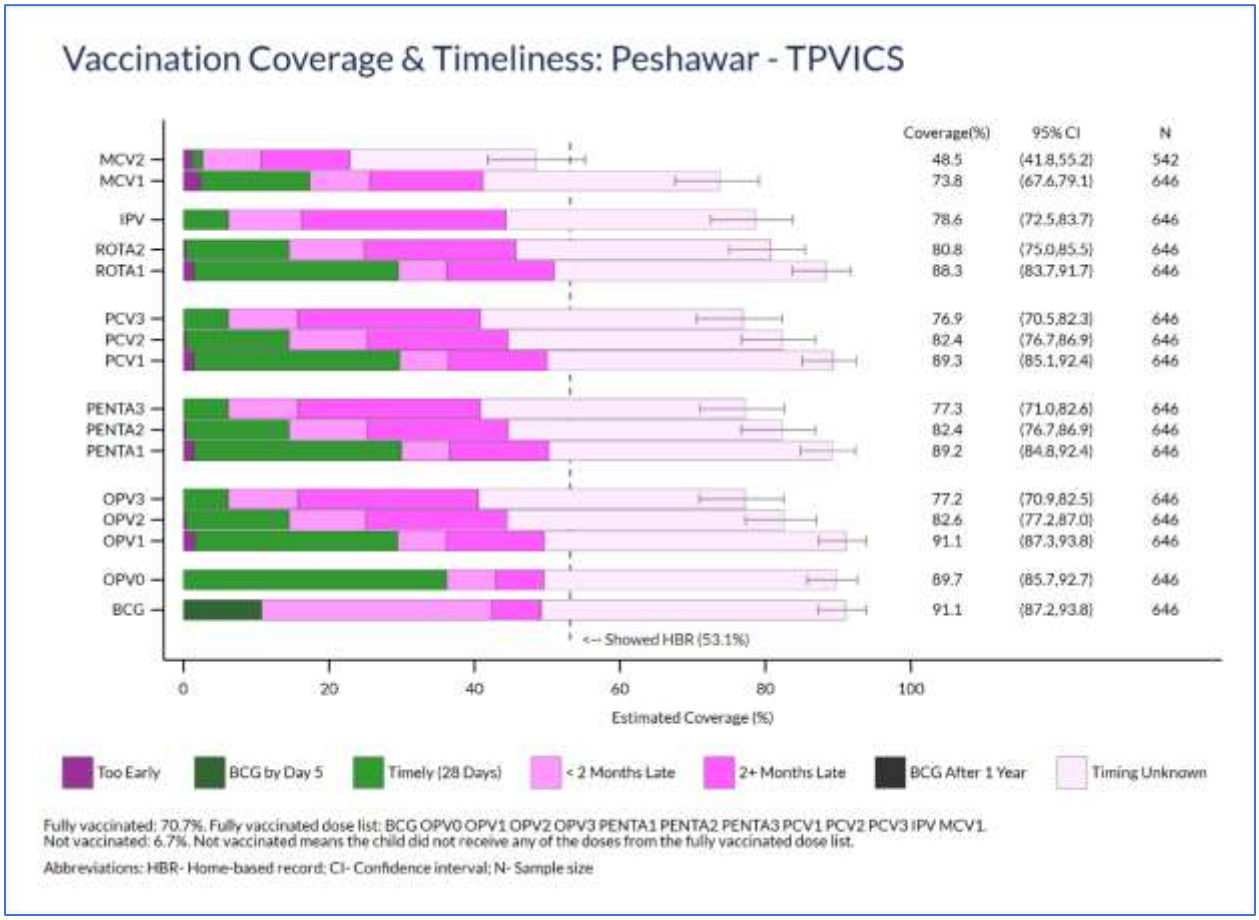


Table 8. Vaccination coverage bar segment lengths (%), Peshawar District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	1.2	1.4	8	12.2	25.6
MCV1	2.3	15	8.3	15.5	32.6
IPV	0	6.1	10.2	28	34.3
ROTA2	0.3	14.2	10.4	20.8	35.1
ROTA1	1.4	28.1	6.7	14.7	37.3
PCV3	0	6.1	9.6	25.1	36.1
PCV2	0.3	14.2	10.7	19.4	37.7
PCV1	1.4	28.3	6.7	13.6	39.3
PENTA3	0	6.1	9.6	25.1	36.5
PENTA2	0.3	14.2	10.7	19.4	37.7
PENTA1	1.4	28.5	6.7	13.6	39
OPV3	0	6.1	9.6	24.8	36.7
OPV2	0.3	14.2	10.5	19.4	38.2
OPV1	1.6	27.9	6.7	13.5	41.5
OPV0	0	36.2	6.8	6.6	40.1
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	10.7	31.7	6.7	0.1	41.9

Figure 4. Vaccination coverage among children aged 12-23 months, Peshawar District, SHRUCs

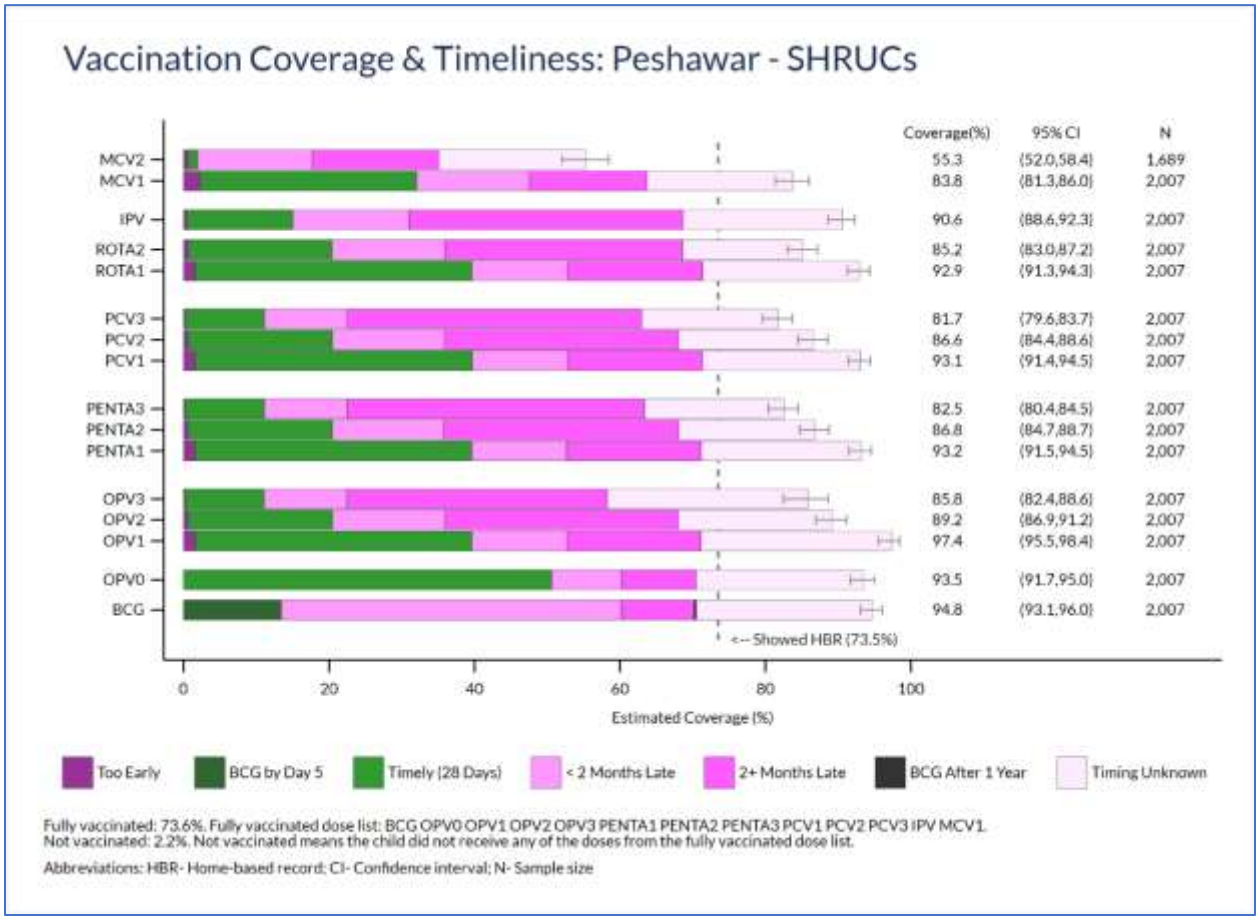


Table 9. Vaccination coverage bar segment lengths (%), Peshawar District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.5	1.4	15.8	17.4	20.2
MCV1	2.3	29.8	15.4	16.2	20.1
IPV	0.4	14.6	16	37.7	22
ROTA2	0.6	19.8	15.6	32.6	16.6
ROTA1	1.6	38.1	13.1	18.6	21.6
PCV3	0.2	11	11.3	40.5	18.8
PCV2	0.6	19.9	15.4	32.2	18.6
PCV1	1.6	38.1	13.1	18.5	21.8
PENTA3	0.2	11	11.4	40.8	19.2
PENTA2	0.6	19.8	15.3	32.3	18.8
PENTA1	1.6	38	13.1	18.5	22
OPV3	0.2	10.9	11.3	35.8	27.6
OPV2	0.6	19.9	15.5	32.1	21.2
OPV1	1.6	38.1	13.1	18.3	26.3
OPV0	0	50.6	9.6	10.3	23.1
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	13.4	46.7	10	0.4	24.2

The Peshawar figures indicate:

- Card availability in the SHRUCs was substantially higher than in TPVICS (71.5% vs. 53.1%).
- Estimated coverage in the SHRUCs was higher for every dose than coverage estimated across the district in TPVICS.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV & ROTA series were nearly the same, but in SHRUCs, coverage for OPV1-3 were somewhat higher than for PENTA1-3 and PCV1-3 and ROTA1-2.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was notably higher than PENTA3 and PCV3.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series.
- Both surveys show poor timeliness with more than half of the doses for which timeliness is known being more than 28 days late.
- Both surveys show that the later doses in the series have many more children receiving the doses 2+ months late than the earlier doses in the series. Far fewer children received timely administration of dose 3 than dose 1, and far more children received dose 3 2+ months late than dose 1.

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Figure 5. Vaccination coverage among children aged 12-23 months, Korangi District, TPVICS

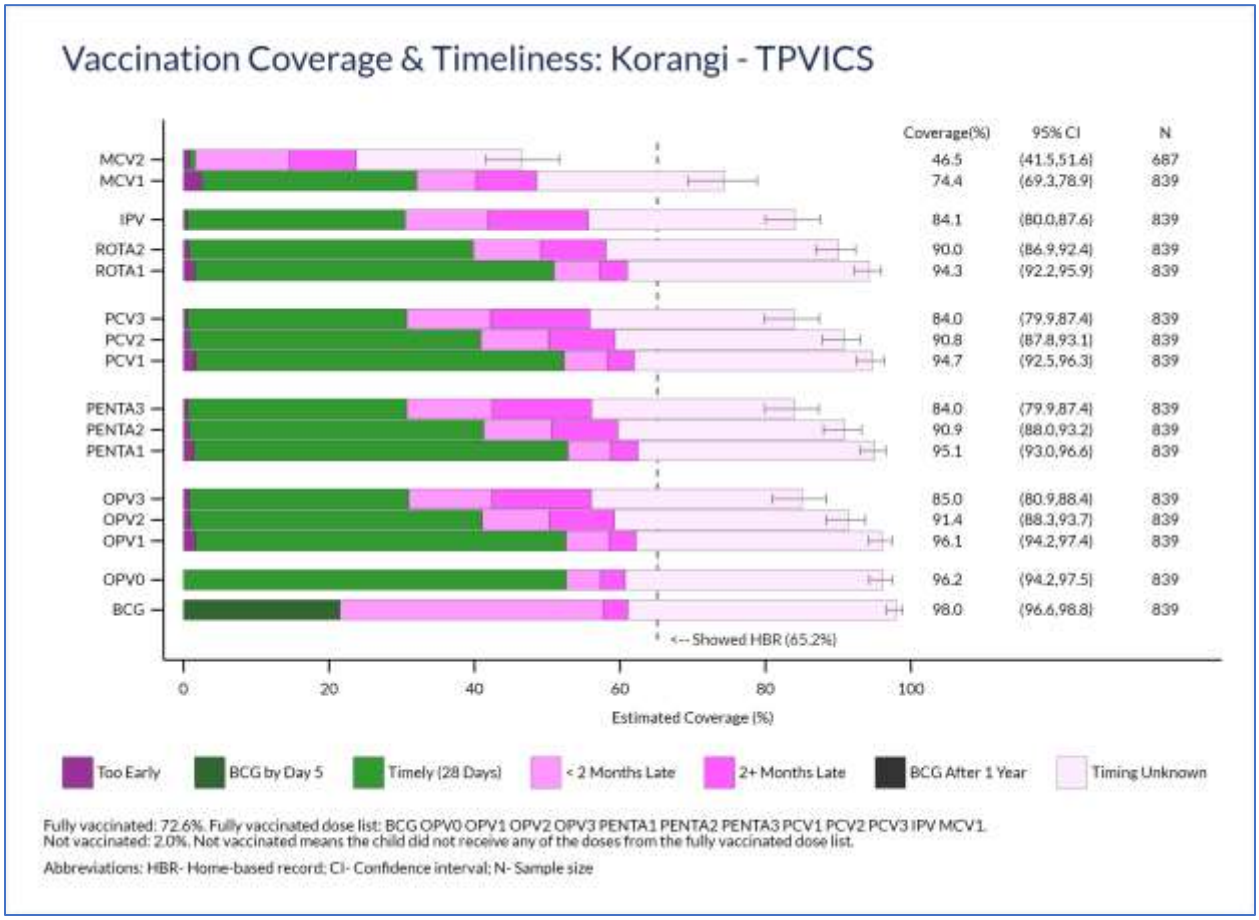

Table 10. Vaccination coverage bar segment lengths (%), Korangi District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.8	0.8	13	9.2	22.8
MCV1	2.5	29.6	8.2	8.3	25.8
IPV	0.5	30	11.4	13.7	28.5
ROTA2	0.8	39	9.3	9	31.9
ROTA1	1.6	49.4	6.3	3.8	33.3
PCV3	0.5	30.2	11.5	13.6	28.1
PCV2	0.8	40.1	9.4	9.1	31.5
PCV1	1.7	50.6	6	3.7	32.8
PENTA3	0.6	30.1	11.8	13.6	27.9
PENTA2	0.8	40.5	9.4	9.1	31.2
PENTA1	1.4	51.3	6	3.7	32.7
OPV3	0.7	30.2	11.5	13.6	29
OPV2	0.9	40.1	9.2	9	32.1
OPV1	1.6	51	6	3.7	33.9
OPV0	0	52.6	4.8	3.3	35.5
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	21.5	36.2	3.3	0	37.0

Figure 6. Vaccination coverage among children aged 12-23 months, Korangi District, SHRUCs

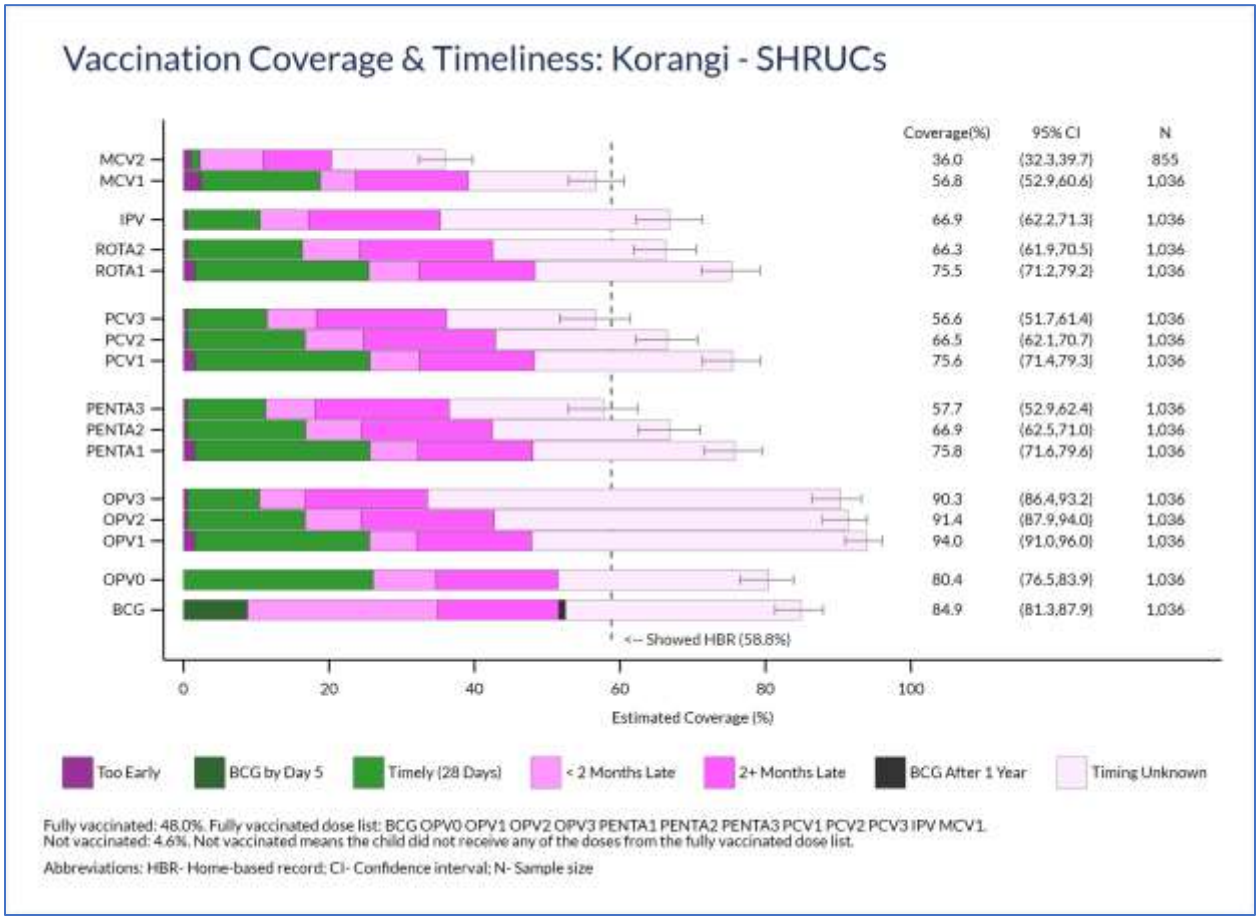

Table *11. Vaccination coverage bar segment lengths (%), Korangi District, SHRUCs*

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	1	1.3	8.7	9.3	15.6
MCV1	2.4	16.4	4.9	15.5	17.7
IPV	0.4	10.1	6.7	18.1	31.6
ROTA2	0.5	15.8	7.9	18.3	23.8
ROTA1	1.6	23.9	6.9	16	27.1
PCV3	0.5	11	6.8	17.9	20.5
PCV2	0.6	16.1	8	18.2	23.6
PCV1	1.6	24.1	6.8	15.8	27.3
PENTA3	0.5	10.8	6.8	18.4	21.2
PENTA2	0.5	16.3	7.6	18	24.4
PENTA1	1.6	24.1	6.6	15.7	27.8
OPV3	0.5	9.9	6.4	16.8	56.8
OPV2	0.6	16.1	7.7	18.3	48.7
OPV1	1.6	24	6.5	15.8	46.2
OPV0	0	26.1	8.7	16.7	29
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	8.8	26.1	16.7	0.9	32.4

The Korangi figures indicate:

- Card availability in the SHRUCs was slightly lower than in TPVICS (58.8% vs. 65.2%).
- Estimated coverage in the TPVICS survey was higher for every dose except those in the OPV series than coverage estimated across the SHRUCs.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV and ROTA series were nearly the same, but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA1-3 and PCV1-3 and ROTA1-2. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was notably higher than PENTA3 and PCV3.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out for OPV is lower in the SHRUCs than in the TPVICS sample.
- The TPVICS survey has better timeliness outcomes than SHRUCs, with larger green bar segments.
- In TPVICS, the later doses in the series have many more children receiving the doses 2+ months late than the earlier doses in the series. Far fewer children received timely administration of dose 3 than dose 1, and far more children received dose 3 2+ months late than dose 1. This pattern is not as evident in the SHRUCs data; roughly the same portion received the later doses 2+ months late as the earlier doses.
- A very small portion of children in the SHRUCs sample (0.9%) received BCG after age one year.

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Figure 7. Vaccination coverage among children aged 12-23 months, Karachi East District, TPVICS

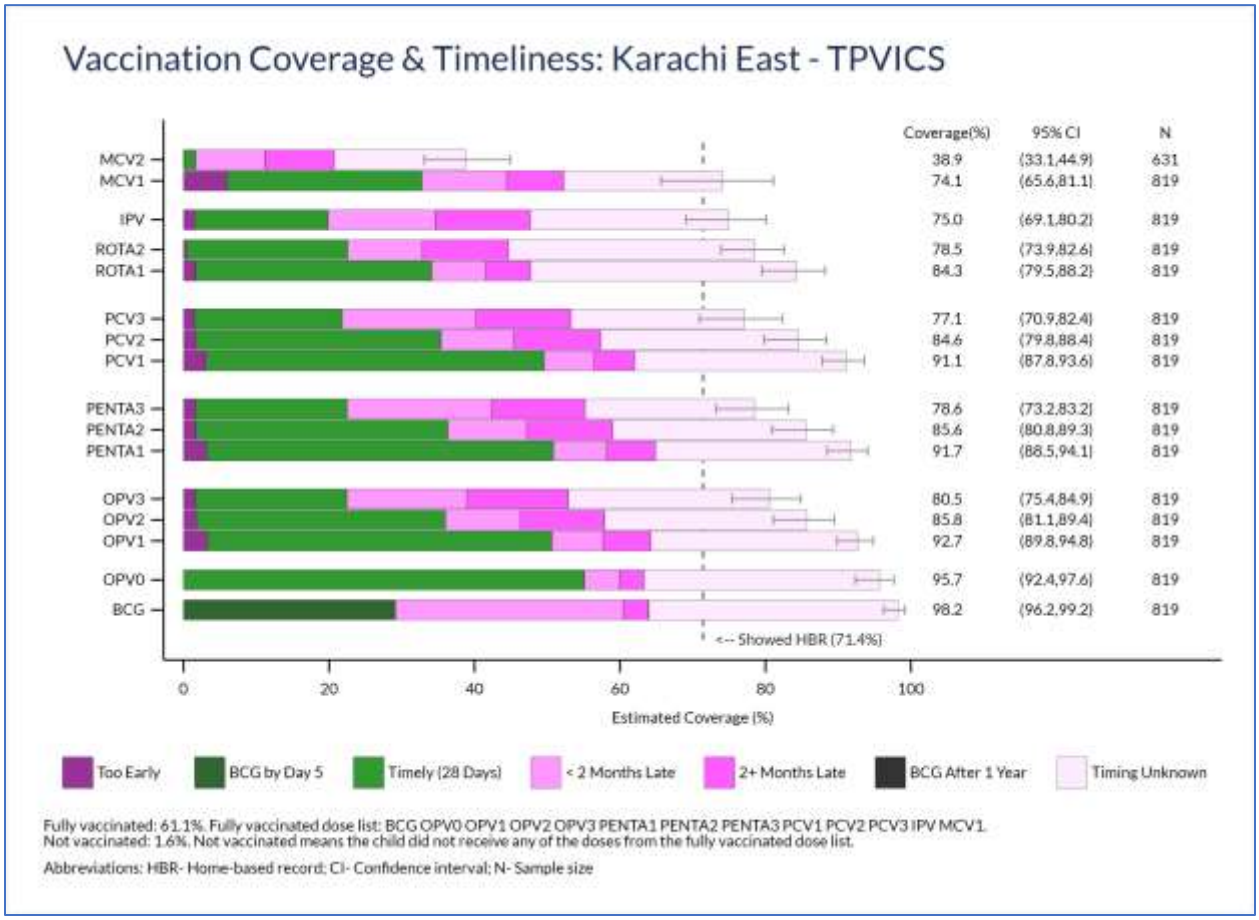

Table 12. Vaccination coverage bar segment lengths (%), Karachi East District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.1	1.6	9.5	9.6	18.1
MCV1	6	26.8	11.6	7.8	21.9
IPV	1.5	18.4	14.7	13.1	27.3
ROTA2	0.4	22.2	10.3	11.8	33.9
ROTA1	1.7	32.5	7.4	6.2	36.6
PCV3	1.5	20.3	18.4	13	23.9
PCV2	1.7	33.7	10	11.9	27.2
PCV1	3.1	46.5	6.9	5.5	29.1
PENTA3	1.6	20.9	19.9	12.9	23.4
PENTA2	1.7	34.6	10.9	11.8	26.6
PENTA1	3.2	47.7	7.3	6.7	26.8
OPV3	1.6	20.8	16.5	13.9	27.7
OPV2	1.8	34.2	10.3	11.5	27.9
OPV1	3.3	47.4	7	6.6	28.5
OPV0	0	55.1	4.8	3.3	32.4
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	29.1	31.4	3.5	0	34.3

Figure 8. Vaccination coverage among children aged 12-23 months, Karachi East District, SHRUCs

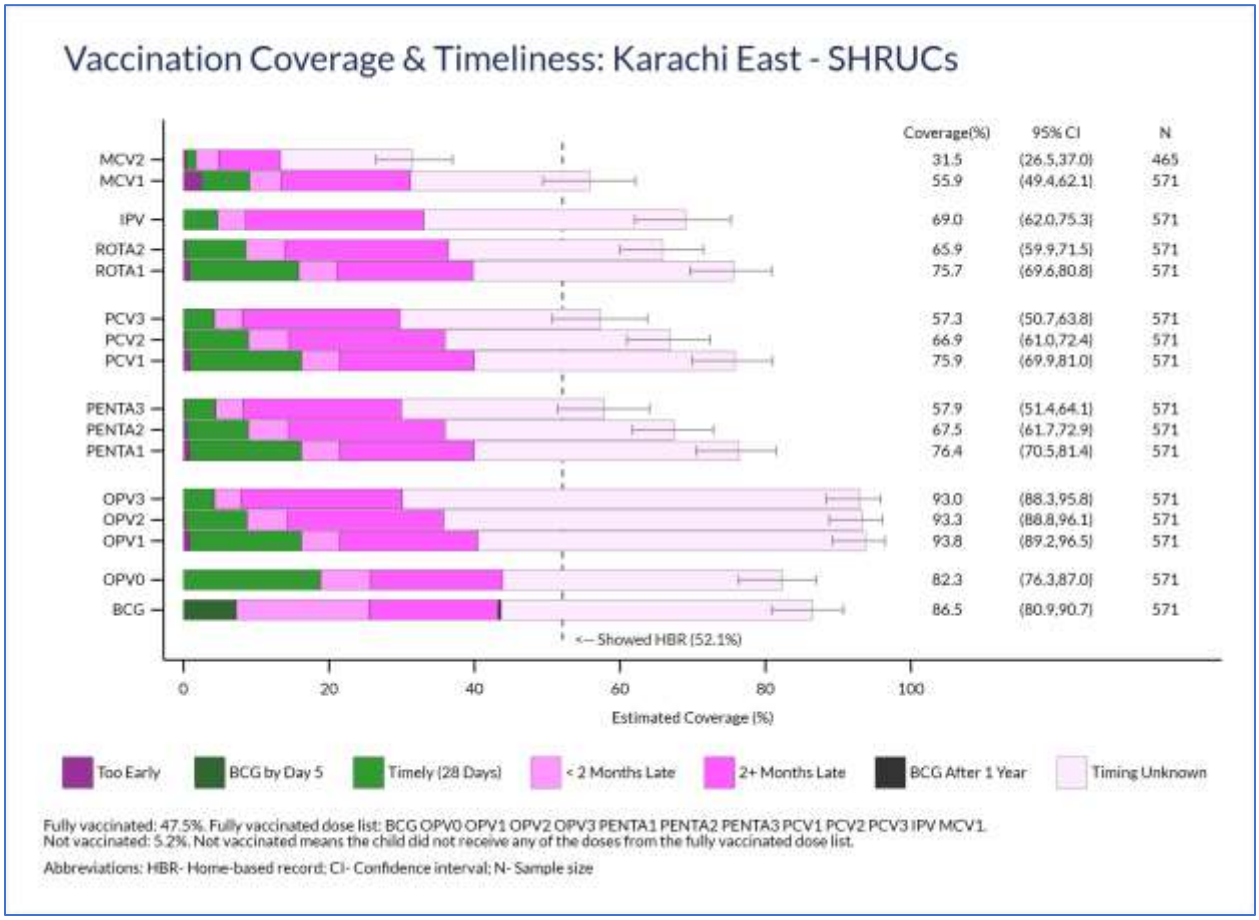

Table 13. Vaccination coverage bar segment lengths (%), Karachi East District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.4	1.3	3.1	8.5	18.2
MCV1	2.5	6.6	4.4	17.7	24.7
IPV	0	4.7	3.9	24.5	36
ROTA2	0.3	8.3	5.3	22.5	29.5
ROTA1	0.8	15	5.3	18.7	35.9
PCV3	0	4.2	3.9	21.7	27.6
PCV2	0.3	8.6	5.5	21.5	31
PCV1	0.8	15.3	5.3	18.5	35.9
PENTA3	0.2	4.2	3.9	21.7	27.9
PENTA2	0.5	8.4	5.5	21.5	31.6
PENTA1	0.8	15.3	5.3	18.5	36.4
OPV3	0	4.2	3.7	22.2	62.9
OPV2	0.3	8.4	5.5	21.5	57.5
OPV1	0.8	15.3	5.3	19	53.3
OPV0	0	18.9	6.9	18.1	38.4
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	7.3	18.3	17.7	0.4	42.9

The Karachi East figures indicate:

- Card availability in the SHRUCs was lower than in TPVICS (52.1% vs. 71.4%).
- Estimated coverage in the TPVICS survey was higher for every dose except those in the OPV series than coverage estimated across the SHRUCs.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same, but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA1-3 and PCV1-3. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was notably higher than PENTA3 and PCV3.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out for OPV is much lower in the SHRUCs than in the TPVICS sample – nearly all of the SHRUCs respondents who started the OPV series received 3 doses.
- The TPVICS survey has better timeliness outcomes than SHRUCs, with larger green bar segments.
- In TPVICS, the later doses in the series have many more children receiving the doses 2+ months late than the earlier doses in the series. Far fewer children received timely administration of dose 3 than dose 1, and far more children received dose 3 2+ months late than dose 1. This pattern is not as evident in the SHRUCs data; roughly the same portion received the later doses 2+ months late as the earlier doses. But in the SHRUCs, many fewer received a timely administration of dose 3 than of dose 1.
- A very small portion of children in the SHRUCs sample (0.4%) received BCG after age one year.

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Figure 9. Vaccination coverage among children aged 12-23 months, Karachi West District, TPVICS

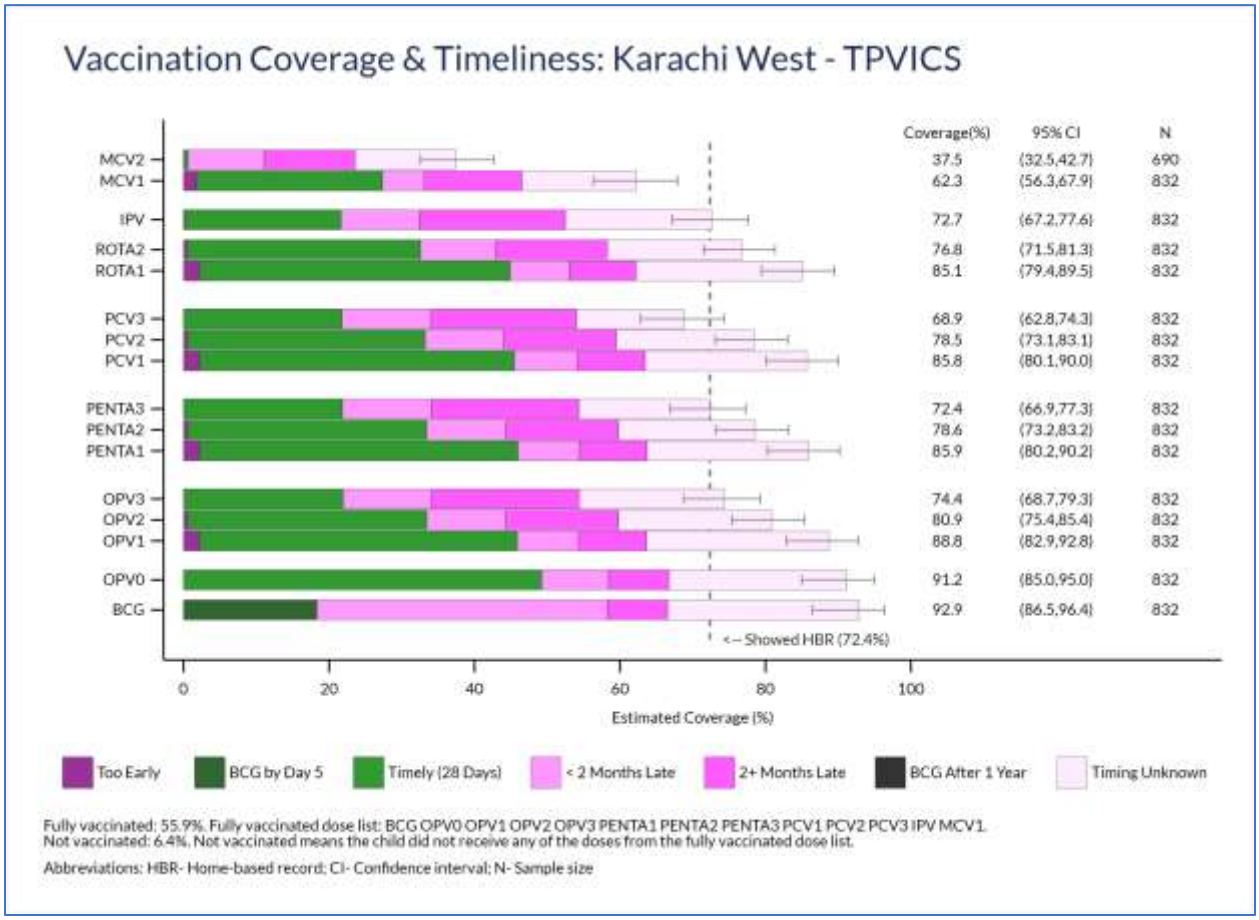

Table 14. Vaccination coverage bar segment lengths (%), Karachi West District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.1	0.5	10.5	12.5	13.9
MCV1	1.8	25.6	5.8	13.4	15.8
IPV	0.2	21.5	10.8	20	20.3
ROTA2	0.5	32.1	10.3	15.4	18.5
ROTA1	2.2	42.7	8.2	9	23
PCV3	0	21.7	12.2	20.1	14.8
PCV2	0.5	32.7	10.8	15.5	19
PCV1	2.2	43.3	8.6	9.3	22.4
PENTA3	0	21.8	12.2	20.3	18
PENTA2	0.5	32.9	10.8	15.5	18.9
PENTA1	2.2	43.7	8.4	9.3	22.2
OPV3	0	21.9	12.1	20.3	20
OPV2	0.5	32.9	10.8	15.5	21.1
OPV1	2.2	43.6	8.4	9.3	25.2
OPV0	0	49.2	9.3	8.3	24.5
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	18.3	39.9	8.3	0	26.4

Figure 10. Vaccination coverage among children aged 12-23 months, Karachi West District, SHRUCs

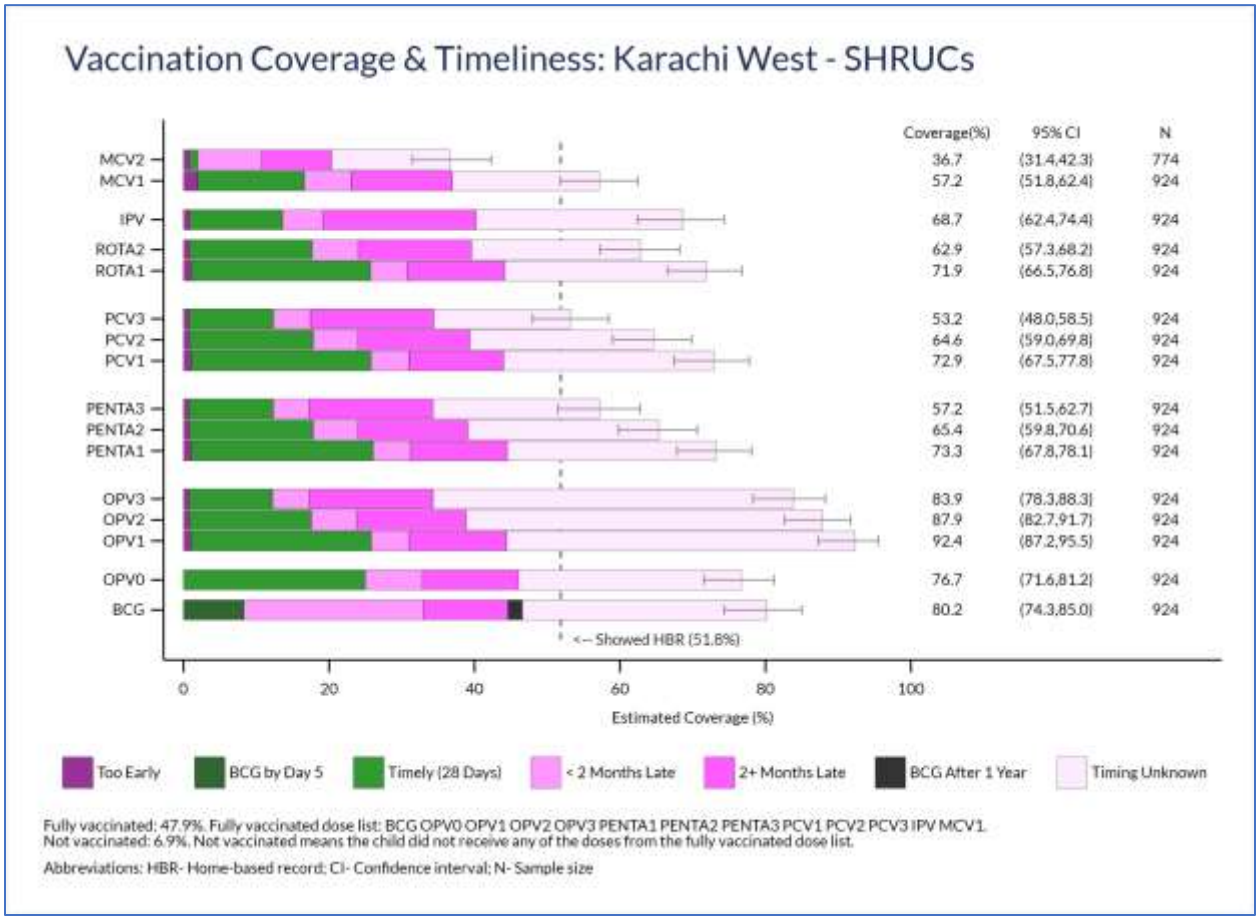

Table 15. Vaccination coverage bar segment lengths (%), Karachi West District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.8	1.2	8.8	9.6	16.4
MCV1	1.9	14.7	6.5	13.8	20.3
IPV	0.8	12.8	5.5	21.1	28.5
ROTA2	0.8	16.9	6.3	15.5	23.3
ROTA1	1.1	24.7	5.1	13.4	27.8
PCV3	0.7	11.6	5.1	16.9	18.9
PCV2	0.8	17	6.2	15.3	25.3
PCV1	1.1	24.7	5.2	13	28.9
PENTA3	0.7	11.6	5	17	22.9
PENTA2	0.8	17	6.2	15.1	26.3
PENTA1	1.1	25	5.2	13.3	28.8
OPV3	0.7	11.5	5.1	17	49.6
OPV2	0.8	16.7	6.3	15	49
OPV1	1.1	24.7	5.2	13.4	48
OPV0	0	25	7.9	13.2	30.7
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	8.3	24.7	11.6	2	33.6

The Karachi West figures indicate:

- Card availability in the SHRUCs was lower than in TPVICS (51.8% vs. 72.4%).
- Estimated coverage in the TPVICS survey was higher for every dose except those in the OPV series than coverage estimated across the SHRUCs.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same, but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA1-3 and PCV1-3. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was notably higher than PENTA3 and PCV3.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out for OPV is less evident in the SHRUCs than in the TPVICS sample.
- The TPVICS survey has better timeliness outcomes than SHRUCs, with larger green bar segments.
- In TPVICS, the later doses in the series have many more children receiving the doses 2+ months late than the earlier doses in the series. Far fewer children received timely administration of dose 3 than dose 1, and far more children received dose 3 2+ months late than dose 1. This pattern is not as evident in the SHRUCs data; roughly the same portion received the later doses 2+ months late as the earlier doses. But in the SHRUCs, many fewer received a timely administration of dose 3 than of dose 1.
- A very small portion of children in the SHRUCs sample (2%) received BCG after age one year.

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Figure 11. Vaccination coverage among children aged 12-23 months, Malir District, TPVICS

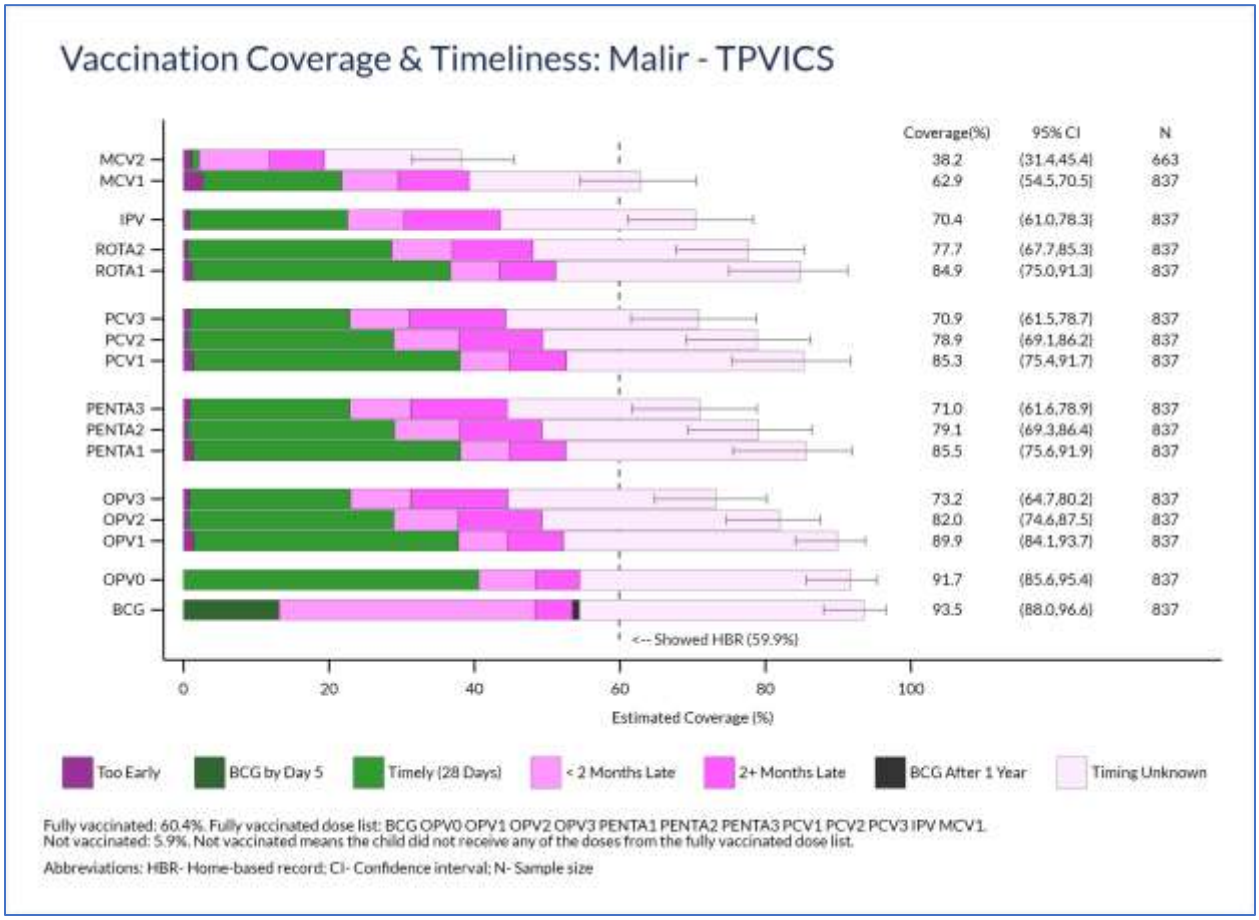

Table 16. Vaccination coverage bar segment lengths (%), Malir District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	1.1	1.1	9.7	7.5	18.8
MCV1	2.7	19.1	7.8	9.7	23.6
IPV	0.8	21.7	7.8	13.2	26.8
ROTA2	0.6	28	8.3	11	29.7
ROTA1	1.2	35.5	6.7	7.7	33.7
PCV3	0.9	22	8.2	13.3	26.5
PCV2	0.7	28.2	9	11.5	29.5
PCV1	1.3	36.7	6.8	7.8	32.7
PENTA3	0.9	22	8.4	13.2	26.5
PENTA2	0.7	28.3	9	11.3	29.9
PENTA1	1.3	36.7	6.7	7.8	33
OPV3	0.8	22.2	8.3	13.3	28.6
OPV2	0.7	28.2	8.9	11.5	32.7
OPV1	1.4	36.3	6.7	7.7	37.7
OPV0	0	40.6	7.9	6	37.3
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	13.1	35.2	5.2	0.9	39.1

Figure 12. Vaccination coverage among children aged 12-23 months, Malir District, SHRUCs

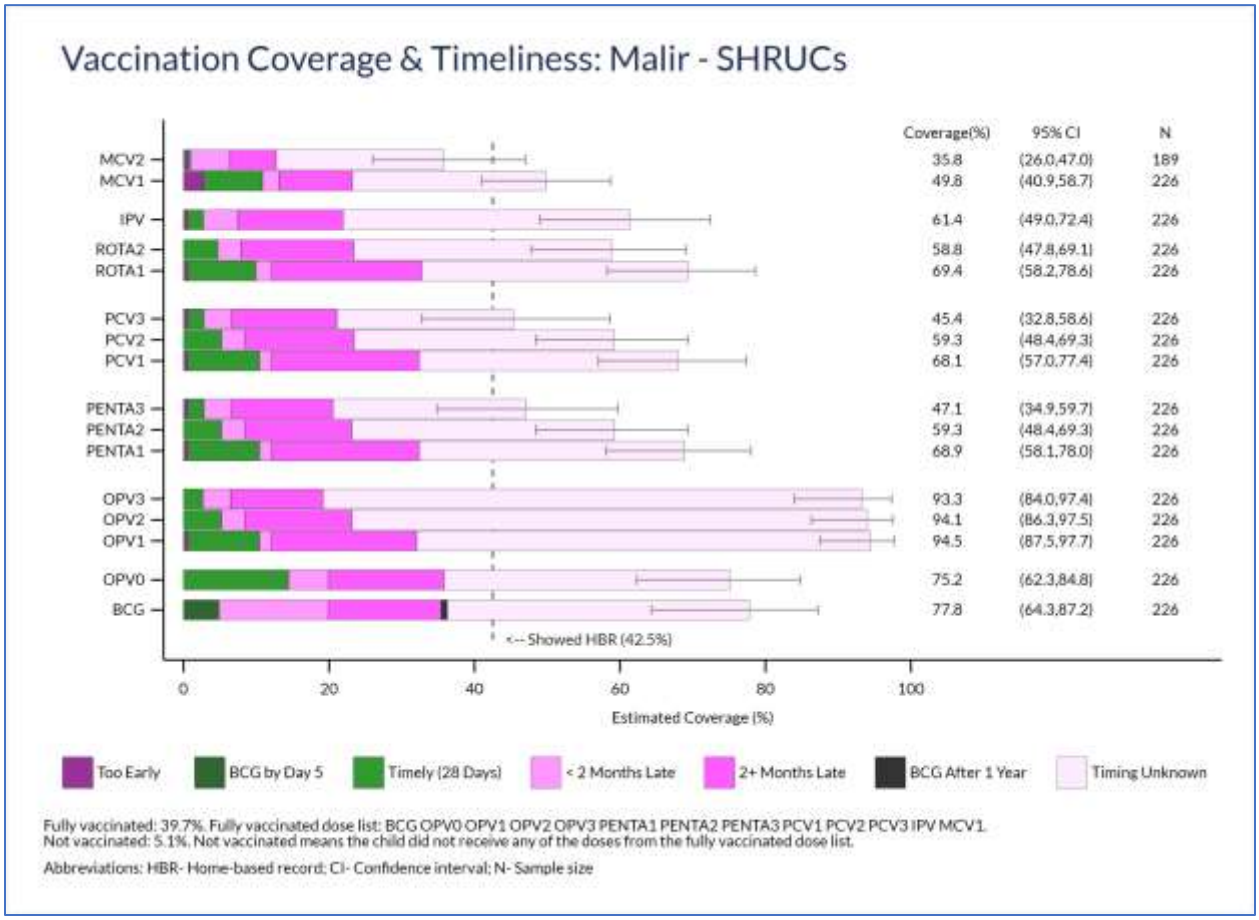

Table 17. Vaccination coverage bar segment lengths (%), Malir District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.5	0.4	5.4	6.4	23.1
MCV1	2.7	8.1	2.3	10	26.6
IPV	0.5	2.2	4.8	14.5	39.4
ROTA2	0	4.7	3.2	15.4	35.5
ROTA1	0.5	9.4	2.1	20.7	36.6
PCV3	0.5	2.3	3.8	14.4	24.3
PCV2	0	5.2	3.2	15.1	35.8
PCV1	0.5	9.9	1.7	20.3	35.6
PENTA3	0.5	2.3	3.8	13.9	26.6
PENTA2	0	5.2	3.2	14.7	36.2
PENTA1	0.5	9.9	1.7	20.3	36.5
OPV3	0	2.7	3.8	12.7	74.1
OPV2	0	5.2	3.2	14.7	70.9
OPV1	0.5	9.9	1.7	19.9	62.4
OPV0	0	14.4	5.5	15.9	39.3
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	4.9	15	15.5	0.9	41.5

The Malir figures indicate:

- Card availability in the SHRUCs was lower than in TPVICS (42.5% vs. 59.9%).
- Estimated coverage in the TPVICS survey was higher for every dose except those in the OPV series than coverage estimated across the SHRUCs.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same, but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA1-3 and PCV1-3. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was notably higher than PENTA3 and PCV3.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out for OPV is almost zero in the SHRUCs survey; nearly every child that started the OPV series there received at least 3 doses.
- The TPVICS survey has better timeliness outcomes than SHRUCs, with larger green bar segments.
- In TPVICS, the later doses in the series have many more children receiving the doses 2+ months late than the earlier doses in the series. Far fewer children received timely administration of dose 3 than dose 1, and far more children received dose 3 2+ months late than dose 1. This pattern is not as evident in the SHRUCs data; the green segments get smaller from dose 1 to 3, but the dark pink (2+ months late) segments also get smaller from dose 1 to 3.
- A very small portion of children in the SHRUCs sample (0.9%) received BCG after age one year.

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Figure 13. Vaccination coverage among children aged 12-23 months, Killa Abdullah District, TPVICS

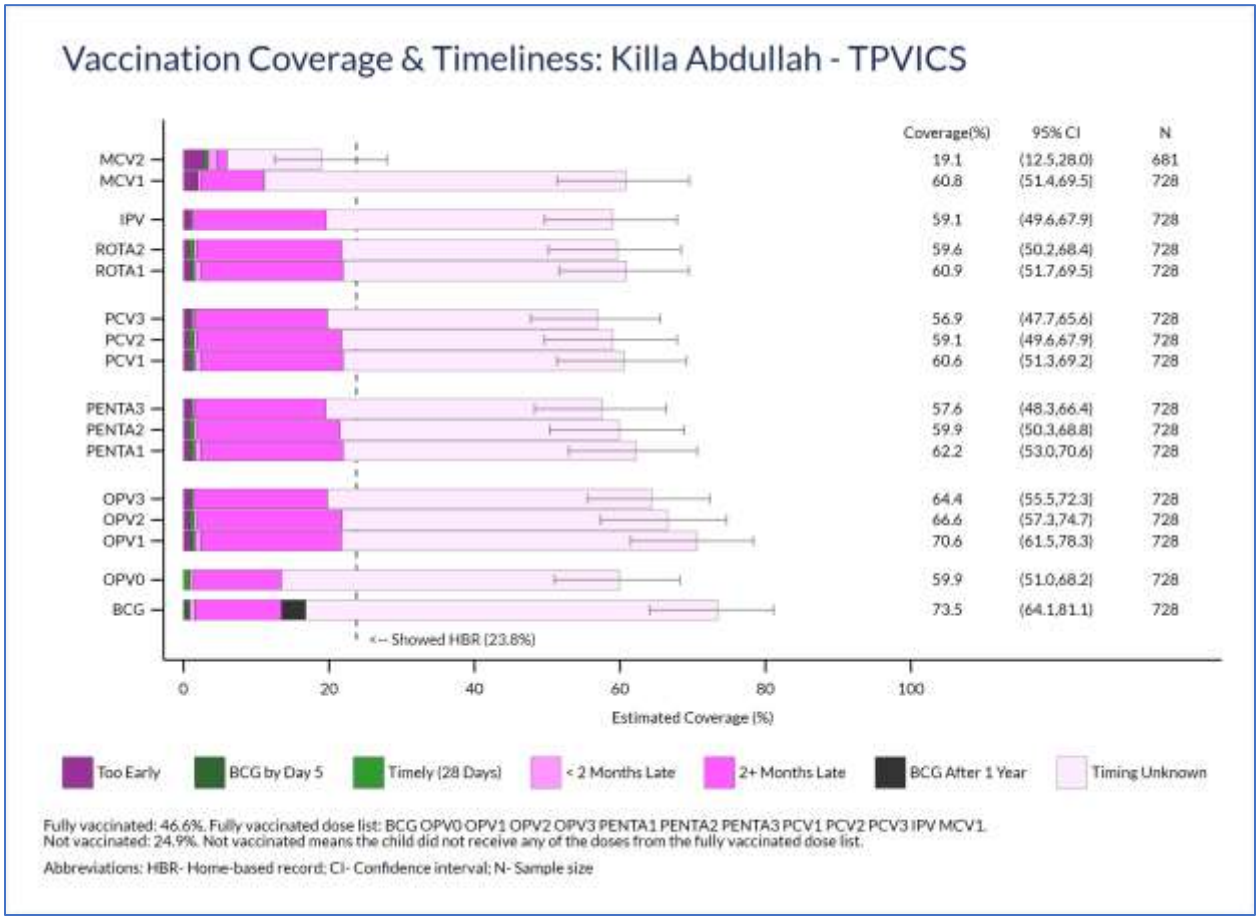

Table 18. Vaccination coverage bar segment lengths (%), Killa Abdullah District, TPVICS

Vaccine	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	2.8	0.6	1.2	1.4	13.1
MCV1	1.8	0.2	0.5	8.7	49.7
IPV	1	0.1	0.3	18.2	39.4
ROTA2	0.8	0.6	0.4	19.9	37.9
ROTA1	1.1	0.5	0.9	19.5	39
PCV3	0.9	0.3	0.3	18.2	37.1
PCV2	0.8	0.6	0.4	19.9	37.3
PCV1	1	0.5	0.9	19.5	38.7
PENTA3	0.9	0.3	0.3	18	38.1
PENTA2	0.8	0.7	0.4	19.6	38.4
PENTA1	1	0.5	0.9	19.5	40.2
OPV3	1	0.3	0.2	18.3	44.6
OPV2	0.8	0.6	0.4	19.9	44.8
OPV1	1.1	0.5	0.9	19.3	48.9
OPV0	0	0.9	0.5	12	46.5
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	0.8	0.8	11.9	3.3	56.7

Figure 14. Vaccination coverage among children aged 12-23 months, Killa Abdullah District, SHRUCs

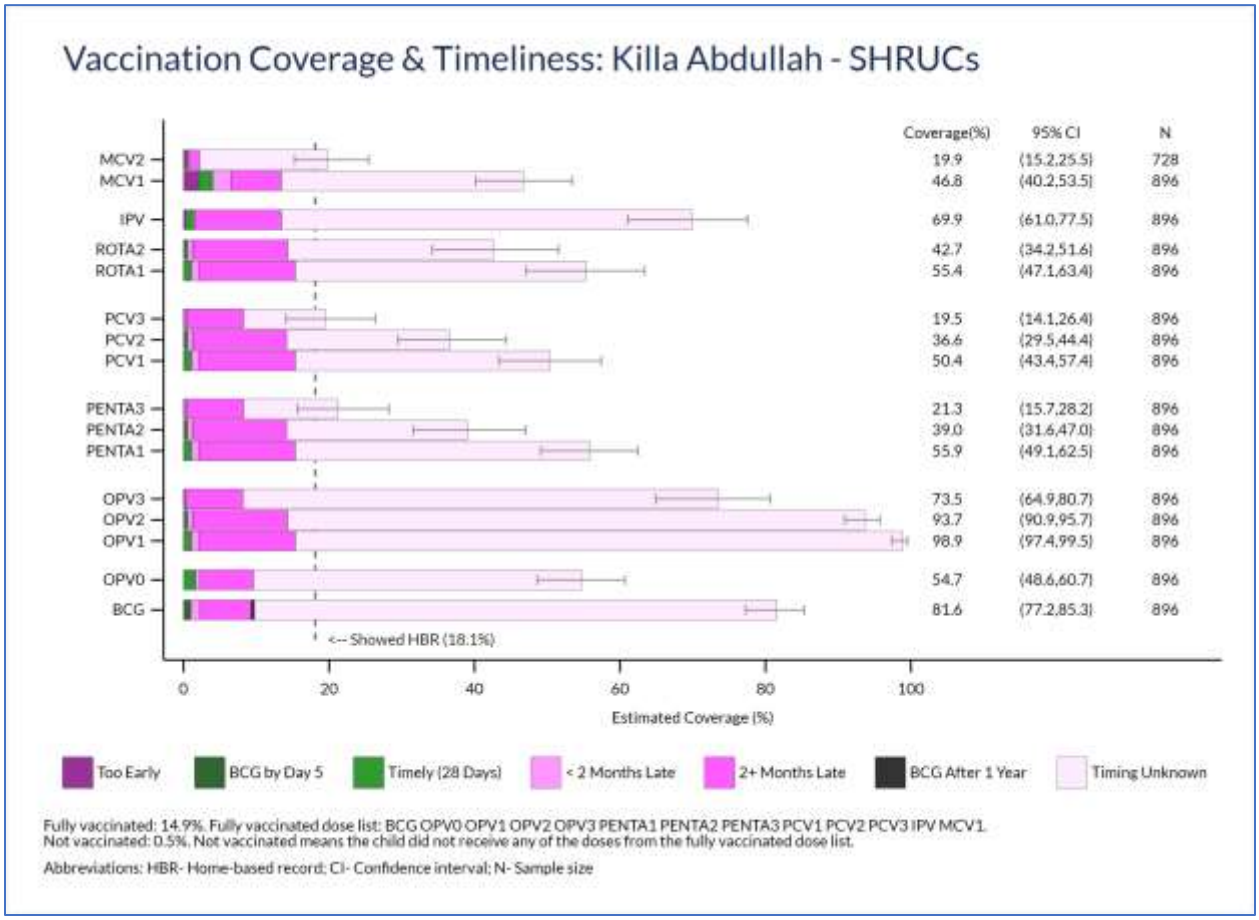

Table 19. Vaccination coverage bar segment lengths (%), Killa Abdullah District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.3	0.3	0	1.5	17.6
MCV1	2.1	2	2.6	6.9	33.3
IPV	0.3	1	0.2	11.8	56.5
ROTA2	0.2	0.4	0.6	13	28.4
ROTA1	0.1	1	0.9	13.3	40
PCV3	0.2	0	0.3	7.8	11.2
PCV2	0.2	0.4	0.6	12.9	22.4
PCV1	0.1	1	0.9	13.3	35
PENTA3	0.2	0	0.3	7.8	13
PENTA2	0.2	0.4	0.6	12.9	24.9
PENTA1	0.1	1	0.9	13.3	40.5
OPV3	0.2	0	0.2	7.8	65.4
OPV2	0.2	0.4	0.6	13	79.5
OPV1	0.1	1	0.9	13.3	83.5
OPV0	0	1.7	0.6	7.4	45.1
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	1	1.2	7.1	0.4	71.9

The Killa Abdullah figures indicate:

- Card availability was notably lower than in the districts from KP and Sindh. Card availability in the SHRUCs was lower than in TPVICS (18.1% vs. 21.8%).
- Estimated coverage in the TPVICS survey was higher in the SHRUCs for OPV0, PENTA1-3, PCV1-3, ROTA1-2 and MCV1. Coverage in the SHRUCs was higher than TPVICS for BCG, OPV1-3 and IPV.
- In TPVICS the coverage for IPV was quite comparable to PENTA3 and PCV3; in SHRUCs the IPV coverage was much higher than PENTA3 and PCV3. This pattern is especially extreme in this district.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same with slightly higher coverage for OPV, but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA, PCV or ROTA. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out in the SHRUCs is much higher than in TPVICS for every dose series.
- Very few does were documented as being timely. Nearly all respondents with cards received nearly all doses 2+ months late.
- TPVICS indicated 3.3% received BCG after one year.

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Figure 15. Vaccination coverage among children aged 12-23 months, Pishin District, TPVICS

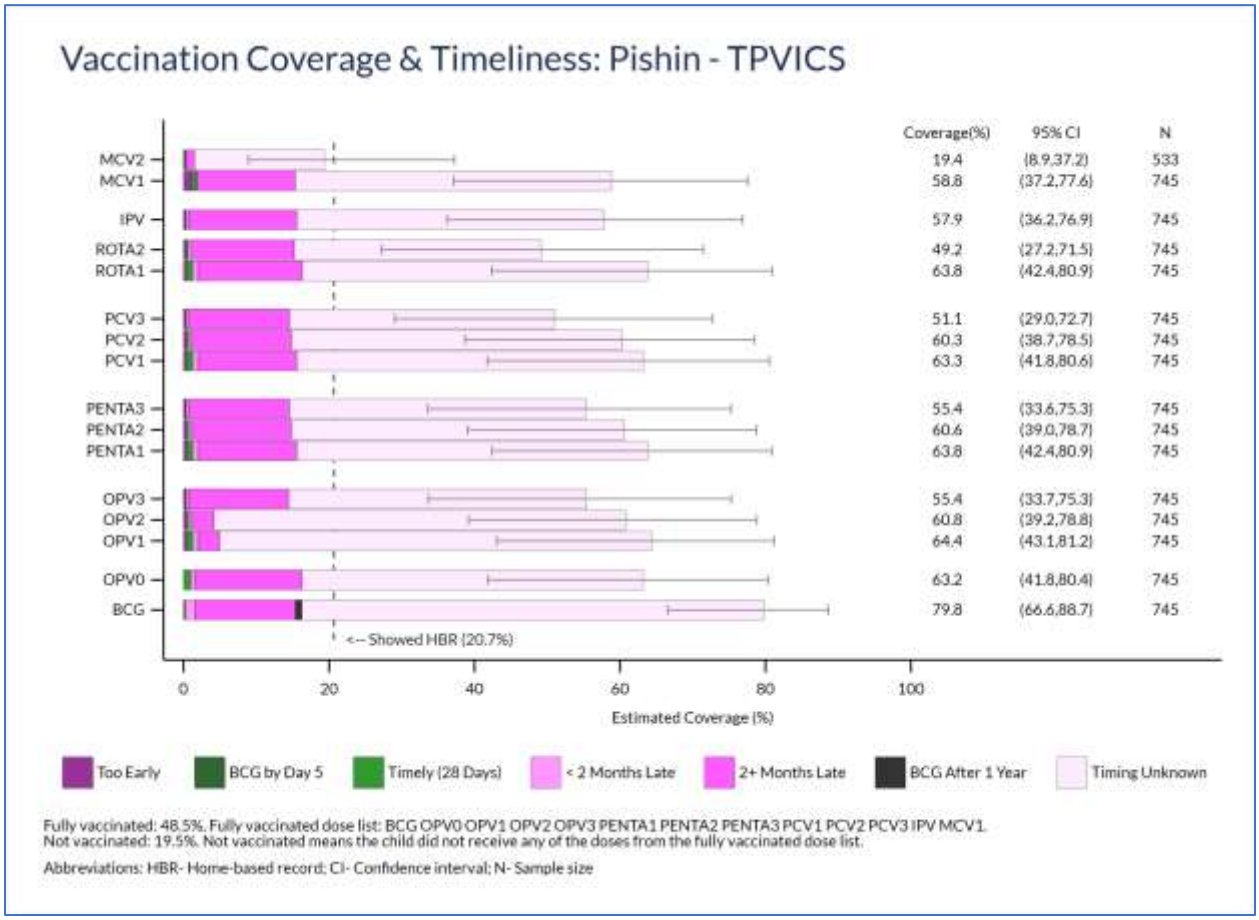

Table 20. Vaccination coverage bar segment lengths (%), Pishin District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.1	0.2	0	1.1	17.9
MCV1	1.1	0.7	0.1	13.5	43.5
IPV	0.3	0.1	0.4	14.8	42.3
ROTA2	0.4	0.3	0.4	14.1	33.9
ROTA1	0.4	0.9	0.7	14.3	47.5
PCV3	0.3	0.1	0.3	13.9	36.5
PCV2	0.4	0.3	0.4	13.7	45.4
PCV1	0.4	0.9	0.7	13.6	47.7
PENTA3	0.3	0.1	0.4	13.8	40.8
PENTA2	0.4	0.3	0.4	13.7	45.8
PENTA1	0.4	0.9	0.7	13.6	48.2
OPV3	0.3	0.1	0.3	13.8	41
OPV2	0.4	0.3	0.4	3	56.6
OPV1	0.4	0.9	0.7	2.9	59.4
OPV0	0	1	0.5	14.7	46.9
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	0.3	1.3	13.8	0.9	63.5

Figure 16. Vaccination coverage among children aged 12-23 months, Pishin District, SHRUCs

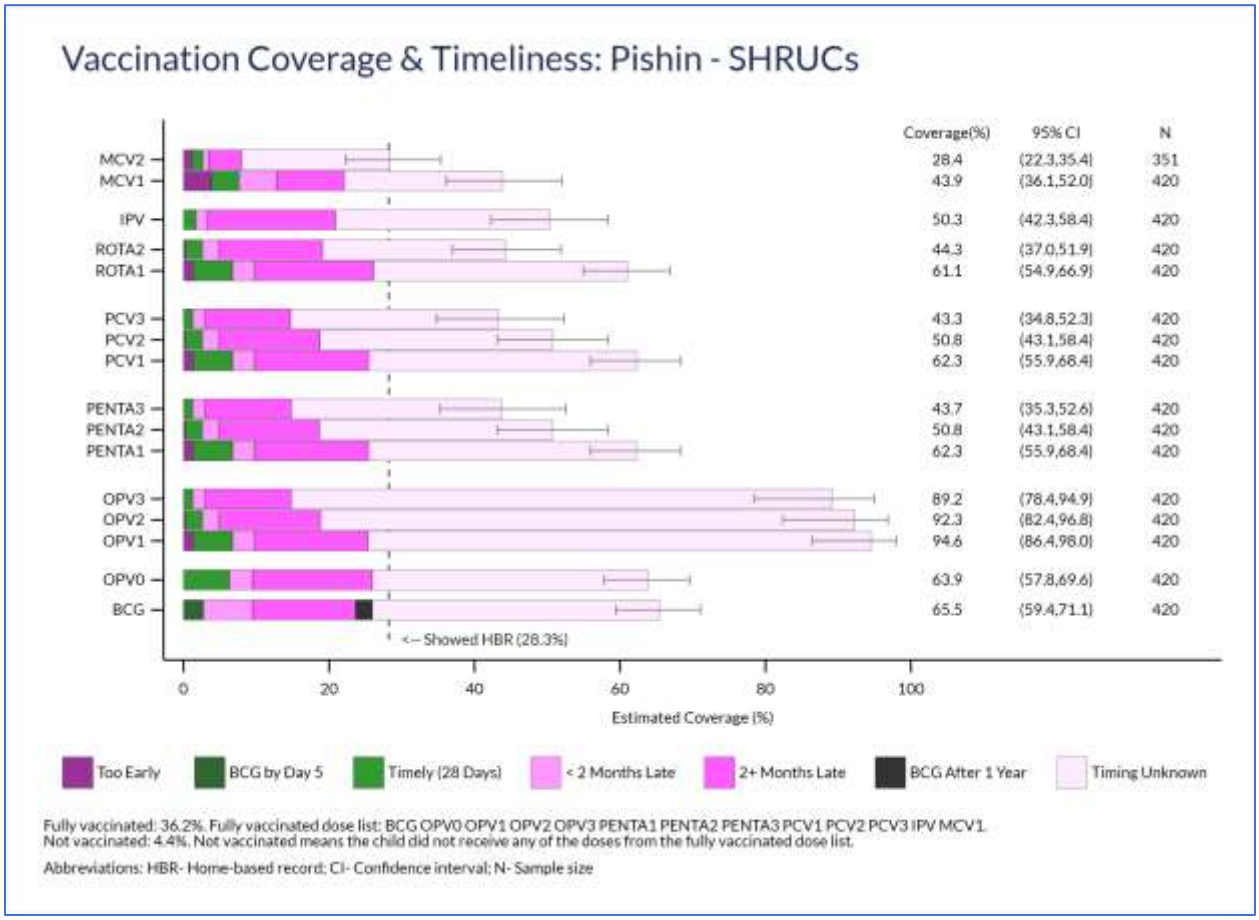

Table 21. Vaccination coverage bar segment lengths (%), Pishin District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	1.1	1.5	0.8	4.5	20.4
MCV1	3.8	3.8	5.2	9.3	21.8
IPV	0	1.7	1.4	17.7	29.4
ROTA2	0.2	2.4	2.2	14.3	25.2
ROTA1	1.4	5.4	3	16.4	35
PCV3	0	1.3	1.7	11.8	28.6
PCV2	0.2	2.4	2.2	13.9	32
PCV1	1.4	5.4	3	15.7	36.9
PENTA3	0	1.3	1.7	11.9	28.9
PENTA2	0.2	2.4	2.2	13.9	32.1
PENTA1	1.4	5.4	3	15.7	36.9
OPV3	0	1.3	1.7	11.9	74.4
OPV2	0.2	2.4	2.2	14	73.4
OPV1	1.4	5.4	3	15.6	69.2
OPV0	0	6.3	3.2	16.5	37.9
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	2.7	6.8	14.2	2.3	39.5

The Pishin figures indicate:

- Card availability was notably lower than in the districts from KP and Sindh. Card availability in the SHRUCs was higher than in TPVICS (28.3% vs. 20.7%).
- Estimated coverage in the TPVICS survey was higher in the SHRUCs for BCG and IPV. Coverage in the SHRUCs was notably higher than TPVICS for OPV1-3.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA, PCV or ROTA. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- The confidence intervals for the TPVICS survey are much wider than for SHRUCs, yet the TPVICS sample size was higher than SHRUCS. This probably indicates that the TPVICS data includes a higher design effect and more underlying variability than the SHRUCs data. This notable difference is unique to Pishin.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out in the SHRUCs is higher for PENTA and PCV than in TPVICS.
- Very few does were documented as being timely. Nearly all respondents with cards received nearly all doses 2+ months late.
- A very small portion of children in both samples received BCG after age one year.

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Figure 17. Vaccination coverage among children aged 12-23 months, Quetta District, TPVICS

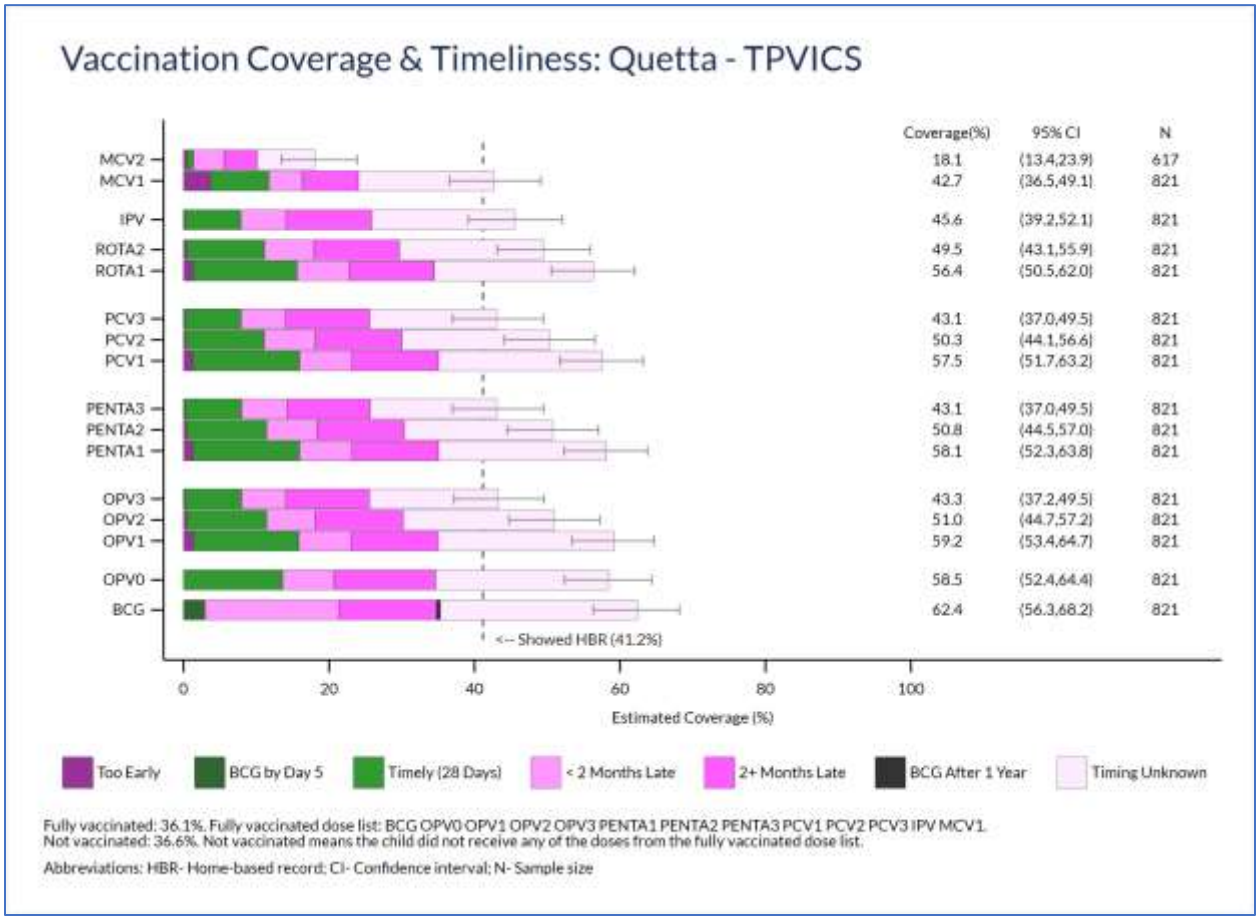


Table 22. Vaccination coverage bar segment lengths (%), Quetta District, TPVICS

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.5	0.9	4.3	4.5	8
MCV1	3.7	8.1	4.6	7.7	18.7
IPV	0.1	7.7	6.3	11.7	19.7
ROTA2	0.4	10.7	6.8	11.7	19.9
ROTA1	1.3	14.4	7.2	11.6	21.9
PCV3	0.1	7.8	6.1	11.5	17.5
PCV2	0.3	10.8	7	11.9	20.3
PCV1	1.3	14.7	7.2	11.9	22.5
PENTA3	0.1	7.8	6.3	11.4	17.4
PENTA2	0.4	11	7	12	20.4
PENTA1	1.3	14.7	7.2	11.9	23.1
OPV3	0.1	7.8	6.1	11.5	17.7
OPV2	0.4	11	6.7	12.1	20.8
OPV1	1.4	14.5	7.2	12	24.2
OPV0	0	13.6	7.1	13.9	23.9
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	2.9	18.4	13.4	0.5	27.1

Figure 18. Vaccination coverage among children aged 12-23 months, Quetta District, SHRUCs

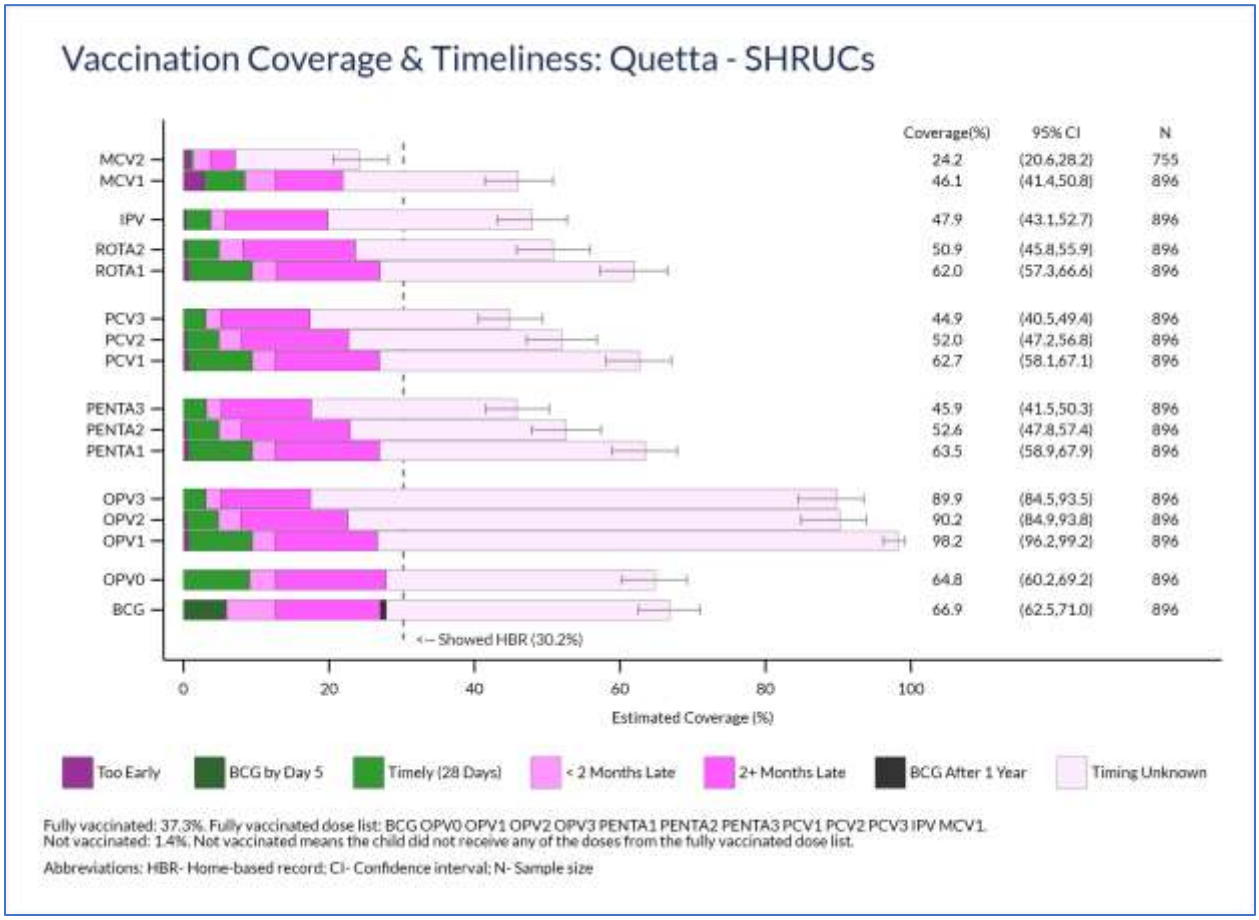


Table 23. Vaccination coverage bar segment lengths (%), Quetta District, SHRUCs

Vaccines	Too Early	Timely (28 days)	< 2 Months Late	2+ Months Late	Timing unknown
MCV2	0.7	0.5	2.4	3.4	17.1
MCV1	2.8	5.6	4.2	9.3	24.2
IPV	0.3	3.4	2.1	14	28.1
ROTA2	0.4	4.5	3.3	15.5	27.2
ROTA1	0.7	8.8	3.3	14.2	35
PCV3	0	3.1	2.1	12.2	27.5
PCV2	0.4	4.5	3.1	14.7	29.3
PCV1	0.7	8.8	3.2	14.3	35.8
PENTA3	0	3.1	2.1	12.3	28.3
PENTA2	0.4	4.5	3.1	14.9	29.7
PENTA1	0.7	8.8	3.2	14.3	36.6
OPV3	0	3	2.1	12.3	72.4
OPV2	0.4	4.4	3.1	14.7	67.6
OPV1	0.7	8.8	3.2	14	71.6
OPV0	0	9.1	3.6	15.2	37
	BCG by day 5	**< 2 Months Late**	**2+ Months Late**	**After 1 Year (BCG only)**	**Timing unknown**
BCG	5.9	6.8	14.4	0.8	39

The Quetta figures indicate:

- Card availability was notably lower than in the districts from KP and Sindh. Card availability in the SHRUCs was lower than in TPVICS (30.2% vs. 41.2%).
- Estimated coverage in the SHRUCs survey was higher than TPVICS for the birth doses and dose 1 of every series.
- In the TPVICS survey, coverage in the OPV, PENTA, PCV series were nearly the same but in SHRUCs, coverage for OPV1-3 were notably higher than for PENTA, PCV or ROTA. This difference is limited to evidence from caregivers' recall. The proportion of children with OPV documented on their card is the same as the proportion with the other series documented there, but more SHRUCs caregivers remember their child receiving OPV than caregivers in the TPVICS surveys.
- Both surveys show some drop-out from dose 1 to dose 2 and then dose 3 in the series. Drop-out in the SHRUCs is lower for OPV than in TPVICS.
- Of the three districts in Balochistan, Quetta has the largest portion of timely doses, but large portions of respondents with cards received nearly many doses 2+ months late.
- A very small portion of children in both samples received BCG after age one year.

3.3.1. Areas for improvement in vaccination coverage and timeliness

Based on the analysis for vaccination coverage and timeliness the following candidate areas for improvement are identified:

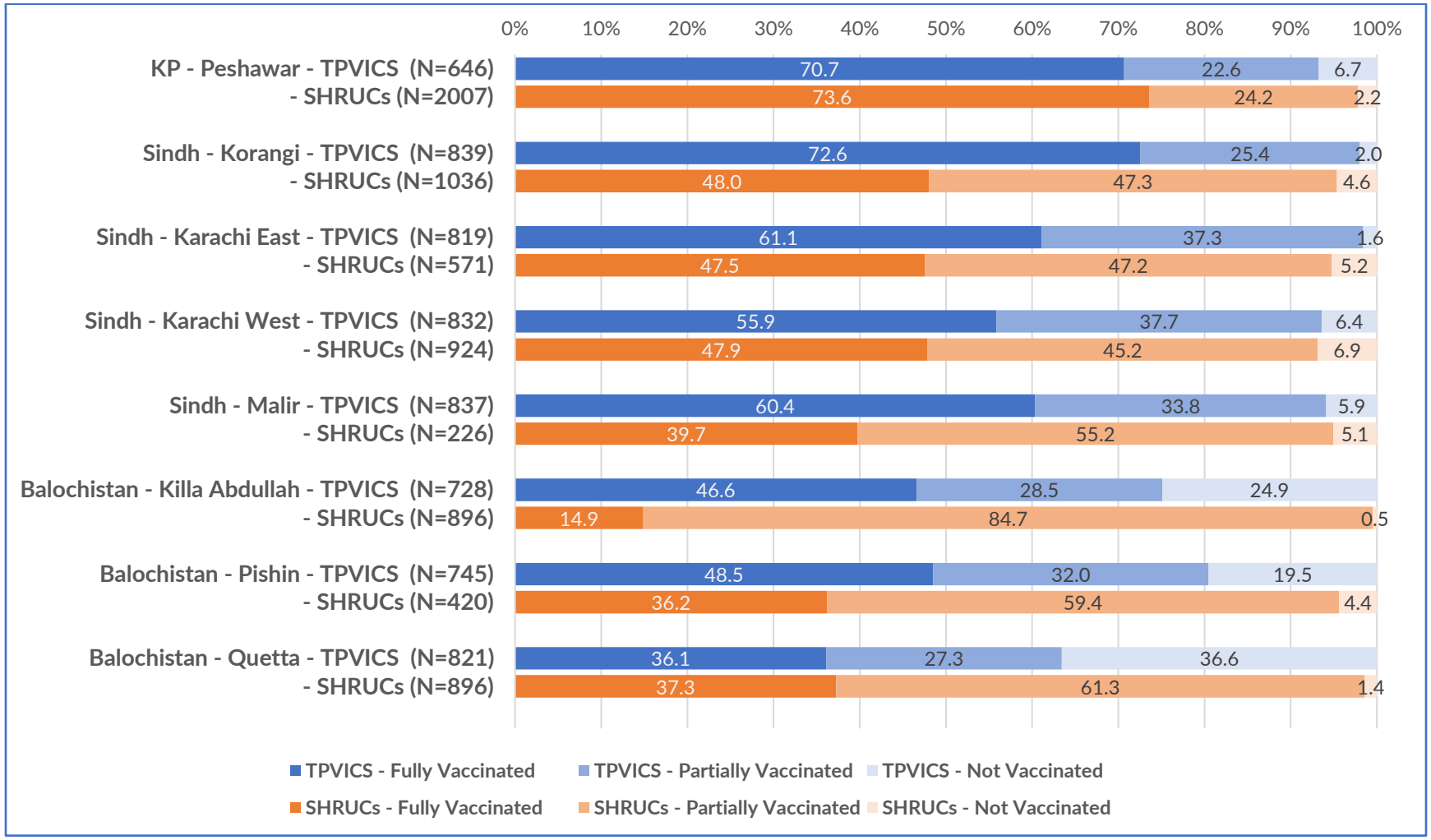
- Be sure all caregivers receive a card for all children.
- Emphasize to caregivers the importance of keeping the card and taking it when going for vaccination.
- Take measures to minimize late administration of all doses.
- Take measures to minimize drop-out.
- Emphasize the importance of administering BCG as early as possible.

3.4. Vaccination coverage status, by district, TPVICS & SHRUCs

Figure 19 shows the proportion of fully- and partially- and not-vaccinated respondents for each district for the TPVICS and SHRUCs surveys. To be considered fully vaccinated, the child should have evidence (by card or by recall) of having received BCG, OPV0, OPV 1-3, PENTA 1-3, PCV 1-3, IPV and MCV1. The definition omits ROTA 1-2 because it is the vaccine introduced most recently and omits MCV2 because it is given in the second year of life. If the child received none of those doses, they are classified as not vaccinated. And if they received some but not all of those doses, they are classified as partially vaccinated.

In KP, the TPVICS and SHRUCs bars are quite comparable. In Sindh and Balochistan, the TPVICS survey found higher proportions of respondents to be fully vaccinated. In Balochistan, the TPVICS survey found much higher proportions of respondents who were not vaccinated. Looking back at the coverage data in figures 3-18, the difference in the not vaccinated category seems to be explained by the higher OPV coverage in the SHRUCs survey than in the TPVICS survey. The OPV difference is entirely due to caregiver recall, so is quite possibly from polio campaigns that are not recorded on the home-based vaccination records.

Figure 19. Vaccination coverage status among children aged 12-23 months, by district, TPVICS & SHRUCs



3.5 Drop-out between vaccination visits

Drop-out between vaccination visits is a constant feature of routine vaccination [13,14], and the survey team observed the same pattern in the target districts (Table 24). A drop-out rate greater than 10% is considered a 'high drop-out' by WHO as a global vaccination practice [15], and a high drop-out rate is indicative of systemic problems in the health system for addressing vaccination coverage.

Table 25 indicates that drop-out was higher than 10% for most dose series in most districts as measured by both TPVICS and SHRUCs surveys. Drop-out was especially high in Killa Abdullah in the SHRUCs survey for all dose pairs. The estimates for MCV1 to MCV2 drop-out are notably high in Killa Abdullah and more consistent between TPVICS and SHRUCs than the estimates for other dose pairs. Drop-out for polio was notably smaller in Balochistan SHRUCs surveys than in TPVICS.

Table 24. Drop-out rates between dose pairs in target districts, TPVICS and SHRUCs

	PENTA1-PENTA3 Dropout (%)	OPV1-OPV3 Dropout (%)	PCV1-PCV3 Dropout (%)	ROTA1-ROTA2 Dropout (%)	MCV1-MCV2 Dropout (%)	BCG-MCV1 Dropout (%)	PENTA1-MCV1 Dropout (%)
KP - Peshawar - TPVICS	13.6	15.5	14.1	8.3	35.0	20.7	18.2
- SHRUCs	9.6	9.0	10.1	8.0	33.4	10.3	8.5
Sindh - Korangi - TPVICS	12.0	12.0	11.8	5.1	40.6	24.5	22.1
- SHRUCs	23.7	3.8	24.8	12.0	38.2	34.2	27.4
Sindh - Karachi East - TPVICS	14.5	12.7	17.8	8.7	50.5	27.3	22.8
- SHRUCs	24.7	.9	24.8	12.8	45.9	36.1	29.3
Sindh - Karachi West - TPVICS	16.8	17.1	20.8	10.6	45.2	34.4	29.1
- SHRUCs	20.5	7.8	25.2	12.1	36.6	27.6	21.2
Sindh - Malir - TPVICS	16.2	17.2	16.1	8.3	41.6	30.7	25.7
- SHRUCs	32.1	1.4	33.8	15.9	35.3	37.3	29.5
Balochistan - Killa Abdullah - TPVICS	7.8	8.7	5.7	2.5	66.0	27.5	6.1
- SHRUCs	65.5	23.2	65.4	25.4	59.3	48.5	35.8
Balochistan - Pishin - TPVICS	20.6	20.7	24.9	32.1	35.5	25.5	19.1
- SHRUCs	32.0	6.3	32.8	27.9	41.9	35.3	31.3
Balochistan - Quetta - TPVICS	26.6	27.6	25.8	12.7	61.6	33.5	28.1
- SHRUCs	28.7	9.9	29.5	20.0	49.7	30.8	25.9
Denominator is all children who received the first dose.							
Colored bars are scaled so that if 100% of children dropped out, the table cell would be fully colored.							

3.6. Dose intervals

The EPI schedule calls for doses in a series to be separated by at least 28 days. If the interval is shorter than 28 days, then the later dose has a smaller chance of triggering an immune response and is not considered to be a valid dose. If the interval is too long, then the child spends unnecessary time under-vaccinated and at risk for disease. For children with HBRs, it is possible to calculate the length of the dose interval in days and report the proportion of intervals that were too short (< 28 days), timely (28-55 days), or too long (56+ days). In the TPVICS and SHRUCs data, all four vaccine series yield similar patterns, shown in Figures 20-23. A small number of intervals were shorter than 28 days. The TPVICS survey showed a surprisingly high proportion of short intervals in Killa Abdullah (8.5% for Penta) whereas the SHRUCs survey showed a more typical proportion (1.3%). Most intervals were between 28 and 55 days and considered to be timely. Between one-fifth and one-half of the intervals were 56 days or longer, leaving children under-protected for a prolonged period of time.

Note: The estimates in Figures 20-23 are unweighted, following the VCQI convention that estimates, where all children are in the denominator, are weighted and estimates with a subset of children in the denominator are not weighted.

Figure 20. Penta dose interval categories among children aged 12-23 months, by district, TPVICS & SHRUCs

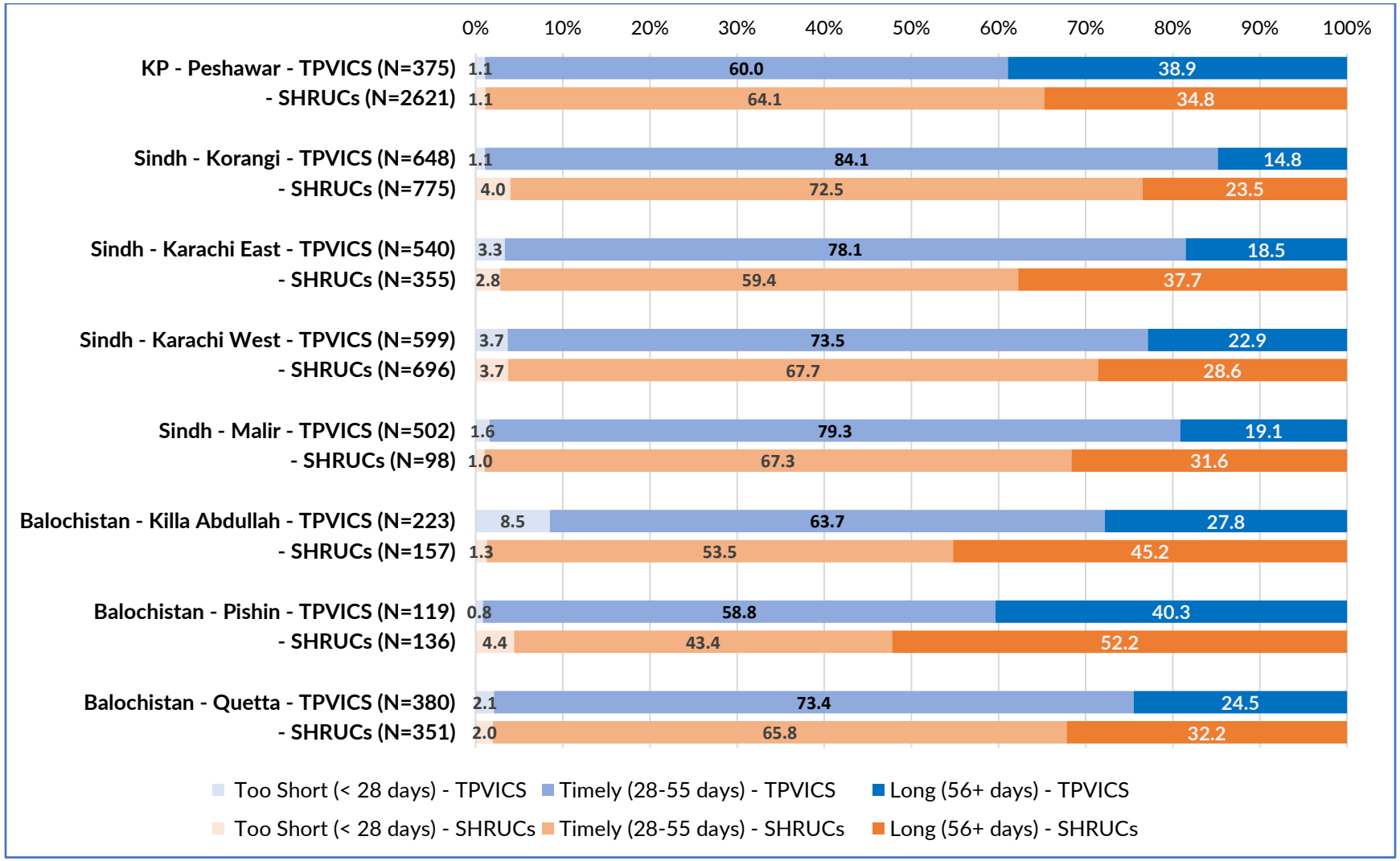


Figure 21. OPV dose interval categories among children aged 12-23 months, by district, TPVICS & SHRUCs

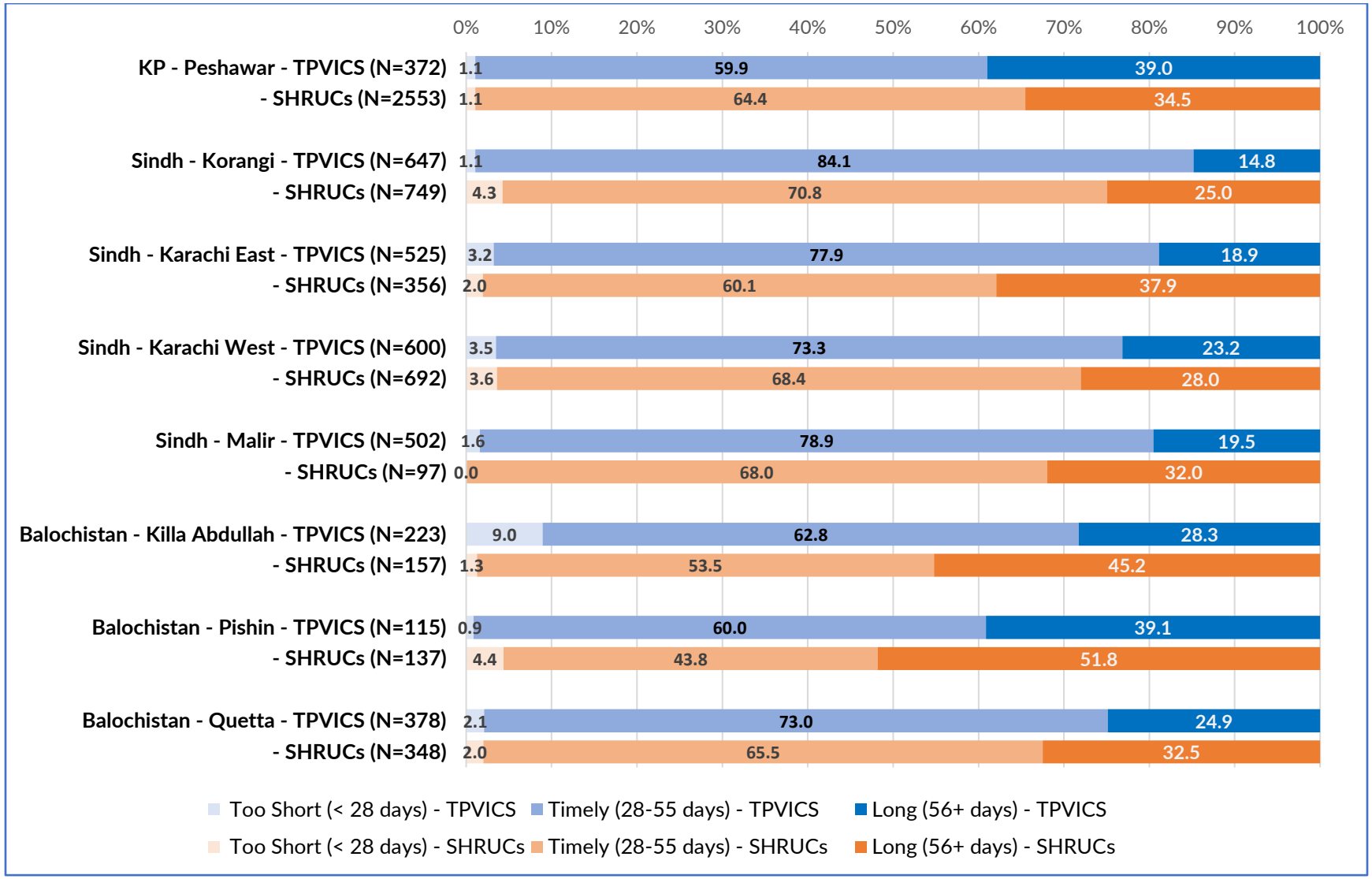


Figure 22. PCV dose interval categories among children aged 12-23 months, by district, TPVICS & SHRUCs

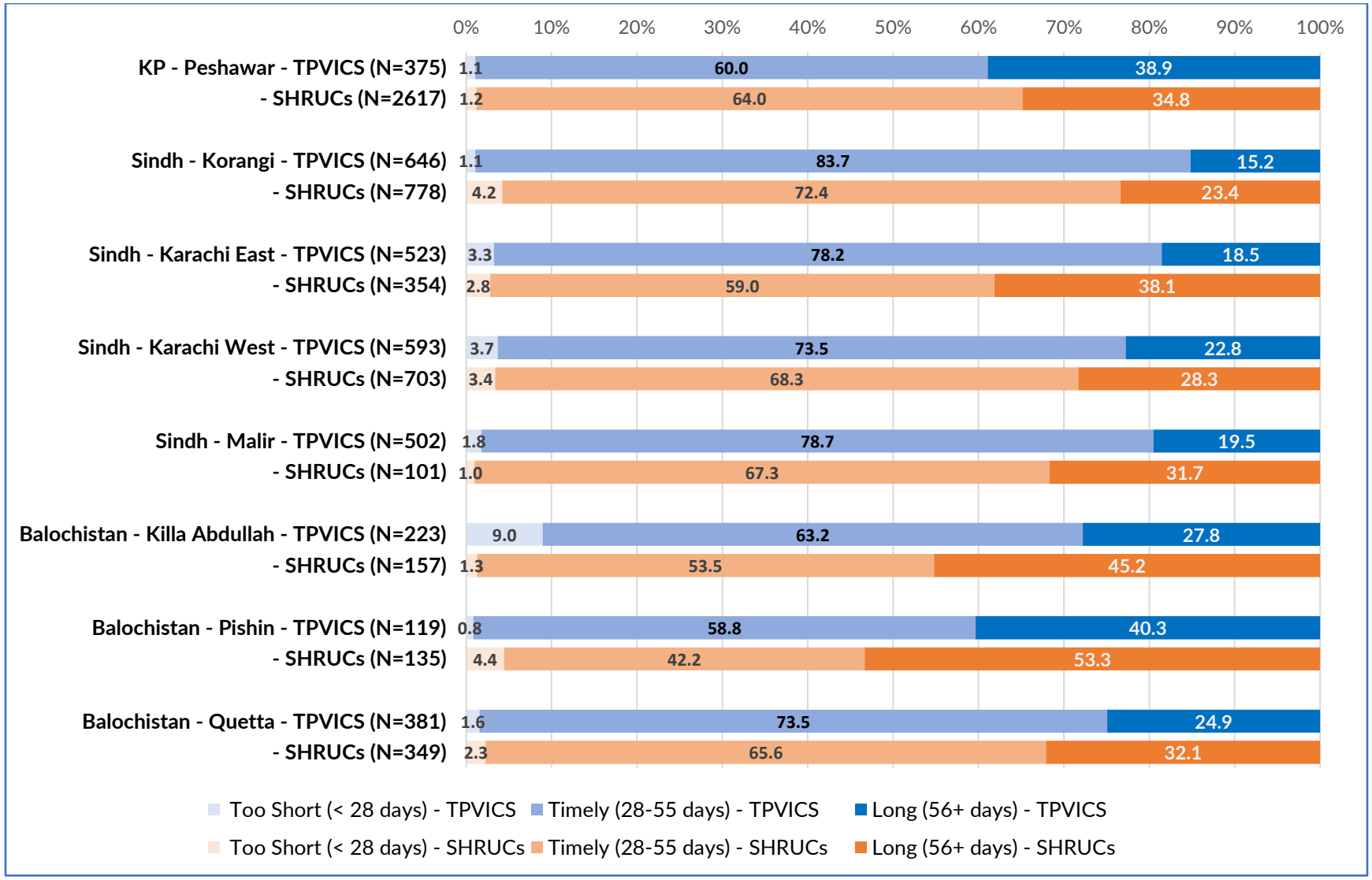


Figure 23. Rota dose interval categories among children aged 12-23 months, by district, TPVICS & SHRUCs

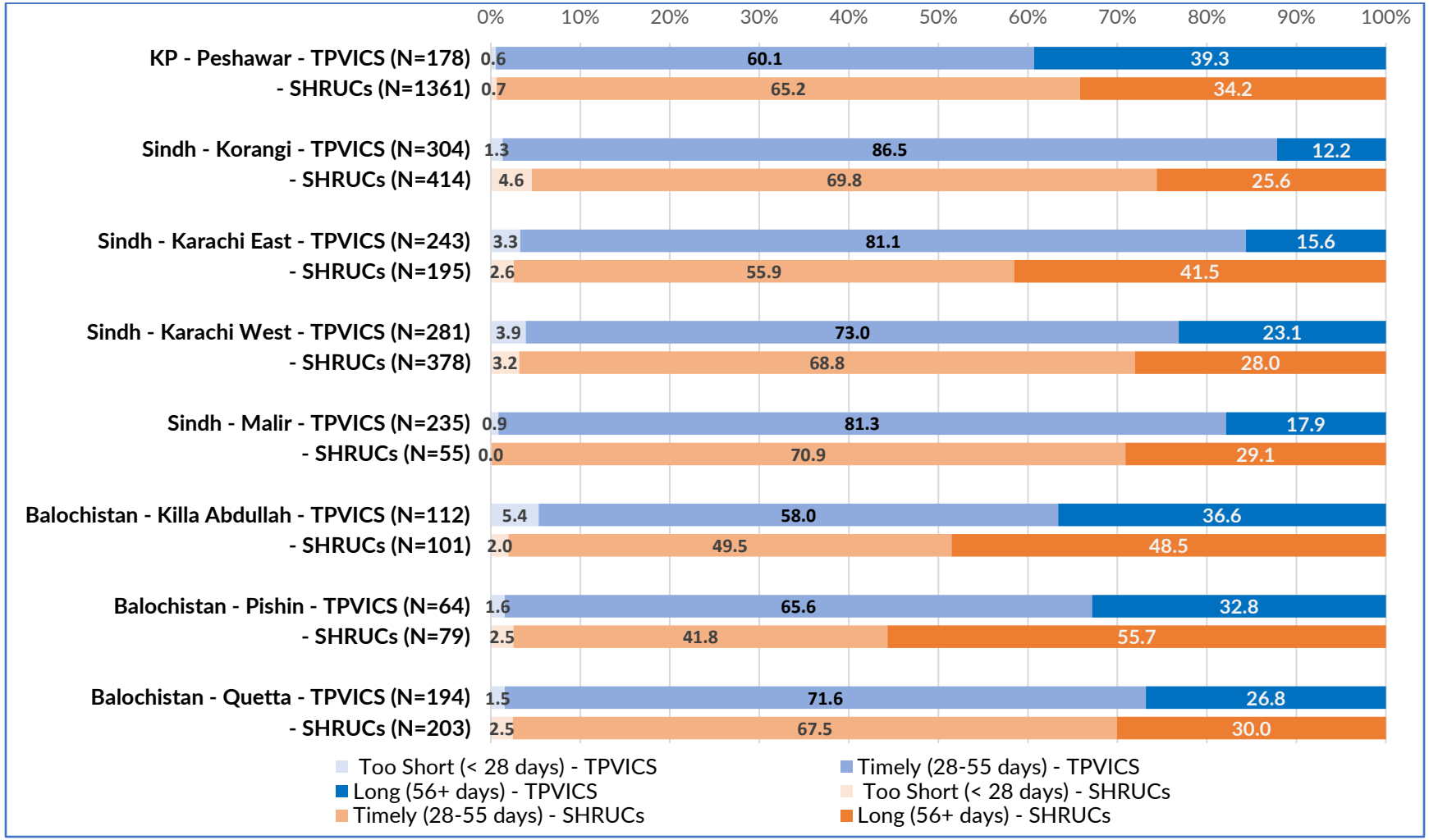


Table 25 holds additional detail about the long dose intervals. Some of the intervals longer than 56 days were very long. Half of those long intervals were longer than 2-3 months with medians between 68 and 119 days. The 75th percentiles were between three and six months (100-178 days).

Table 25. Long intradose interval summary, TPVICS and SHRUCs

	Median intradose interval among intervals 56+ days (days)	**75th percentile intradose interval among intervals 56+ days (days)**	**Number of intradose intervals 56+ days**
Peshawar - TPVICS	88.5	143	528
- SHRUCs	91	127	3,272
Korangi - TPVICS	86	147	350
- SHRUCs	97	166	696
Karachi East - TPVICS	79	119	353
- SHRUCs	98	145	509
Karachi West - TPVICS	90	140	498
- SHRUCs	107	161	717
Malir - TPVICS	111	153	348
- SHRUCs	93	177	128
Killa Abdullah - TPVICS	89	104	246
- SHRUCs	68.5	100	268
Pishin - TPVICS	96	163	165
- SHRUCs	119	178	265
Quetta - TPVICS	77	149	373
- SHRUCs	101	163	403

3.7. Missed opportunities for simultaneous vaccination

A missed opportunity for vaccination (MOV) occurs when a child has contact with the health system but does not receive all the vaccinations, they were eligible for during that visit. A missed opportunity for simultaneous vaccination (MOSV) is a type of MOV that occurs when a child has a health centre visit at which they receive one or more vaccinations, but do not receive all the vaccine doses for which they were eligible. The dates of vaccination visits recorded on a home-based record of vaccination visits can be used to identify MOSVs and summarize the frequency of missed opportunities.

This section summarizes (a) the proportion of vaccination visits at which a MOSV occurred, in aggregate and for each individual dose (Table 26) and (b) the proportion of children who experienced one or more MOSVs, and whether those missed opportunities were corrected at later health centre visits or had not been corrected by the time of the survey (Figure 24). Both analyses show relatively few MOSVs for most vaccine doses in most locations; however, there are many MOSVs for IPV (Figures 24 and 25), and MOSVs are also more common for the first dose in a multi-dose series (Figure 24).

When a child has their first health system contact after becoming eligible for a vaccine dose, that child may (a) receive the dose at the first eligible opportunity during that visit or (b) experience a missed opportunity to be vaccinated. For children who had a MOSV, we say that the missed opportunity is corrected if the dose is administered at a later date, and uncorrected if the child has still not received the dose at the time of the survey. When examining corrected MOSVs we can also consider the time to correction: the number of days that elapsed between the initial missed opportunity and the visit at which the dose was administered (Figure 27).

Table 26. Percent of visits with MOSVs

		Peshawar		Korangi		Karachi East		Karachi West		Malir		Killa Abdullah		Pishin		Quetta	
		TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs	TPVICS	SHRUCs
BCG	%	2.4	10.1	0.4	8.8	2.1	7.9	2.4	7.8	2.9	10.6	40.7	64.5	11.4	5.2	2.2	7.8
	N	123	1,558	237	592	190	267	212	490	206	94	86	197	35	116	139	269
OPV0	%	1.6	0.1	0.6	0.5	0.0	0.0	0.7	1.0	0.9	0.0	0.0	0.0	0.0	5.9	3.3	1.5
	N	61	813	156	205	126	83	135	191	114	23	4	11	2	17	30	68
OPV1	%	7.9	4.8	4.6	21.5	6.7	23.4	9.2	19.5	10.5	21.7	18.8	7.7	17.9	10.6	22.6	10.0
	N	126	1,444	238	606	179	291	206	519	210	92	69	130	28	113	159	259
OPV2	%	1.0	0.6	0.5	4.4	1.9	4.1	1.8	4.3	0.6	2.0	1.8	1.0	0.0	1.3	2.8	2.1
	N	103	1,333	211	410	160	193	163	370	170	50	55	99	19	76	108	194
OPV3	%	3.3	3.8	1.0	6.2	2.1	3.2	2.1	3.2	2.6	4.9	0.0	3.6	6.7	5.3	3.5	0.7
	N	92	1,222	195	324	143	154	140	311	154	41	44	55	15	57	86	148
Penta1	%	7.9	5.6	5.0	25.3	6.6	29.3	7.9	22.3	10.0	29.8	18.3	9.8	17.2	10.5	22.2	11.3
	N	127	1,456	241	640	181	311	203	542	210	104	71	133	29	114	158	265
Penta2	%	1.0	0.8	0.5	5.8	1.9	7.5	1.8	4.8	0.6	3.9	1.8	1.0	0.0	2.6	3.6	3.5
	N	103	1,338	213	414	162	199	163	376	169	51	57	99	20	76	110	199
Penta3	%	3.3	2.7	1.0	5.1	1.4	8.1	1.4	6.3	2.6	9.3	2.1	14.5	0.0	14.3	5.7	3.9
	N	92	1,275	196	351	144	160	138	320	152	43	47	62	15	63	87	154
PCV1	%	7.9	5.0	6.3	25.9	8.9	29.3	8.9	22.9	10.4	29.8	18.3	9.8	17.2	10.5	22.2	11.3
	N	127	1,451	240	648	179	311	202	542	211	104	71	133	29	114	158	265
PCV2	%	1.0	0.7	0.5	5.7	1.9	7.6	1.9	3.7	0.0	5.7	1.8	1.0	0.0	3.9	2.8	3.0
	N	103	1,339	211	418	155	198	160	375	168	53	57	99	20	77	109	197
PCV3	%	4.3	3.7	1.0	4.6	1.5	5.2	1.5	6.4	3.9	8.9	2.2	14.5	6.3	14.5	5.7	6.4
	N	93	1,284	196	348	137	155	135	327	154	45	46	62	16	62	88	156
IPV	%	51.9	35.2	28.2	59.4	42.8	60.4	39.3	45.5	43.5	66.7	70.2	45.5	60.3	55.9	57.9	59.6
	N	214	2,103	277	881	236	470	244	715	276	147	171	191	58	195	221	441
MCV1	%	18.5	10.1	11.0	33.2	10.4	37.0	15.6	24.3	19.5	53.0	63.6	27.7	27.6	25.0	14.8	18.8
	N	108	1,373	181	566	134	254	154	461	154	100	77	130	29	104	88	213
MCV2	%	0.0	2.3	0.0	5.0	100.0	18.1	6.3	4.1	0.0	6.9	0.0	65.0	60.0	19.4	0.0	12.3
	N	9	724	32	201	1	83	16	195	21	29	1	40	5	36	14	65
Rota1	%	7.8	5.3	7.1	26.6	14.9	30.3	9.8	24.3	14.4	29.5	19.4	10.4	9.1	10.3	24.4	12.9
	N	128	1,458	239	655	188	314	204	555	216	105	72	134	33	117	160	271
Rota2	%	1.9	0.9	0.5	7.6	3.2	11.8	6.1	6.0	1.2	5.5	1.8	2.0	0.0	3.8	3.7	4.9
	N	108	1,353	204	423	156	212	165	386	166	55	57	101	22	80	109	206
All	%	25.9	16.1	10.9	31.6	17.8	41.1	16.7	25.6	18.7	42.8	72.8	59.9	50.0	40.7	31.7	35.3
	N	506	7,090	1,078	2,448	805	1,052	857	2,131	876	334	195	354	88	354	520	920

Percent of visits where children were eligible for the dose and did not receive it.
Note: Early doses are accepted in this analysis; all doses are considered valid doses.
Colored bars are scaled so that if 100% of children had an MOSV for that dose, the table cell would be fully colored. Bars are desaturated and text is grey when n < 25.

Table 27 shows the proportion of vaccination visits at which a MOSV occurred, by district and by dose; results are shown for both the SHRUCs and TPVICS surveys. The bottom row of the figure shows the percentage of visits where a MOSV for any dose occurred. Data bars in each cell show the percentage of visits with a MOSV to make it easier to see where MOSVs are concentrated at a glance.

In the SHRUCs, the percentage of visits at which there was a MOSV for any dose ranges from 16.1% of visits in Peshawar to 59.9% of visits in Killa Abdullah (Table 26). MOSVs for IPV are more common than those for other antigens. In general, missed opportunities are more common for the first dose in a series (OPV1, Penta1, PCV1, MCV1, Rota1) than subsequent doses in the series.

Similar patterns are seen in the child-based analysis of missed opportunities, which considers MOSVs experienced by each child rather than MOSVs at each visit. Figure 24 shows, for each stratum and each dose, the percentage of children who received the dose at the first eligible opportunity (blue), the percentage who had a missed opportunity that was corrected at a later visit (gold), and the percentage

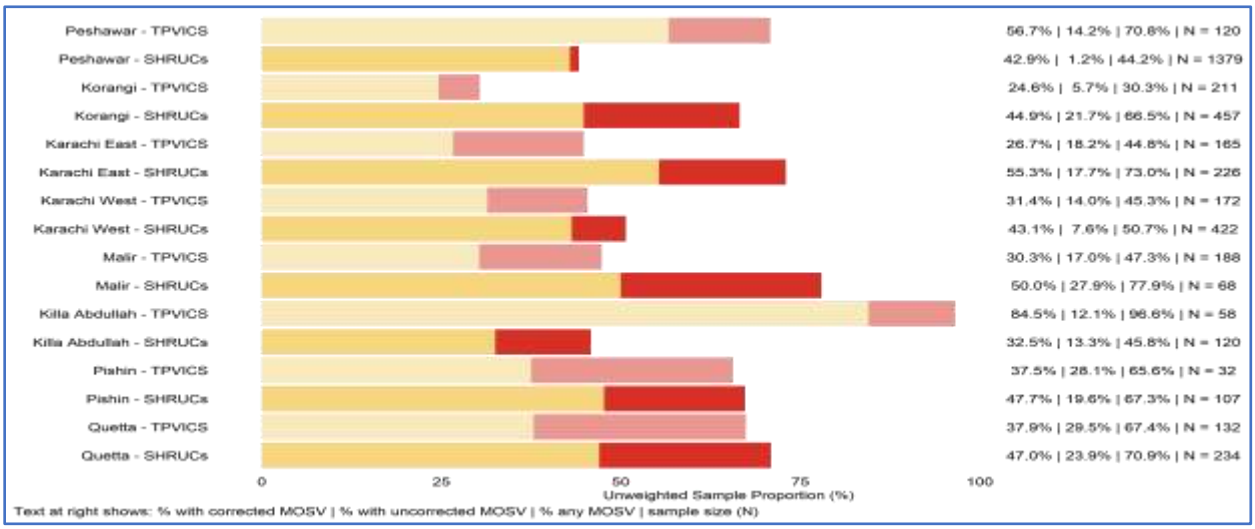
who had a missed opportunity that was uncorrected at the time of the survey (red). The sample size (the number of children in the stratum who had at least one health centre visit where they were eligible to receive the dose) is printed on each bar, and bars with N < 25 are shown in faded colors. The table on the right summarizes experiences of MOSVs for all doses, showing the percentages of children who had no MOSVs for any dose (NM), the percentage who had 1+ MOSVs which were all corrected (AC), the percentage who had a mix of corrected and uncorrected MOSVs (SC), and the percentage who had MOSVs which were all uncorrected at the time of the survey (NC).

Figure 24 again shows clearly that MOSVs for IPV are common across districts. More detail on IPV MOSVs is shown in Figure 25. In the SHRUCs, the percentage of respondents who had a MOSV for IPV ranges from 44.2% in Peshawar to 77.9% in Malir, and in the TPVICS survey, the range is from 30.3% in Korangi to 96.6% in Killa Abdullah.

The child-based analysis of MOSVs also shows that MOSVs tend to be more common for the first dose in a multi-dose series than for later doses. For most vaccine doses in most districts, MOSVs that are experienced are likely to be corrected, though there are exceptions – for instance, in the SHRUCs of Killa Abdullah, there are many uncorrected MOSVs for BCG.

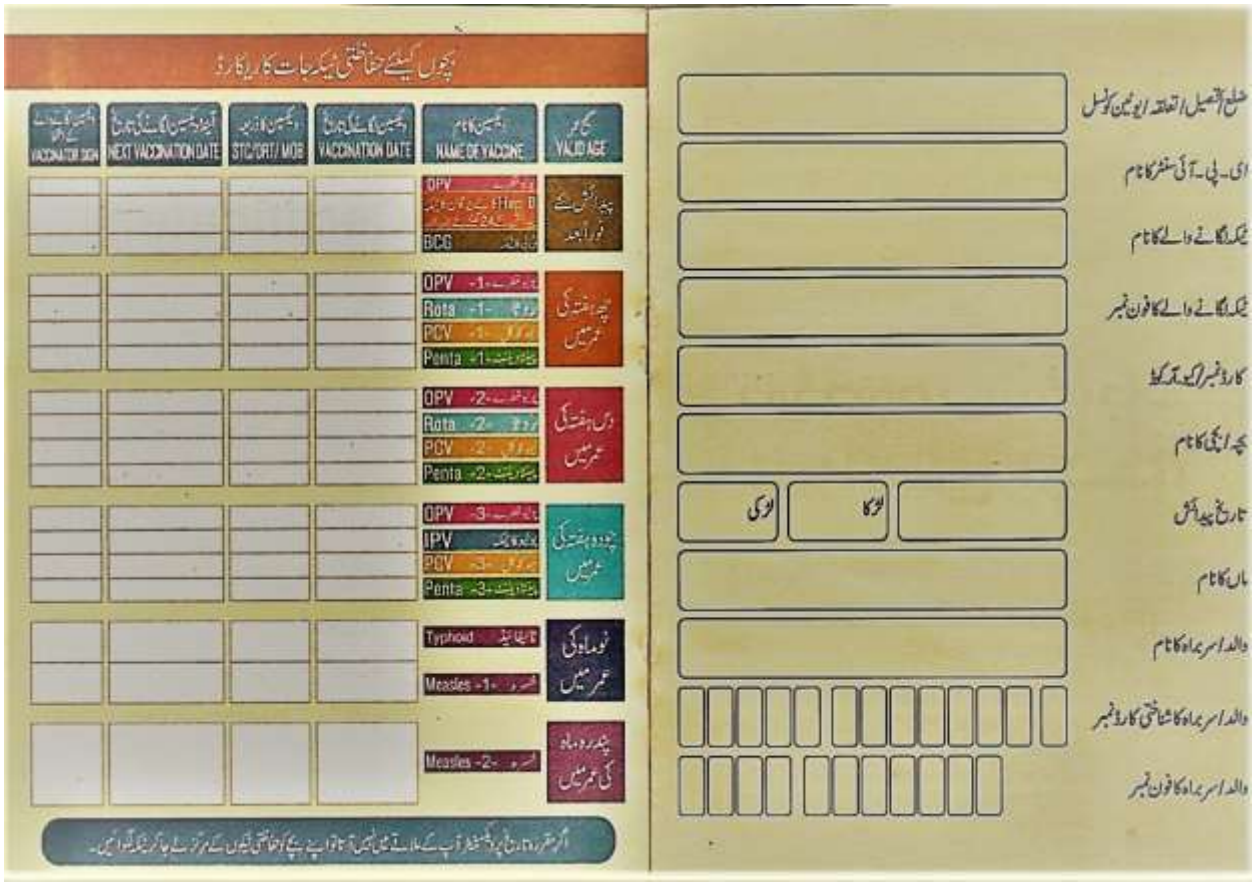
Figure 24. Percent of respondents with MOSVs

Figure 25. Respondents with MOSV for IPV



In Pakistan, children are eligible to receive IPV once they are 14 weeks old, and it is standard practice to administer IPV at the same time as the third dose of Penta, OPV, and PCV, which are also due at 14 weeks (Figure 26).

Figure 26. Sample of home-base record being used in Pakistan



This practice can lead to missed opportunities to vaccinate for IPV; for instance, consider a child who receives their *second* doses of Penta, OPV, and PCV late – when they are 15 weeks old. The child is eligible to receive IPV at that same visit, but if the practice of administering IPV with third doses is followed, then the child will experience a MOSV for IPV and will spend additional weeks or months unprotected by that vaccination.

For children who had a MOSV for IPV but later received the dose, we can calculate the number of days between the initial MOSV and the date IPV was given (the *time to correction*). In the SHRUCs survey, children with a corrected MOSV for IPV had a median time to correction of 68 days, and in the TPVICS survey, the median was 63 days (table 28). More detail on time to correction, reported by district and dose, is in Figure 27.

Table 27. Excess days unprotected: children with a corrected MOSV for IPV

Survey	Days Between First IPV MOSV and IPV Received		N
	Median	Mean	
TPVICS	63	89	386
SHRUCs	68	93	1,338

Other children experienced a MOSV for IPV that was *not* corrected by the time the survey was conducted. For these children, we can calculate the number of days between the initial MOSV and the date of the survey as a truncated estimate of excess days unprotected. In the SHRUCs, surveyed children with a MOSV for IPV that had not been corrected by the time of survey spent a median of 267 days unprotected between their first MOSV and the survey date, and in the TPVICS survey, the median was 264 days (Table 28).

Table 28. Excess days unprotected: children with an uncorrected MOSV for IPV

Survey	Days Between First IPV MOSV and Survey Date		N
	Median	Mean	
TPVICS	264	225	170
SHRUCs	267	271	300

Figure 27. Time to MOSV correction

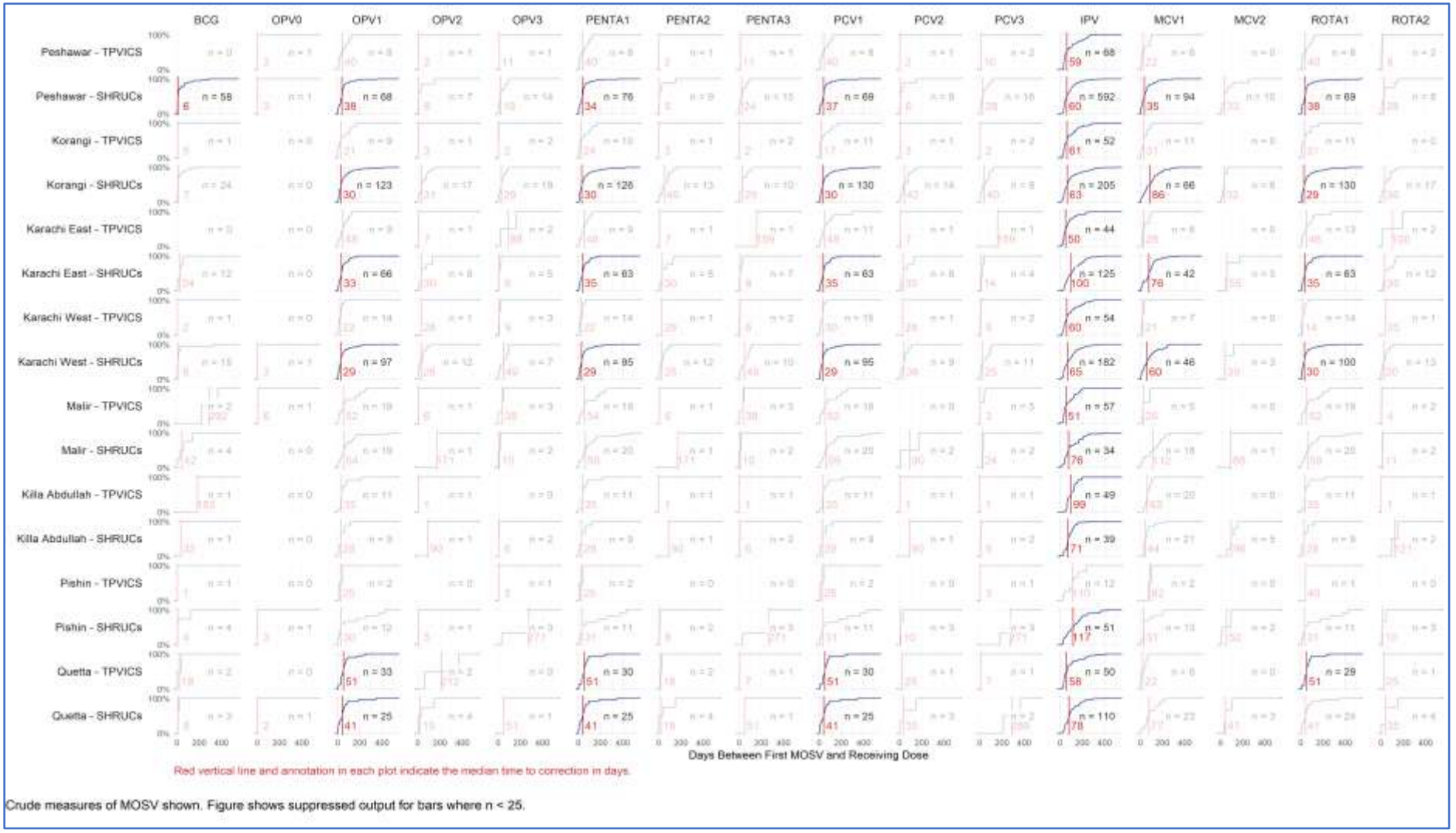


Figure 27 summarizes the time to correction for the subset of MOSVs that were corrected before the survey (the gold portion of the bars in Figure 25). As in Figure 24, results are shown by district and by dose, and the figure shows results for both the SHRUCs and TPVICS surveys. Days elapsed since the initial MOSV are on the X-axis, and the cumulative percentage of MOSVs that have been corrected by that point in time is shown on the Y-axis. Each cumulative curve begins at 0% at 0 days after the initial MOSV and reaches 100% when all MOSVs have been corrected.

The red vertical line and red number in each plot indicate the median time to correction in days. For instance, in the SHRUCs of Peshawar, 50% of MOSVs for BCG were corrected within 6 days of the initial missed opportunity. The sample size (n) in each tile is shown in grey font. When the sample size is less than 25, the plot is shown in faded colors; in many districts and for many doses there were fewer than 25 corrected MOSVs, so more than half of the tiles in Figure 27 are faded.

Because there are relatively many corrected MOSVs for IPV and for the first doses in multi-dose series, those columns have more full-saturation plots. The median time to correction for IPV in the SHRUCs ranges from 60 days in Peshawar to 117 days in Pishin. For OPV1, Penta1, PCV1, and Rota1 in the SHRUCs, the median time to correction is generally shorter – around one month.

3.8. Reasons for not vaccinating children

As shown in Table 29, the primary reasons reported for not vaccinating children were related to rumors, lack of faith in immunization, fear of side effects of vaccines.

Table 29. Reasons children are not fully vaccinated, by district, TPVICS & SHRUCs

	KP - Peshawar - TPVICS	- SHRUCs	Sindh - Korangi - TPVICS	- SHRUCs	Sindh - Karachi East - TPVICS	- SHRUCs	Sindh - Karachi West - TPVICS	- SHRUCs	Sindh - Malir - TPVICS	- SHRUCs	Balochistan - Killa Abdullah - TPVICS	- SHRUCs	Balochistan - Pishin - TPVICS	- SHRUCs	Balochistan - Quetta - TPVICS	- SHRUCs
Place of immunization too far (%)	0.1	0.0	0.0	0.5	0.1	0.9	0.1	1.6	0.0	1.3	3.1	0.3	1.4	2.9	3.3	2.6
Time of immunization not convenient (%)	0.0	0.0	0.0	2.7	0.1	0.7	0.0	0.3	0.0	4.9	1.6	0.0	0.3	0.9	0.2	0.3
Mother too busy (%)	0.4	0.1	0.4	1.1	0.0	1.3	0.2	1.1	0.0	2.2	3.5	0.0	1.4	2.9	11.0	1.6
Family problem including mother ill (%)	0.4	0.2	0.3	1.0	0.0	1.7	0.2	0.5	0.3	1.8	0.6	0.0	1.1	1.9	1.4	4.1
Child ill, not brought (%)	0.4	0.4	0.4	1.8	0.4	2.3	0.5	3.2	0.4	5.4	1.6	0.0	1.3	3.1	2.3	4.6
Child ill, brought but not vaccinated (%)	0.3	0.0	0.0	0.2	0.1	1.0	0.0	0.1	0.2	0.8	0.1	0.1	0.2	0.8	1.8	0.4
Long wait (%)	0.4	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.4	2.4	0.6	0.3	1.2	1.3	0.8
Rumors (%)	2.7	1.2	0.5	3.2	0.3	4.7	1.6	5.7	1.7	5.8	7.2	9.4	4.4	2.5	17.1	3.6
No faith in immunization (%)	2.5	1.7	1.2	3.7	0.6	5.2	3.3	5.7	2.9	7.6	3.2	6.3	4.3	10.0	10.6	9.0
Fear of side reaction (%)	0.1	1.1	0.5	4.0	0.4	2.3	1.5	4.6	1.5	5.9	0.0	3.0	5.4	7.1	8.6	2.9
Time or Place of immunization not Known (%)	0.2	0.0	0.0	0.3	0.2	0.0	2.0	0.2	0.3	0.4	0.0	0.2	1.2	2.7	12.6	1.7
Took child but no vaccine available (%)	0.0	0.1	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0
Took child but no vaccinator (%)	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	1.0	0.1	0.1	0.1	0.0	0.2	0.0
Took child facility closed (%)	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0
Child was sick (%)	0.1	0.4	0.0	1.0	0.2	1.1	0.2	0.9	0.8	2.3	0.5	0.1	1.4	1.3	9.3	2.9
Took child but not vaccination day (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.7	0.3	0.0
Other (%)	0.6	0.1	0.3	0.2	0.0	0.0	0.8	0.0	1.5	0.0	2.9	0.0	2.5	2.1	1.6	0.1
Family does not allow (%)	0.0	0.0	0.0	2.1	0.0	2.2	0.0	1.6	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Don't Know (%)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.2
N	646	2,007	839	1,036	819	571	832	924	837	226	728	896	745	420	821	896

Denominator is all children aged 12-23 months.

Colored bars are scaled so that if 20% of children gave a reason, the table cell would be fully colored.

4. Discussion

This section highlights the most important survey findings, as well as strengths and limitations of the project design and methods.

In KP and Sindh, respondents in the SHRUCs were slightly less likely than TPVICS respondents to report ever having received an HBR and were slightly less likely to show an HBR to the survey team. In Balochistan, the situation was reversed: SHRUCs respondents were slightly more likely than TPVICS respondents to report having received an HBR and slightly more likely to show it to the survey team. Providing HBRs to every caregiver and reminding them to bring it to the vaccination appointments is an important measure for every district and UC.

Vaccination coverage and timeliness details for each district are listed in Section 3; several patterns are notable.

- Coverage of OPV was higher among SHRUCs respondents than among TPVICS respondents.
- Coverage of other doses tended to be higher among TPVICS respondents than SHRUCs respondents (except in Peshawar).
- In the TPVICS surveys, coverage for IPV was very similar to that of OPV3, Penta3, and PCV3. In the SHRUCs, it tended to be somewhat higher than those doses.
- All the multi-dose antigens show drop-out from dose 1 to dose 2 and again from dose 2 to dose 3. Except in Peshawar, drop-out among SHRUCs respondents tended to be higher than among TPVICS respondents. Drop-out for Penta and PCV was much higher among SHRUCs respondents in Killa Abdullah.
- All of the records with HBRs show a notable portion of children receiving many doses more than two months after they were scheduled to receive them. In most cases, the portion of respondents receiving doses very late is higher for later doses than for early ones.
- Except in Peshawar, a higher portion of intradose intervals among SHRUCs respondents were 8 weeks (56 days) or more than among TPVICS respondents. Between 15% and 55% of the intervals were 8 or more weeks. Among intervals longer than 8 weeks, the median interval ranged from 12-25 weeks instead of the 4 weeks listed in the national immunization schedule.
- All districts showed fairly high rates of administering the IPV vaccine with OPV3, Penta3, and PCV3 even if the child was eligible for IPV at an earlier vaccination visit. This results in a high rate of

missed opportunities for simultaneous vaccination for IPV in both the TPVICS and SHRUCs surveys. The median time to correction for IPV MOSVs that were corrected ranged from 51 days in the Malir TPVICS survey to 117 days in the Pishin SHRUCs survey.

- Among other doses, MOSVs were more common in first doses in a series like OPV1, Penta1, PCV1 and Rota1 than in later doses. There were notably more MOSVs among SHRUCs respondents than TPVICS respondents. Most but not all of those MOSVs were corrected and there were more uncorrected MOSVs among SHRUCs respondents than among TPVICS respondents.

The SHRUCs survey has several strengths. It followed shortly after the TPVICS survey and was able to leverage the infrastructure of the TPVICS questionnaire, data collection infrastructure, data quality review procedures, and data cleaning procedures. The SHRUCs survey was able to mobilize quite rapidly after doing the geographic information systems work needed to construct the frame of PSUs in each relevant union council. In households that showed an HBR, clear photographs helped to verify the recorded vaccination dates and helped to review and correct dates that were flagged as illogical during data quality checks. The data were weighted using the probability of respondent selection to estimate conclusions representative of all children age 12-23 months in the SHRUCs and the weights were post-stratified by the SHRUC population, so the combined estimates give appropriate weight to larger and smaller union councils. The closely spaced timing of the TPVICS and SHRUCs survey yields an opportunity to compare outcomes in high-risk union councils with the representative results of those districts as a whole, to see which outcomes are better or worse or comparable to the surrounding district. Finally, the SHRUCs survey might serve as the first in a pair or a series of surveys to monitor vaccination coverage in those important union councils.

The survey has several limitations. For the resources available, it was not possible to collect a large enough sample to estimate outcomes precisely in each union council, so this report focuses on outcomes aggregated across UCs within each SHRUCs district. Aggregation may mask some interesting differences in outcomes within districts. Documented evidence was only sought from HBRs, not from any neighborhood ladies or vaccination facilities. So if the caregiver did not show the card, the child's vaccination data was based on their memory instead of documented evidence.

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