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World Health Organization

TAJIKISTAN VACCINE COLD CHAIN INVENTORY ASSESSMENT REPORT

Dushanbe 2022

ACKNOWLEDGMENTS

This assessment was conducted by the USAID Local Health System Sustainability Project (LHSS) at the request of the Ministry of Health and Social Protection of the Population (MoHSPP) of the Republic of Tajikistan.

The support of Dr. Abduholik Amirzoda, the Deputy Minister MoHSPP, Dr. Fayzali Saidzoda, the General Director of the State Institution “Republican Center of Immunoprophylaxis” (RCIP), and RCIP team was critical in establishing the national team of assessors; conducting data collection fieldwork, data cleaning, and data entry; and providing further inputs in data processing and analysis.

Working through LHSS, USAID Tajikistan provided funding and technical assistance for in-country training of assessors, data collection, data entry, and data cleaning; and engaged local expertise to support the process. The Regional Office for Europe of the World Health Organization (WHO/EURO) provided technical guidance, engaged external expertise, and supported in-country capacity building to implement the work. The WHO country office provided continuous support throughout all stages by engaging national stakeholders and partners, coordinating activities, and providing oversight and monitoring of the project’s implementation.

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Acronyms

30DTR	30 Day electronic temperature recording
CCE	Cold chain equipment
CCEOP	Cold chain equipment optimization platform (GAVI)
cMYP	Comprehensive Multi-Year Plan for Immunization
DRS	Districts of Republican Subordination
EPI	Expanded Program on Immunization
GBAO	Gorno-Badakhshan Autonomous Oblast
HSS	Health System Strengthening (GAVI project)
IGA	Inventory gap analysis
ILR	Ice-lined refrigerator
IPV	Inactivated polio vaccine
MMR	Measles, mumps, rubella
MoHSPP	Ministry of Health and Social Protection of the Population
NIP	National Immunization Program
OOPE	Out-of-pocket health expenditure
OPV	Oral polio vaccine
PCV	Pneumococcal conjugate vaccine
PHC	Primary health care
PQS	Performance, Quality, Safety - WHO prequalification of immunization equipment and devices
PIS	Product information Sheets
RCIP	Republican Center for Immunoprophylaxis
RT	Republic of Tajikistan
SDD	Solar direct drive
SOP	Standard operating procedure
UCC	Ultra cold chain
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

Executive Summary

The Republic of Tajikistan's Ministry of Health and Social Protection of the Population (MoHSPP) wanted to assess the vaccine cold chain in the country to make informed decisions regarding cold chain rehabilitation and asked for technical and financial support from WHO and the United States Agency for International Development (USAID), respectively. Following a review of the available data and information on the national vaccine cold chain, WHO and USAID recommended conducting a comprehensive cold chain inventory and needs assessment, targeting all facilities providing immunization services in Tajikistan.

The web-based Inventory Gap Analysis (IGA) tool was used to assess the vaccine cold chain. The MoHSPP collected facility-based data on the infrastructure of facilities providing immunization services, their target population and the services provided, as well as the available cold chain equipment (CCE) and its operating status. Due to lack/poor internet connectivity in remote areas, it was difficult to collect data electronically. Therefore, the data collection was done on paper, not directly using the web-based IGA tool. The data were entered into the tool after data collection was completed.

Approximately 96.5 percent of vaccine refrigerators and freezers were found to be in satisfactory working condition, whereas 2.7 percent of those in working condition required maintenance. Only 3.5 percent of all equipment recorded was found not in working condition.

The inventory recorded 1,501 ice-lined refrigerators (ILRs), 133 vaccine or ice pack freezers, and 1,481 domestic refrigerators at all levels of the supply chain and immunization service delivery points.

A total of 106 out of 133 (79.7 percent) vaccine freezers are available and used at the national, regional, and district level warehouses.

Out of 1,501 units of the ILRs, about 1,403 units (93.5 percent) are in working condition, and 25 units (1.7 percent) are working but require maintenance. Only 56 units (3.7 percent) are not working and need repair or replacement. In general, the proportion of aging ILRs (over 10 years of age) is high, and almost 40 percent (573 units) of the ILRs in Tajikistan will require replacement soon.

A total of 7,095 passive storage devices were recorded during the cold chain inventory, including 911 vaccine cold boxes (with a volume of more than 8 L) and 6,534 vaccine carriers (0–8 L). The total number of functioning passive storage devices is 7,052 pieces; 43 (0.6 percent) were reported as non-functional during the assessment.

The average number of ice/water packs per facility is 3.0, and the average number of ice/water packs per passive storage device is 1.3, with important variation by facility type.

A total of 2,212 temperature monitoring devices were recorded in the inventory. The most commonly reported type of temperature monitoring equipment is arrow thermometers (898 or 40.6 percent), followed by 30-day electronic devices (643 or 29.1 percent), column thermometers (634 or 28.7 percent), and electronic thermometers (37 or 1.7 percent).

A total of 118 vehicles, including 8 refrigerated trucks, 3 non-refrigerated trucks, and 107 cars and minivans were reported to be engaged in vaccine transportation in the country. About 66 (63 percent) are small, 4x4, general purpose vehicles (mainly VAZ NIVA); 26 vehicles (24 percent) are common purpose, small passenger vehicles (mainly VAZ models); and 15 (13 percent) are Tangem minivan, Lada, Hyundai, and other models.

A total of 128 autonomous power generators were documented. Most of the power generators were more than 10 years old (put into service in 2009-2013). Out of the total number, 109 united (87.2 percent) were reported as working well, while 9 (7.2 percent) were not working, and 3 (2.4 percent) needed maintenance. The working status of the rest is unknown.

This inventory assessment is useful to compare the current inventory of cold chain equipment with the one done in 2017, and with future demand projections in order to identify and address potential gaps. The assessment findings will inform the MoHSPP and its international partners on interventions to improve the quality of vaccination services, not only for COVID-19 but beyond. This will ultimately lead to increased access to improved services in Tajikistan.

1. Introduction

Country Context

Tajikistan is a mountainous, landlocked country in Central Asia covering an area of 143,100 km2. It is bordered by Kyrgyzstan to the north, China to the east, Afghanistan to the south, and Uzbekistan to the west. The country's geography (93 percent of the territory consists of high mountains) makes in-country and regional communications and transportation challenging, especially in winter.

Tajikistan is divided into three regions (Sughd and Khatlon oblasts and Ghorno-Badakhshan Autonomous Oblast, GBAO), the Regions of Republican Subordination consisting of 13 districts (rayons) and cities, and the capital city of Dushanbe. At the second administrative level are 14 cities and 38 rayons. The rayons, in turn, include 368 rural municipalities (jamoats) and 65 towns at the third administrative tier, which are further subdivided into villages (deha).

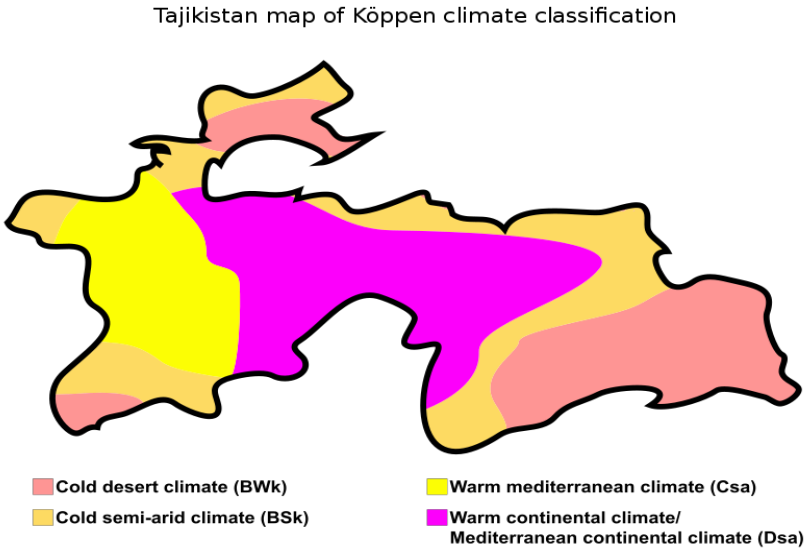
Tajikistan's climate is continental, subtropical, and semiarid, with some desert areas.

The climate changes drastically according to elevation. The Fergana Valley and other lowlands are shielded by mountains from Arctic air masses, but temperatures in that region still drop below freezing for more than 100 days a year. In the subtropical

Figure 1. Map of Tajikistan and regions

Source: Tajikistan Maps & Facts - World Atlas

Figure 2. Map of Tajikistan According to Köppen Climate Classification



Source: Adapted (enhanced, modified, and vectorized) by Ali Zifan from World Koppen Classification.svg., CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=47085580

southwestern lowlands, which have the highest average temperatures, the climate is arid. At Tajikistan's lower elevations, the average temperature range is 23 to 30°C in July and −1 to 3°C in January. In the eastern Pamir mountains, the average July temperature is 5 to 10°C, and the average January temperature is −15 to −20°C.

Tajikistan is the wettest of the Central Asian republics, with the average annual precipitation for the Kafernigan and Vakhsh valleys in the south being around 500 to 600 mm, and up to 1,500 mm in the mountains. At the Fedchenko Glacier, as much as 223.6 cm of snow falls each year. Only in the northern Fergana Valley and in the rain shadow areas of the eastern Pamirs is precipitation as low as in other parts of Central Asia: in the eastern Pamirs less than 100 mm falls per year. Most precipitation occurs in the winter and spring.

Tajikistan's population is the fastest growing, youngest, and least urbanized among Central Asian countries. With an estimated 9.2 million inhabitants as of 2020, Tajikistan is the third largest country in Central Asia by population, with Khatlon being the most populous region. Very few people live in vast GBAO, where the population density stands at just 3.6 inhabitants per square kilometer. Dushanbe, now approaching 1 million residents, is the largest city by far. The overall urbanization rate has remained constant, at just over 40 percent, over the last decade, and is the lowest in Central Asia. High fertility, with an estimated 3.5 births per woman, is the main driver of Tajikistan's rapid population growth, which, at around 2.5 percent per year, is substantially higher than anywhere else in Central Asia. Consequently, the median population age in Tajikistan, at 22.4, is far below that of its neighbors, and the age-dependency ratio substantially higher, with 68 people below age 15 or above age 64 per 100 people of working age.

Tajikistan is a primarily Muslim, multiethnic country where Uzbeks form the largest minority. An estimated 98 percent of Tajiks are Muslims. Uzbeks make up an estimated population share of 13.8 percent, primarily concentrated in the Sughd region. It is assumed that Tajik is the first language for around 80 percent of the population, with Russian being used frequently in government and business affairs. Officially, literacy is near universal and compulsory schooling comprehensively enforced, but adjusted for education quality, the expected number of years of schooling is just 6.8.[1]

Tajikistan is classified as a low-income country, with a national income just below the lower middle-income threshold. Due to the coronavirus disease 2019 (COVID-19) pandemic, gross domestic product (GDP) per capita is projected to shrink by 1 percent in 2020, and to rebound to 4 percent growth in 2021. With a per-capita gross national income of US$1,030 as of 2019, Tajikistan is classified as a low-income country according to World Bank methodology, falling just below the lower-middle-income group threshold of US$1,035. The Tajik economy's high vulnerability to the Russian business cycle in part results from of its heavy dependence on remittances from Tajik labor migrants. As of 2019, remittances coming primarily from Russia amounted to 29 percent of GDP, the second highest rate in the world. Meanwhile, inflation, which had already accelerated in 2019, is projected to reach 8.1 percent in 2020, its highest level since 2011.

Health System Context

At the national level, the MoHSPP formulates health policy, plans capital investments, and regulates and is accountable for medical equipment, supplies, and service provision and quality

[1] World Bank, Tajikistan, Human Capital Index 2020. https://databank.worldbank.org/data

in both the public and private sectors. The MoHSPP regulates the health sector through ministerial decrees, decisions of the advisory board (kollegia), guidelines, instructions, and recommendations. It also monitors and visits health care facilities and considers citizens' claims or suggestions. The monthly kollegia, which is chaired by the Minister of Health, assesses the implementation of national programs and policies and is responsible for the consideration of any urgent problems or priority issues.[2] Together with the Ministry of Education and Science, MoHSPP manages medical education and research institutions and operates a number of specialized tertiary hospitals in Dushanbe and nationwide vertical networks of facilities for prevention and infectious disease control, such as the Republican Center for Immunoprophylaxis (RCIP) and the Republican Tuberculosis Control Center. Other central line ministries such as Internal Affairs, Defense, Security, Taxation, and Transport operate their own health facilities, which exclusively serve their employees and dependents.[3]

Most health care in Tajikistan is delivered under the auspices of subnational governments. The health departments of regions operate large hospitals and specialized outpatient facilities. They also assume a supervisory role for health care provision in their subordinate cities and rayons.[4] At the rayon and city levels, there are separate administrative structures for hospitals and outpatient facilities. Central rayon and central city hospitals and the smaller hospitals under their auspices are managed by chief physicians of central rayon and city hospitals, whereas primary care managers are responsible for the operation of city and rayon health centers[5] and the subordinate networks of rural health centers and health houses. Depending on their place of residence, all citizens are assigned to either a health house, rural health center, rayon health center, or city health center as their primary care provider and gatekeeper to higher levels of care. In 2019, city health centers on average had about 46,200 and rayon health centers about 13,200 people in their catchment areas, while rural health centers and health houses on average served about 4,400 and 1,700 people, respectively.

All revenue for Tajikistan's public health care system comes from three sources: government transfers from general taxes, formal and informal direct payments from patients, and foreign financial aid. The general taxes and other public levies used for government health spending are set and collected at all tiers of government. Taxes that are set at the republican level include value-added tax, income and profit tax, excise duties, taxes on the extraction of natural resources, and road taxes. Taxes that are set by subnational governments include vehicle and real estate taxes. The revenue of the taxes set by subnational governments is fully retained at the subnational level but is small compared to that of republican taxes, amounting to about 8 percent of total tax revenue as of 2019. The annual budget law determines what share of the locally collected republican tax revenue a subnational government can keep and what is to be passed up to the center for republican spending or regional redistribution.

In the absence of comprehensive, tax-financed coverage, access to appropriate treatments in Tajikistan is often determined by ability to pay, as evidenced by the much higher out-of-pocket health expenditures (OOPEs) and health care utilization rates among more the more affluent parts of the population. It will be challenging to achieve more equitable health care access and a reduction in catastrophic OOPEs unless a substantial portion of current fee-based services and, even more importantly, medicines are included in Tajikistan's public benefit packages.

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[2] Health Systems in Transition (HiT) 2016. Health System Review. Vol. 18 No. 1
[3] Parallel health care systems are also run by certain state-owned enterprises such as the Tajik Railway.
[4] Health care providers in Dushanbe city and the Region of Republican Subordination, where there are no oblast-level administrative structures, are directly accountable to MoHSPP.
[5] Rayon and city health centers are also referred to as polyclinics and may be physically co-located with the central hospitals of rayons and cities.

Moreover, without more comprehensive public health care coverage, the potential of strategic purchasing to align facility funding with health care need will remain limited, as provider incomes in areas where patients have a higher ability to make direct formal and informal payments will continue to exceed those in areas where the population is poor.

Organization of Immunization Services

The National Immunization Program (NIP) is implemented and managed by RCIP and is the responsibility of the MoHSPP. NIP is one of the main preventive health care services in Tajikistan. It is implemented by primary health care facilities (polyclinics and district health centers) in both urban and rural areas as well as in maternity hospitals for newborns. The NIP in Tajikistan generally operates as a vertical program (at least at the national level), with its own funding stream, dedicated national-level staff, specific procurement and logistics systems, and separate planning and information system. This separation was determined by historical patterns of government funding and donor investments. The NIP functions that are most integrated into health systems are service delivery and surveillance of vaccine-preventable diseases.

Service Delivery

At the service delivery level, vaccination services are mostly integrated with primary health care services and delivered by primary health care (PHC) workers; there is also a vertical element where vaccinations are offered through outreach services. Governance of the NIP tends to be less integrated at higher levels than at the district level or below within the health system. International organizations, such as GAVI, the Government of Japan, WHO, the United Nations Children's Fund (UNICEF), USAID, Médecins sans Frontières (Doctors Without Borders), the International Committee of the Red Cross, and the International Development Association of the World Bank have made important contributions to the NIP since its inception. More recently, the main donor has been GAVI with co-financing support for some vaccines such as pentavalent (DTP-HepB-Hib), rotavirus, inactivated polio (IPV), and all other vaccines funded from domestic resources. With the support of GAVI, the country is planning to introduce pneumococcal conjugate (PCV) and a second dose of the IPV vaccine into the National Immunization Schedule during 2022. Administration of diphtheria and tetanus vaccination for persons age 16, 26, 36, and 56 years, will be instituted as indicated in the National Immunization Schedule.

In urban areas, immunization services are provided by city health centers (polyclinics), family medicine centers, and general and children's clinics. In rural areas, immunization is delivered via health houses, village health centers, and district health centers. Under the Expanded Program on Immunization (EPI), the majority (80–85 percent) of the target population receives immunization services from existing PHC facilities. Immunization sessions are offered twice a week at most service delivery points. Out of all clinics, only 277 (or 9.6 percent) facilities provide immunization services through outreach (i.e., mobile teams), which may cover 15-20 percent of the population.

Access to fixed facilities is often limited to only one or two days per week (for two-fifths of children). Immunizations are given in accordance with the National Immunization Schedule at certain times, and the number of sessions for vaccination each month depends on the target population. In remote and hard-to-reach locations, mobile teams implement vaccination four times per year.

Planning and Administration

MoHSPP has also approved major strategic documents related to the provision of immunization services – National Immunization Program for the period of 2021-2025 and the Comprehensive Multi-Year Plan for Immunization (cMYP) for 2016-2020. A National Immunization Strategy for the period up to 2030 will be developed during the second half of 2022. This strategy will replace the cMYP and will serve as a basis for NIP management in Tajikistan.

Procurement, Logistics, and Distribution

The Republic of Tajikistan purchases all vaccines for routine immunization exclusively through the UNICEF Supply Unit. MoHSPP and UNICEF signed a Memorandum of Understanding on the procurement of vaccines on the March 30, 2004. The coronavirus vaccine is included in the existing vaccine procurement system.

The country's only port of delivery of vaccines is the Dushanbe International Airport. There is a unified practice of vaccine delivery for routine immunization by the aerial route; however, in emergencies or non-standard situations (e.g., lockdown), the vaccines and other commodities can be shipped to Tashkent, Uzbekistan, by air and then delivered to Tajikistan by ground transport.

Upon arrival, the vaccines are temporarily stored in a refrigerator at Dushanbe International Airport. RCIP employees are responsible for maintaining the cold chain during the storage period. The temperature reading is recorded in a standard UNICEF Vaccine Arrival Report. All batches of vaccines are transported from the airport to the national vaccine warehouse in refrigerated trucks and accompanied by an RCIP employee. The responsible employees have been trained on required procedures for checking the temperature of vaccines on arrival at central, regional, and district cold storage warehouses based on the approved standard operating procedures (SOPs) for effective vaccine management. The responsible staff usually performs a monthly inventory of existing vaccines, syringes, safety boxes, and other items in the warehouse. To ensure the security of vaccines and supplies, security cameras have been installed at the national and regional vaccine warehouses. There are contingency plans in case of emergency in all vaccine warehouses. All immunization materials (syringes and safety boxes) are delivered by air/land to international terminals in Dushanbe and Tursunzade.

The RCIP of the MoHSPP is responsible for organizing, managing, and implementing immunization activities at all levels of the national immunization system.

The four-level national immunization supply chain includes numerous vaccine cold storage points:

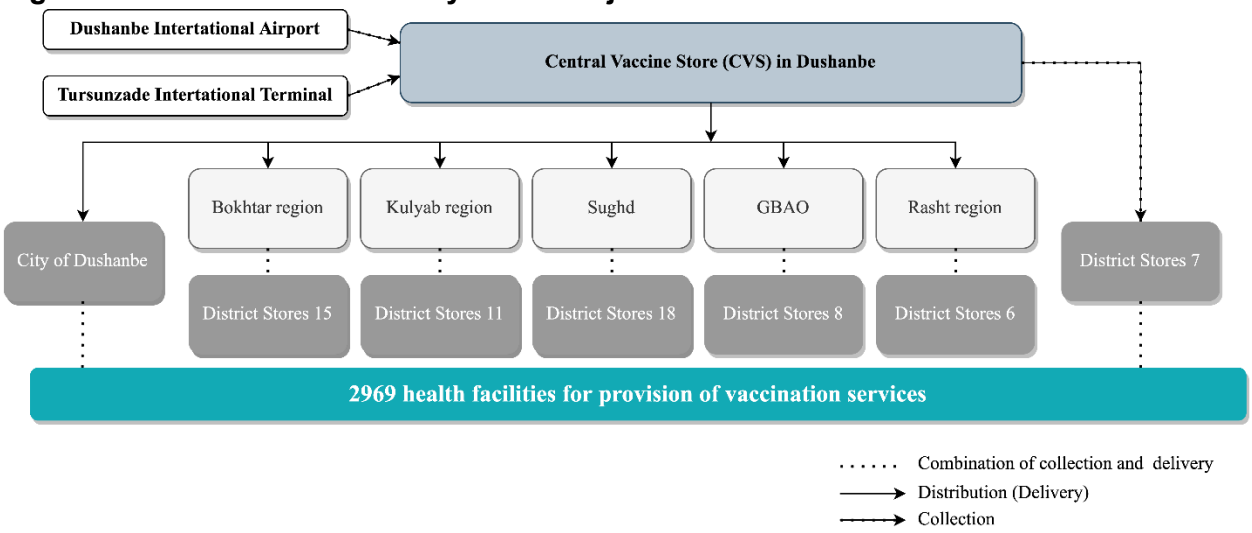
1. At national level, there is one central vaccine warehouse in Dushanbe
2. At regional level, there are six vaccine warehouses in Dushanbe (which serves Dushanbe city), Bokhtar (former Kurgantube), Kulyab, Sughd, GBAO, and Rasht (which serves six Districts of Republican Subordination (DRS) in Rasht valley)
3. At rayon level, there are 65 vaccine warehouses
4. At facility level, there are 2,969 health facilities of different types which serve as vaccination points.

All vaccines and other immunization supplies are distributed from the central vaccine warehouse to:

- Six regional vaccine warehouses by refrigerator truck, quarterly
- Seven district vaccine warehouses in DRS, located around the capital of Dushanbe, by refrigerator truck, monthly

At the lower levels, the vaccine supply chain in Tajikistan is primarily based on collection rather than distribution. Every month, 58 district vaccine warehouses collect their vaccines and supplies from six regional/zonal warehouses. Every month, all 2,969 health facilities collect vaccines and other supplies from their corresponding district warehouses. Figure 3 presents a scheme of the national vaccine supply chain of Tajikistan.

Figure 3: Vaccine Distribution System in Tajikistan



Source: MoHSPP/RCIP

RCIP and its regional branches have eight refrigerator trucks for safe transportation of vaccines (two at the national vaccine warehouse and six at regional vaccine warehouses). Refrigerated trucks help the national vaccine warehouse collect vaccines from the airport upon arrival and distribute them to the six regional and seven district vaccine warehouses of the DRS. The regional vaccines warehouses, in turn, ensure the safe distribution of vaccines to the district vaccine warehouses. In some circumstances, each district center of Immunoprophylaxis collects vaccines from the RCIP's regional branches every month, using cold boxes. Health facilities collect vaccines from the district centers of Immunoprophylaxis monthly. Vaccines are transported from one level to another based on the SOPs for effective vaccine management approved by MoHSPP.

Cold Chain Adequacy at Different Administrative Levels

In 2017, with technical support from WHO's Regional Office for Europe, MOHSPP conducted a comprehensive vaccine cold chain inventory, needs assessment, and rehabilitation plan across the country. Based on the results of the cold chain inventory, a Cold Chain Equipment Optimization Platform (CCEOP) grants application was developed and submitted to GAVI. Funds were granted and, from 2018 to 2022, about 1,129 refrigerators were procured and delivered to Tajikistan through UNICEF's Supply Division. The last shipment of refrigerators

within the CCEOP was received in the country in February 2022. This shipment happened after the completion of the current cold chain assessment and is therefore not included in this report.

In 2021 the RCIP, with technical support from UNICEF, WHO, and GAVI, conducted a cold chain assessment at the national, regional, and district levels. The purpose was to develop a cold chain improvement plan for ensuring sufficient capacity to receive, manage, and effectively distribute COVID-19 and routine vaccines to all immunization sites of the country.

The assessment results revealed the following capacity gaps at the various levels of the cold chain system:

- At the national level, the capacity gap amounted to 5.3 m3 of net volume at + 2°C + 8°C and 3.9 m3 net volume at -15°C -25°C.
- At the regional level, the cold chain capacity gap at the regional level amounted to 3.2 m3 of net volume at the temperature + 2°C + 8°C and 3.2 m3 at the temperature of -15°C -25°C.
- At the district level, the capacity gap amounted to 0.9 m3 of net volume at + 2°C + 8ºC and 4.3m3 - at a temperature of -15°C -25°C.

The cold chain assessment results were used to develop the application for COVAX, a worldwide initiative aimed at equitable access to COVID-19 vaccine, cold chain funding, which was approved in 2021. Therefore, through the COVAX cold chain support, the country will receive the following additional cold chain equipment (CCE):

- 60 refrigerators VLS 404A AC
- 4 refrigerator VLS 354A
- 5 refrigerators VLS 304A
- 3 refrigerators VLS 204A
- 46 freezers MF 114
- 35 freezers MF 214
- 132 cold boxes, B. Kings CB/20
- 1,550 ice/water packs, 0.6 L capacity.

In 2022, the cold chain's temperature monitoring system will be improved by installing 60 remote temperature monitoring devices (Haier U-Cool refrigerator model with bundled services).

To ensure availability of ultra cold chain (UCC) capacity for receipt and management of Pfizer vaccines for COVID-19, the country procured and installed eight UCC freezers (ULF Vestfrost VTS258) with 256 L capacity each, trained national experts, and developed SOPs on UCC use and administration of the Pfizer vaccine. The UCC equipment was installed at the regional warehouses in Kulyab, Bokhtar, and Sughd, while six UCC freezers were installed at the national vaccine warehouse.

The MoHSSP has conducted a comprehensive assessment of the CCE at all four supply chain levels and immunization service delivery points covering 3,041 health facilities in the country, with support provided by USAID.

Through the GAVI performance-based funding and HSS Flexibility Grants, the United Nations Development Programme Country Office in Tajikistan supported the construction and rehabilitation of the vaccine warehouses in Dushanbe, Bokhtar, Rudaki, Khorog, Kulyab, Rasht, and Khujand cities. The type and status of the projects are provided in Table 1.

Table 1: Details and status of warehouse construction/reconstruction

№	Name of region, city, zone	Type of vaccine warehouse	Size of warehouses under construction (m^2)			
			Cold warehouse area (m^2)	Dry warehouse area (m^2)	Type of work	Status
1	Dushanbe city	City warehouse of RCIP branch	65.0	32.3	New construction	Ongoing; expected completion is June 2022 (new 10 m^3 cold room)
2	Khorog, GBAO	Regional warehouse, regional branch of RCIP	65.0	32.3	New construction	Completed
3	Rasht, Rasht valley	Zonal warehouse, Zonal branch of RCIP	65.0	32.3	New construction	Completed; re-installation of the cold room is ongoing
4	DRS, Rudaki	No intermediate warehouse	65.0	32.3	New construction	Completed and new 10 m^3 cold room was installed
5	Khatlon oblast, Bokhtar region, Bokhtar city	Zonal warehouse, Zonal branch of RCIP	134.6	67.5	New construction	Completed; re-installation of the cold room is ongoing
6	Khatlon oblast, Kulyab region, Kulyab city	Zonal warehouse, Zonal branch of RCIP	125.5	78.3	Recon-struction	Completed
7	Sughd oblast, Khujand city	Regional warehouse, Regional branch of RCIP	134.6	67.5	New construction	Completed; new 30 m^3 cold room is ongoing
8	Dushanbe, national warehouse of RCIP		501.7	287.7	New construction and recon-struction	Ongoing; expected completion is June 2022 (3 new cold rooms of 30 m^3)
	TOTAL		**1,156.4**	**630.2**		

Routine Immunization Schedule

The National Immunization Schedule in Tajikistan consists of 12 antigens. In 2008, the country introduced the pentavalent vaccine and in 2015 introduced the rotavirus vaccine with GAVI support. In January 2016, based on WHO recommendations, the country introduced one dose of IPV at 4 months of age and switched from trivalent oral polio vaccine (tOPV) to bivalent vaccine (bOPV) as part of the globally synchronized effort to withdraw type 2 oral polio vaccine. In November 2020, the country replaced measles and rubella vaccine with the measles, mumps, and rubella (MMR) vaccine. Tajikistan is planning to introduce three doses of PCV and the second dose of IPV vaccine into the National Immunization Schedule starting in September 2022. The current schedule is presented in Table 2.

Table 2. The National Immunization Schedule for Tajikistan

Antigens	Number of doses	Age
HepB	1	0 – birth dose
BCG against Tuberculosis	1	3-5 days after birth
DTwP (Diphtheria, Tetanus, and whole cell Pertussis)- - HepB-Hib	3	2, 3, 4 – months
bOPV	4	0 - birth dose, 2, 3, 12 months
IPV*	2	4 months
Rotavirus	2	2 and 3 months
MMR	2	12 months, 6 years
DTwP	1	16-23 months
DT	1	6 years
Td**	5	16, 26, 36, 46 and 56 years
PCV***	3	2,4,12

* The IPV second dose will be introduced in July 2022.
** Tajikistan cannot afford the procurement of Td, but there are donations from time to time.
*** PCV vaccine will be introduced in the National Immunization Schedule in September 2022.

Coverage with routine vaccines is traditionally reported as high in Tajikistan. According to the available data, Tajikistan has achieved and maintained a high level of coverage nationally for all antigens for the last five years. The Tajikistan Demographic and Health Survey in 2012 provided some insight into existing inequity and variation in coverage according to region, parental education level, and socio-economic status. There was a variation reported in the vaccine coverage across different sources.

Use of Non-Routine Vaccines

In the context of the COVID-19 pandemic, as part of its response measures Tajikistan introduced and is using five types of COVID-19 vaccines (AstraZeneca, SII Covishield, Sputnik V, Coronavac, Pfizer, and Moderna). Apart from routine vaccines and COVID-19 vaccines, the immunization supply chain in Tajikistan warehouses also distributes non-routine vaccines, including anti-rabies, seasonal influenza, yellow fever, and typhoid vaccines targeting the needs of specific risk groups. Procured at the central level and distributed by public health services, these vaccines also require considerable cold storage space at all levels of the immunization supply chain.

Immunization Supply Chain Design

The immunization supply chain follows the structure of EPI and has four levels:

- National vaccine warehouse at RCIP
- Regional vaccine warehouses
- District/city-level vaccine warehouses
- Immunization service delivery sites

Vaccine forecasting is the responsibility of RCIP, following a well-established bottom-up approach to collecting demographic and vaccine stock data.

Vaccine financing: There is a dedicated budget for vaccine procurement. Routine vaccines are financed centrally by MoHSPP, which allocates the dedicated budget for vaccine procurement

to RCIP. For non-routine vaccines, financing is independent of the NIP and is managed by other public health structures.

Supply chain financing: There are no dedicated budget lines for the immunization supply chain. The immunization supply chain's operational costs in Tajikistan are financed from various sources, including RCIP's central budget (vaccine receipt and running the national vaccine warehouse), district immunoprophylaxis centers from the local budget (vaccine transportation and storage at the district level), and the PHC budget (vaccine transportation and storage at service delivery sites). Managers of facilities at each level are responsible for allocating funds to cover all needs of facilities, including costs related to salaries, infrastructure, and operation and maintenance of the immunization supply chain.

Vaccine procurement: Routine vaccines are procured by RCIP via UNICEF SD. For non-routine vaccines, procurement is organized by the national public health structure.

Vaccine receipt and storage: There is no local vaccine production in Tajikistan. All routine vaccines are received at the national vaccine warehouse and stored there until further distribution to the lower levels. Non-routine vaccines are managed separately (received and stored) from routine vaccines by national, regional, and district sanitary-epidemiological service centers, but the current assessment did not cover these facilities.

Due to a lack of financial resources and vehicles for the distribution of vaccines and immunization supplies, in certain circumstances district warehouses are collecting its vaccines from higher levels:

- National vaccine warehouse: Collects vaccines from the airport using refrigerated trucks as soon as each shipment arrives.
- Regional warehouses: Using refrigerated trucks, RCIP distributes vaccines and supplies to regional warehouses based on their quarterly demand. DRSs (seven districts) collect vaccines from the national warehouse every month based on their monthly demand. Vaccines are loaded in cold boxes or vaccine manufacturers' transportation containers and transported using general-purpose vehicles. Vaccines are stored in ILRs and in some cases in walk-in cold-rooms (WCR) at subnational warehouses.
- District warehouses are expected to collect vaccines from regional vaccine warehouses monthly, using cold boxes and general-purpose vehicles. Vaccines are stored in WHO-prequalified ILRs.
- Immunization service providers collect vaccines once a month from district vaccine warehouses using vaccine carriers. Vaccines are stored with immunization providers' maximum supply for one month – in most cases in domestic refrigerators, not prequalified for vaccine storage. Due to the small number of children and frequent power outages, immunization service providers often may receive vaccine for one immunization session only.

2. Objectives and Methodology

Objectives and Scope of Work

In 2022, the MoHSPP and RCIP initiated a comprehensive assessment of the vaccine cold chain in order to satisfy the following objectives:

- Characterize the overall condition of CCE, looking at age, working status, models, location, and availability of WHO prequalified equipment (PQS).
- Identify the existing gap for active and passive CCE, temperature monitoring devices, power generators, and voltage regulators.
- Develop an optimized equipment plan to allow MoHSPP to meet current and future vaccination storage needs.

Methodology

The web-based Inventory Gap Analysis (IGA) tool was used to assess the vaccine cold chain. The assessment team collected facility-based data on the infrastructure of facilities providing immunization services, their target population and the provided services, as well as the available CCE and its operation status. Due to lack/poor internet connectivity in remote areas, it was difficult to collect data electronically. Therefore, the data collection was done on paper, not directly using the web-based IGA tool. The data were entered into the tool after data collection was completed.

MoHSPP selected the IGA tool MoHSPP in collaboration with WHO/EURO for this activity because of this tool's unique design as a facility-based CCE inventory and analysis tool. IGA is matched with a set of field-validated data collection tools and has been deployed in two countries to support vaccine supply chain readiness assessments and equipment planning.

MoHSPP decided to conduct the national equipment inventory survey in all health facilities that provide routine immunization services or are involved in vaccine storage and distribution.

Preparations and Training

The national EPI steering committee customized and tailored the IGA and data collection forms to the Tajikistan context. MoHSPP tailored the standard forms for collecting facility data and data on CCE types including vaccine refrigerators, freezers, cold boxes, vaccine carriers, and voltage regulators.

One of the important elements of fieldwork logistics is ensuring that all facilities have been visited (or having clear evidence which facilities have been visited and which have not). An important task is tracking completed individual equipment questionnaires in each facility. To have a good record of the equipment questionnaires completed in a facility, the facility questionnaire was supplemented with questions asking how many individual equipment questionnaires were completed in the facility. This helped make sure that a facility questionnaire is accompanied by all relevant individual equipment questionnaires and checking that none of the completed questionnaires is missing during data entry.

The MoHSPP with WHO support conducted a CCE inventory and needs assessment training workshop to launch the data collection for IGA. The training was tailored for 13 national experts (4 national and 9 regional coordinators) in Tajikistan as a training-of-trainers event.

Data Quality Assurance

A two-level monitoring system of technical/internal monitoring and independent/external monitoring was designed and implemented during the fieldwork to ensure the quality of collected data. Technical monitoring was further divided into two sub-levels—three national coordinators were assigned to monitor the work in specific regions, and zonal/regional coordinators were assigned to implement a set of monitoring activities in the districts of each region.

Dedicated monitoring tools were developed and used during the process; namely, the questionnaire for independent monitoring, the monitoring questionnaire of the national coordinator(s), and the monitoring questionnaire of the regional coordinator(s). Each questionnaire provided guidance regarding its objective, instructions for its use, and a description of the monitoring process.

Data Collection

Data were collected in all 65 listed districts located in seven regions: Dushanbe city, Rasht region (6 districts), Kulyab region (11 districts), Bokhtar region (15 districts) Sughd oblast (18 districts), GBAO (8 districts), and the Region of Republican Subordination (7 districts).

Each data collector was assigned to collect data in his/her district regardless of geographical obstacles or the expected number of health facilities to be visited. Pilot testing estimated that a facility data collection could be accomplished in about 2 hours, not considering travel time. The data collectors were tasked with visiting all target facilities in their assigned districts.

The data collection started immediately after the national training workshop and was finalized by March 2022.

In all facility questionnaires, the data collectors noted phone numbers for facility representatives, who were called to clarify results during data cleaning if required.

Data Entry and Cleaning

The data entry process took place during a training and data entry workshop organized at the central level during the first week of March 2022. Each regional coordinator entered data from his/her region. A WHO consultant provided onsite data entry guidance, training, and data consistency checks. Participants were provided with one day of training on the IGA tool, then proceeded to enter data over 7 days. Each regional coordinator used a computer with access to the IGA web-based tool and with Tajikistan administrative information set up.

Data cleaning took place at the same time as preliminary data analysis, as this process helped to identify and resolve most of the problems with the available data.

Data Analysis and Forecasting

The data were analyzed during April 2022, using the various reports available in the IGA tool as well as its forecasting module to define cold chain requirements. Additional analysis and tabulations were conducted using Microsoft Excel 2010.

Challenges

Some challenges were faced in regard to IGA tool functioning and use on various computers during data entry and analysis, requiring additional time and effort to overcome the shortcomings.

3. Findings and Discussion

Immunization Facilities and Services

The cold chain inventory and needs assessment study collected CCE and facility data from a total of 3,041 health facilities involved in the immunization supply chain according to RCIP data for the end of 2021, covering 100 percent of health centers.

Table 3 presents assessed facilities categorized by type of facility.

Table 3: Assessed facilities

Facility type	Total no. of assessed facilities	Total existing facilities based on RCIP data for end of 2021	Percentage of assessed facilities
National vaccine warehouse	1	1	100%
Regional vaccine warehouses	6	6	100%
District vaccine warehouses	65	65	100%
State maternity hospitals and maternity departments	207	207	100%
Family medicine centers	13	13	100%
City health centers	44	44	100%
District health centers	38	38	100%
Rural health centers	895	895	100%
Family medicine outpatient clinics	19	19	100%
Health houses	1,728	1,728	100%
Health posts	25	25	100%
TOTAL	**3,041**	**3,041**	100%

* Dushanbe city branch is considered a district (lowest delivery) level warehouse.

The most common types of health facilities identified were health houses (56.8 percent) and rural health centers (29.4 percent), followed by state maternity hospitals and maternity departments (6.8 percent).

Vaccine Management Functions

The health workers from assessed facilities were asked to define the types of services they provide regarding fixed and outreach immunization services. Vaccine warehouses at the national, regional, and district levels were excluded since they do not provide immunization services. Table 4 shows the percentage of various types of facilities providing fixed or outreach immunization services. Fixed delivery of immunization services is a universal practice in assessed facilities (100 percent).

Table 4: Percentage of immunization service providers performing fixed or outreach delivery

Facility type	Fixed Immunization Service		Outreach Immunization Service		No. of facilities
	No.	Percent	No.	Percent	
State maternity hospitals and maternity departments	207	100%	0	0.00%	207
Family medicine centers	13	100%	0	20.00%	13
City health centers	44	100%	3	6.80%	44
District health centers	38	100%	7	18.40%	38
Rural health centers	895	100%	34	3.80%	895
Family medicine outpatient clinics	19	100%	0	0.00%	19
Health houses	1,728	100%	0	0.00%	1,728
Health posts	25	100%	0	0.00%	25
Total	**2,969**	**99.50%**	**44**	**1.50%**	**2,969**

Only 1.5 percent of immunization providers reported performing outreach delivery of immunization services. In total, 44 facilities reported providing outreach services; of them, 77.3 percent are rural health centers, 15.9 percent are district health centers, and 6.8 percent are city health centers. Almost all immunization facilities reporting outreach immunization service perform it as an added option along with the fixed services.

Mode of Vaccine Supply

Table 5 provides detailed information on the mode of vaccine supply by facility type. Vaccine collection is the most common mode of the vaccine supply in Tajikistan. With very few exceptions, vaccine warehouses and immunization service providers collect their vaccine supply from upper levels in the immunization supply chain. Few immunization providers' facilities receive vaccines from a higher level. About 95.6 percent of health facilities have reported collection of vaccines from a higher level.

Table 5: Distribution of facilities by vaccine delivery mode

Facility Type	Vaccine delivery mode				No. of facilities
	Delivered	Collected	Both	Unknown	
Regional vaccine warehouse	0	0	6	0	**6**
District vaccine warehouse	3	57	5	0	**65**
State maternity hospitals and maternity departments	4	201	2	0	**207**
Family medicine centers	0	13	0	0	**13**
City health centers	2	42	0	0	**44**
District health centers	2	36	0	0	**38**
Rural health centers	30	859	6	0	**895**
Family medicine outpatient clinics	0	19	0	0	**19**
Health houses	56	1,653	19	0	**1,728**
Health posts	0	25	0	0	**25**
Total	**97**	**2,905**	**38**	**0**	**3,040**

Distance to Supply Source

Table 6 provides data on average distance (in km) to the vaccine supply source by facility type as well as distribution of facilities by various distances from the supply source.

Table 6: Median distance and distribution of facilities by distance to supply source

Facility Type	Median distance to the supply source (km)	Distribution of facilities by distance to supply source						No. of facilities
		0-4 km	5-9 km	10-49 km	50-99 km	100-199 km	> 200 km	
National vaccine warehouse	-	1	-	-	-	-	-	**1**
Regional vaccine warehouses	220	1	-	-	-	1	4	**6**
District vaccine warehouses	60	5	1	22	12	18	7	**65**
State maternity hospitals	5	78	17	97	12	3	-	**207**
Family medicine centers	1	11	2	0	-	-	-	**13**
City health centers	5	32	10	2	-	-	-	**44**
District health centers	1	29	1	8	-	-	-	**38**
Rural health centers	16	63	144	590	87	19	2	**895**
Family medicine outpatient clinics	9	11	5	3	-	-	-	**19**
Health houses	14	200	302	1013	178	31	4	**1728**
Health posts	17	1	3	17	3	-	1	**25**
TOTAL		**432**	**485**	**1752**	**292**	**72**	**18**	**3041**

The results show that the average distance from supply source to regional warehouses is 312 km with a median of 220 km; the average distance from the regional warehouses to district warehouses is about 77 km with a median of 60 km. More than half of the district warehouses (58 percent) are located at 50 km or more from their supply source. The median distance from district warehouses to immunization delivery sites varies from 1 km for family medicine centers and district health centers to 16 km for rural health centers. Health workers from lower-level health facilities (health houses and health posts) have an average distance of 20 km to reach their vaccine supply source, and most facilities are within 50 km reach. Health workers from about 172 facilities delivering immunization services (6 percent) have to travel more than 50 km (one way) to collect their vaccines.

Access to Grid Power Supply

Availability of electricity may have an important impact on immunization service delivery and vaccination coverage, as documented in the section above. WHO-prequalified ILRs can maintain the effective range of temperatures if power supply is provided for 8 or more hours a day. Domestic refrigerators, due to very short cold holdover time, require electricity supply of 24 per day. In facilities with electrical power supply less than 8 hours a day, alternative energy technologies (such as solar-powered refrigerators) could be considered. It should be noted, however, that implementing equipment based on alternative energy technologies is not a simple task. It requires expertise for installation, maintenance, and repair. Therefore, alternative technology options should be considered carefully against other options, such as increasing access to grid power supply (obtaining local authorities' support, establishing partnerships with the private sector, allocating appropriate budgets) and re-designing service delivery schemes (i.e., providing outreach immunization sessions). Table 7 shows availability of grid electricity by facility types in Tajikistan.

Table 7. Access to grid electricity by facility type

FACILITY TYPE	Electricity supply of facilities				Total
	>16 hours per day	8-16 hours per day	<8 hours per day	Not available	
National vaccine warehouse	1	-	-	-	1
Regional vaccine warehouses	6	-	-	-	6
District vaccine warehouses	65	-	-	-	65
State maternity hospitals	207	-	-	-	207
Family medicine centers	13	-	-	-	13
City health centers	44	-	-	-	44
District health centers	38	-	-	-	38
Rural health centers	736	123	31	5	895
Family medicine outpatient clinics	19	-	-	-	19
Health houses	1,418	241	50	19	1,728
Health posts	15	10	-	-	25
TOTAL	**2,562**	**374**	**81**	**24**	3,041
Percentage	**84.2%**	**12.3%**	**2.7%**	**0.8%**	**100.0%**

In general, approximately 96.5 percent of health facilities in Tajikistan have access to grid electricity for more than 8 hours per day. A total of 374 (12.3 percent) facilities reported access to power supply for 8–16 hours a day, and 81 facilities (2.7 percent) did report that electricity supply was available for less than 8 hours.

However, access to a reliable, continuous power supply is a problem, in particular affecting remote facilities providing immunization services such as health houses and health posts. Appropriate immunization strategies supported by distribution and storage technology and procedures must be implemented in this category of facilities to ensure vaccine quality and safety. Unless adequate equipment is in place, facilities with unreliable power supply (immunization service providers) should adapt their operation, considering supply of vaccine in vaccine carriers for each immunization session.

Facilities not equipped with active CCE

Active CCE includes equipment able to generate cold, such as refrigerators, freezers, and cold and freezer rooms.

The cold chain inventory covered 100 percent of facilities storing vaccines and providing immunization services; out of them 413 (13.6%) facilities did not have an active refrigeration equipment (refer to Table 8). Tables 9 provides data on distribution of facilities not equipped with CCE by region.

Table 8. Facilities NOT equipped with active CCE

Type of Facility	Number of Facilities
Health houses	290
Rural health centers	123
Grand Total	**413**

Table 9. Facilities NOT equipped with active CCE by region

Regions	Number of Facilities	Percentage not equipped
Bokhtar region	106	25.7%
DRS	21	5.1%
GBAO	20	4.8%
Kulyab region	63	15.3%
Rasht region	61	14.8%
Sughd oblast	142	34.4%
Grand Total	**413**	

The highest percentage of facilities not equipped with active CCE is in Bokhtar and Sughd regions (34 and 26 percent, respectively), followed by Kulyab and Rasht regions (15.3 percent and 14.8 percent, respectively). None of the regional or district warehouses reported lack of active refrigeration equipment.

Cold Chain Equipment

Cold Rooms, Refrigerators, and Freezers

Refrigerators and freezers can operate on electricity or on heat derived from burning liquid fuel or gas. Electricity may be supplied from the grid, from an electric generator, or from renewable energy sources; typically, solar power is supplied from a photovoltaic array (with or without storage batteries). Most electric refrigerators are vapor-compression cycle units, of which the ice-lined refrigerator (ILR) is a special type. Absorption cycle refrigerators use heat to produce refrigeration. Most absorption units burn liquefied petroleum gas or kerosene. Some operate with electric resistance heating, and combination units can use fuel or electricity in the same refrigerator.

WHO has established a prequalification process (Performance, Quality, and Safety—PQS) to assess suitability of CCE, including vaccine refrigerators, according to a set of minimum requirements. The WHO PQS prequalification process involves laboratory testing and field evaluation.

WHO prequalified ILRs can maintain acceptable temperatures below +10°C on as little as 8 hours of electricity per 24 hours, day after day. ILRs are the best choice wherever there is at least 8 hours of electricity a day, but no standby power supply. In addition, new equipment has been made available to maintain safe temperature ranges if power is available at least 4 hours a day.

The cold chain inventory assessed 100.0 percent of facilities storing vaccines and providing immunization services; out of them, 2,628 (86.4 percent) facilities did report using active refrigeration equipment. The inventory recorded the following equipment in use in the immunization supply chain:

- 10 cold rooms and 3 freezing rooms
- 3,115 refrigerators and freezers, i.e.:
  - 1,501 (48.2 percent) PQS/Product Information Sheets (PIS) ILRs
  - 1,481 (47.5 percent) domestic refrigerators
  - 133 (4.3 percent) PQS/PIS Freezers

Tables 10a, 10b, 10c, 10d, 10e, and 10f provide further details on equipment distribution by equipment manufacturer, model, age, and functional status.

Table 10a. ILRs by Equipment Model

Model	Quantity
GVR 51 LITE AC	1
HBC - 1000	33
HBC - 95	7
HBC-70	113
HBC-80	503
MK 144	80
MK 4010	7
MK172	1
MK204	92
MK-302	1
MK304	53
MK4010	1
MK-4010	6
MK404	2
MKF074	199
TCW2000DC	48
VLS 024 Solar Direct Drive (SDD) Green Line	1
VLS 200A Greenline	58
VLS 300A Greenline	129
VLS 350A Greenline	160
VLS 354 A AC	1
VLS 354A AC	3
VLS 400 Green line	2
TOTAL	**1,501**

Table 10b. PQL Freezers by Equipment Model

Model	Quantity
DW 25W60	5
DW- YL270	1

HBD-116	5
HBD-286	8
MF 114	14
MF 214	71
MF 314	19
MF 60	1
SB-300	4
TFW 791	1
TFW 800	4
TOTAL	**133**

Table 10c. Domestic Refrigerators by Equipment Model

Model	Quantity
Domestic refrigerators	1171
LG	54
PAMIR-04	47
TIA-140	36
Premium	20
Orvica	17
LEC	14
NORD	12
ALMAZ-130	9
MEDIA	9
Super general	9
ROYAL	8
SARATOV	7
POZIS	5
ARTEL	4
DAEWOO	4
NIKAI	4
Avangard	3
AVEST	3
FISHER	3
Shivaki	3
BRUSSA	2
ELAN	2
EURO	2
HITACHI	2
Humdes BS -92	2
Indezit	2
SERENA	2
MINSK	2
OMSK	2
TCW 1990 Electrolux	1
Accord	1
ALETANT	1
BUOBASE	1
Cuper General	1

Model	Quantity
Dansaat	1
Elegant	1
Emersun	1
Erviga	1
Gorenje	1
Important	1
Inbel	1
KINA	1
SAMSUNG 170L	1
SNEZHINKA	1
Tricity	1
Universal	1
VERTICAL	1
VOLNa	1
Whirlpool	1
BOSCH 2132	1
TOTAL	**1,481**

Table 10d. Refrigerators and Freezers by Location

Facility type	Count of item class
National vaccine warehouse	11
Regional vaccine warehouses	66
District vaccine warehouses	275
City health centers	78
District Health Centers	46
Family medicine centers	16
State maternity hospitals or departments	192
Family medicine outpatient clinics	21
Rural health centers	962
Health houses)	1,427
Health points	21
Grand Total	**3,115**

Table 10e demonstrates that 48 percent of equipment is less than 10 years old, 18.6 percent is 10-14 years old, and the remaining 33 percent is 15 years old or older and thus reaching the end of its life.

Table 10e. Refrigerators and Freezers by Age

Year of installation	Quantity	Percentage
0 - 4 years	1,073	34.4%
5 - 9 years	432	13.9%
10 - 14 years	578	18.6%
15 - 19 years	261	8.4%
20+ years	771	24.8%
Total	**3,115**	**100%**

Table 10f. Refrigerators and Freezers' Functional Status

Working Status	Quantity	(%)
Working	2,921	93.8%
Requiring maintenance	83	2.7%
Not working	111	3.5%
Total	**3,115**	**100%**

Approximately 96.5 percent of vaccine refrigerators and freezers were found to be in satisfactory working condition, whereas 2.7 percent of those in working condition required maintenance. Only 3.5 percent of all equipment recorded was found not in working condition.

The proportion of non-working equipment, although moderate, requires documentation of factors contributing to it. The main reason for refrigerators and freezers not working is reported to be lack of spare parts and lack of funds. Some of the equipment needs to be repaired and some to be replaced.

Cold rooms and freezer rooms

Ten cold rooms and three freezing rooms are available at national and subnational vaccine warehouses in Tajikistan.

At the national vaccine warehouse there are 5 cold rooms with 30.7 m3 gross storage volume: two from 2008; two from 2013 and a new one from 2016, procured through UNICEF SD. All cold rooms (except one at the national vaccine warehouse) have two functional cooling units, complying with PQS requirements.

Two 30 m3 cold rooms in the Sughd and Bokhtar regional warehouses were installed in 1995-1996, each of them with two cooling units, and have been reported to work well. However, none of them have been connected to a backup generator. Another 30 m3 cold room was installed in 2009 in Kulyab with two cooling units and with backup generator. Two 10 m3 cold rooms were installed during 2012-2013 at the regional warehouses in Rasht and GBAO and are connected to backup generators.

The three freezing rooms are located at three sites: the national vaccine warehouse and the Sughd and Bokhtar regional warehouses.

The distribution of equipment by country national and subnational warehouses is provided in Table 11.

Table 11. Distribution of cold rooms by vaccine warehouses

	Domain	No. of cold rooms by gross capacity		No. of freezing rooms by gross capacity	Total no. of cold rooms & freezing rooms
		30 m^3	10 m^3	24m^3	
National warehouse:	Dushanbe	5		1	6
Regional warehouses:	Rasht		1		1
	Kulyab	1			1
	Bokhtar	1		1	2
	Sughd	1		1	2
	GBAO		1		1
	TOTAL	**8**	**2**	**3**	**13**

Effective vaccine management requires that each cold room should be connected to a backup power source at all levels. Cold rooms have a short cold life; therefore, vaccines may be at risk in case of power cuts. In the country, all 13 cold rooms and freezing rooms were connected to backup power sources. All cold and freezing rooms reported having embedded functional temperature monitoring systems. Not all cold rooms have 30-days temperature monitoring devices.

With increasing vaccine storage requirements, installation of cold rooms of adequate net capacity with dual cooling units and supported by power backup should be considered in order to address the existing and future vaccine storage needs.

Vaccine freezers

The inventory recorded 133 vaccine or ice pack freezers at all levels of the supply chain and immunization service delivery points. A total of 106 (79.7 percent) of vaccine freezers are available and used at the national, regional, and district level warehouses. Twenty-seven pieces of freezing equipment are used at the immunization service provision points. The freezing equipment is represented by PQS models, including Vestfrost MF 114,214 and 314 and Vestfrost SB 300 (an older PIS model), as well as other TFW models (see Tables 12a, 12b, 12c, and 12d for more details).

Table 12a: Distribution of Vaccine Freezer Models

Model	Quantity
DW 25W60	5
DW- YL270	1
HBD-116	5
HBD-286	8
MF 114	14
MF 214	71
MF 314	19
MF 60	1
SB-300	4
TFW 791	1
TFW 800	4
TOTAL	**133**

Table 12b: Distribution of Vaccine Freezers by Working Status and locations

Location	Not working	Working	Require maintenance	Grand Total
Dushanbe		11		11
DRS	1	17		18
Rasht region	2	9		11
GBAO		8		8
Bokhtar region		16	1	17
Kulyab region		31		31
Sughd oblast		36	1	37
Total	**3**	**128**	**2**	**133**

Table 12c: Distribution of Vaccine Freezers by Working Status and Health Care Facilities

Type of health care facility	Not working	Working	Require maintenance	Grand Total
National vaccine warehouse		9		9
Regional vaccine warehouses		22	1	23
District vaccine warehouses	3	70	1	74
District health centers		1		1
Family medicine centers		1		1
State maternity hospital or department		3		3
Rural health centers		14		14
Health houses		8		8
Grand Total	**3**	**128**	**2**	**133**

As demonstrated in Table 12d, out of the total number of freezers, 59 (44 percent) were older than 10 years; 96.2 percent of equipment units were reported to be in working condition (refer to Table 12e).

Table 12d Distribution of vaccine freezers by age and working status

Year of installation	Quantity			Total
	Working	Not working	Require maintenance	
0 - 4 years	65		1	66
5 - 9 years	8			8
10 - 14 years	11	1		12
15 - 19 years	16	1		17
20 + years	28	1	1	30
Total	**128**	**3**	**2**	**133**

Table 12e: Distribution of vaccine freezers by working status

Working status	Quantity	(%)
Working	128	96.2%
Requiring maintenance	2	1.5%
Not working	3	2.3%
Total	**133**	**100.0%**

Even though the percentage of non-working units is very low, corrective maintenance shall be established to keep the functionality of equipment in the future. A comprehensive equipment replacement program is required, considering that most of the equipment has reached or is reaching the end of its life. In addition, equipment shall be supplied with voltage regulators to reduce exposure of equipment to voltage fluctuations and prevent equipment failure.

ILRs

The cold chain inventory recorded 1,501 ILRs. Vaccine ILRs are largely available and used by subnational and district-level warehouses, as well as by a number of immunization service providers. Equipment models are represented mainly by Vestfrost and Haier refrigerators, including the following models: MKF 074 (199 units), MK 204 (92 units), MK 144 (80 units), MK 304 (53 units), VLS 350A Greenline (160 units), VLS 300A Greenline (129 units), VLS 200A Greenline (58 units), HBC-80 (503 units), HBC-70 (133 units), and HBC-1000 (33 units). (See Table 13a for more details).

Table 13a Distribution of ILRs refrigerators by model

Model	Quantity
GVR 51 LITE AC	1
HBC - 1000	33
HBC - 95	7
HBC-70	113
HBC-80	503
MK 144	80
MK 4010	7
MK172	1
MK204	92
MK-302	1
MK304	53
MK4010	1
MK-4010	6
MK404	2
MKF074	199
TCW2000DC	48
VLS 024 SDD Green Line	1
VLS 200A Greenline	58
VLS 300A Greenline	129
VLS 350A Greenline	160
VLS 354 A AC	1
VLS 354A AC	3
VLS 400 Green line	2
Total	**1,501**

Tables 13b and 13c demonstrate that out of 1,501 ILRs, 1,403 units (93.5 percent) are in working condition, and 25 units (1.7 percent) are working but require maintenance. Only 56 units (3.7 percent) are not working and need repair or replacement.

Table 13b Distribution of vaccine refrigerators by working status

Working status	Quantity	(%)
Working	1403	93.5%
Requiring maintenance	41	2.7%
Not working	57	3.8%
Total	**1,501**	**100.0%**

Per Table 13c most of the ILRs that need repair are in Bokhtar (13 units) and Sughd regions (7 units).

Table 13c: Distribution of vaccine refrigerators by regions and working status

Regions	Not working	Working	Working but needs maintenance	Grand Total
Dushanbe	1	37		38
DRS	8	147	6	161
Rasht region	7	147	3	157
GBAO	4	162	6	172
Bokhtar region	15	324	15	354
Kulyab region	11	214	3	228
Sughd region	10	372	9	391
Grand Total	**56**	**1,403**	**42**	**1,501**
Percentage	**3.7%**	**93.5%**	**2.8%**	**100.0%**

Table 13d shows the distribution of the ILRs by immunization supply chain level and working condition. Out of 56 ILRs, 47 units (84 percent) that are not working, and 20 units (80 percent) that are working but need repair, are located at the level of immunization service provision points.

Table 13d: Distribution of the ILRs by immunization supply chain level and working condition

Facility type	Not working	Working	Working but needs maintenance	Grand Total
National vaccine warehouse		2		2
Regional vaccine warehouses		32		32
District vaccine warehouses	3	165	1	169
City health centers	3	57	3	63
District health centers	2	26	3	31
Family medicine centers	1	9		10
State maternity hospitals or departments	3	79	5	87
Family medicine outpatient clinics		9		9
Rural health centers	33	383	11	427
Health houses	11	631	18	660
Health points		10	1	11
Grand Total	**56**	**1,403**	**42**	**1,501**
Percentage	**3.7%**	**93.5%**	**2.8%**	**100.0%**

As demonstrated in table 13e, out of the total number of ILRs (1,501), 573 (38.2 percent) are older than 10 years (or of unknown age) and require replacement according to global vaccine management policies. Of 573 units, 46 (8.0 percent) are not working, and 17 (3 percent) need maintenance.

Table 13e. Distribution of the ILRs by model and age

Type of equipment	Not working		Working		Requires repair		Total
	More than 10 years	Less than 10 years	More than 10 years	Less than 10 years	More than 10 years	Less than 10 years	
GVR 51 LITE AC	0	0	0	1	0	0	1
HBC - 1000	0	0	11	16	6	0	33
HBC - 95	1	0	3	0	3	0	7
HBC-70	3	2	50	57	1	0	113
HBC-80	0	2	31	467	1	2	503
MK 144	7	1	61	7	4	0	80
MK 4010	0	0	5	2	0	0	7
MK172	0	0	1	0	0	0	1
MK204	4	2	64	20	2	0	92
MK-302	0	0	1	0	0	0	1
MK304	6	0	39	5	3	0	53
MK4010	1	0	0	0	0	0	1
MK-4010	2	0	3	1	0	0	6
MK404	0	0	1	1	0	0	2
MKF074	21	1	145	19	13	0	199
TCW2000DC	1	0	27	17	3	0	48
VLS 024 SDD Green Line	0	0	0	1	0	0	1
VLS 200A Greenline	0	0	9	47	1	1	58
VLS 300A Greenline	0	1	15	112	1	0	129
VLS 350A Greenline	0	1	21	137	1	0	160
VLS 354 A AC	0	0	0	1	0	0	1
VLS 354A AC	0	0	0	3	0	0	3
VLS 400 Green line	0	0	2	0	0	0	2
Grand Total	**46**	**10**	**489**	**914**	**38**	**3**	**1,501**

Table 13f. Distribution of the ILRs by age and model

Year of installation	Quantity			Total
	Working	Not working	Require maintenance	
0 - 4 years	808	5	0	813
5 - 9 years	90	5	1	96
10 - 14 years	169	6	8	183
15 - 19 years	113	15	6	134
20 + years	223	25	10	258
Unknown				17
Total	**1,403**	**56**	**25**	**1,501**
Percentage	**93.5%**	**3.7%**	**1.7%**	**100.0%**

Domestic refrigerators

The inventory recorded 1,481 domestic refrigerators in use in the immunization supply chain in Tajikistan. Domestic refrigerators are widely used in particular by immunization service providers in rural health centers and health houses, but they are also available at the district vaccine warehouses. The variety of domestic refrigerators used to store vaccines is large and includes more than 100 makes and models (see Table 14a for more details). The most common makes of domestic refrigerators are LG – 54 units, Pamir-04 – 47 units, TIA-140 – 36 units, Premium – 20 units, Orvica – 17 units, LEC – 14 units, and NORD – 12 units, followed by equipment from various other manufacturers.

Table 14a. Distribution of domestic refrigerators by models

Model	Quantity
Domestic refrigerators	1,171
LG	54
PAMIR-04	47
TIA-140	36
Premium	20
Orvica	17
LEC	14
NORD	12
ALMAZ-130	9
MEDIA	9
Super general	9
ROYAL	8
SARATOV	7
POZIS	5
ARTEL	4
DAEWOO	4
NIKAI	4
Avangard	3
AVEST	3
FISHER	3
Shivaki	3
BRUSSA	2
ELAN	2

Model	Quantity
EURO	2
HITACHI	2
Humdes BS -92	2
Indezit	2
SERENA	2
MINSK	2
OMSK	2
TCW 1990 Electrolux	1
Accord	1
ALETANT	1
BUOBASE	1
Cuper General	1
Dansaat	1
Elegant	1
Emersun	1
Erviga	1
Gorenje	1
Important	1
Inbel	1
KINA	1
SAMSUNG 170L	1
SNEZHINKA	1
Tricity	1
Universal	1
VERTICAL	1
VOLNa	1
Whirlpool	1
BOSCH 2132	1
TOTAL	**1,481**

As illustrated in Table 14b, out of the total number of domestic refrigerators, 685 (46.3 percent) are less than 10 years old. This demonstrates the efforts of the MoHSPP to strengthen the immunization supply chain by procuring and supplying health care facilities with new CCE. Unfortunately, that investment has been made in equipment that does not comply with WHO PQS requirements and may bring risks to the stored vaccines; in particular risks, related to grid power cuts.

Table 14b. Distribution of domestic refrigerators by age and working status

Year of installation	Quantity			Total
	Working	Not working	Require maintenance	
0 - 4 years	452	3	2	457
5 - 9 years	224	4	0	228
10 - 14 years	235	4	18	257
15 - 19 years	78	8	4	90
20 + years	401	32	16	449
Total	**1390**	**51**	**40**	**1481**
Percentage	**93.9%**	**3.4%**	**2.7%**	**100.0%**

Nearly all (93.9 percent) of domestic refrigerators were found to be in working order. Only 51 units (3.4 percent) do not work, and 40 units (2.7 percent) need repair. However, this equipment does not comply with WHO PQS requirements and may bring risks to the stored vaccines. It is recommended that all domestic refrigerators should be replaced with ILRs for storage of vaccines.

Table 14c. Distribution of domestic refrigerators by location and working status

Regions	Quantity			Total
	Working	Not working	Require maintenance	
Dushanbe	0	68	1	69
DRS	17	334	3	354
Rasht region	2	77	2	81
GBAO	0	57	2	59
Bokhtar region	10	291	16	317
Kulyab region	7	279	2	288
Sughd region	15	284	14	313
Grand Total	**51**	**1390**	**40**	**1481**
Percentage	**3.4%**	**93.9%**	**2.7%**	**100.0%**

Table 14d. Distribution of domestic refrigerators by health care facility and working status

Type of facility	Quantity			Total
	Working	Not working	Require maintenance	
City health centers	49			49
District health centers	18	1		19
Family medicine centers	12			12
State maternity hospitals or departments	107	1	1	109
Family medicine outpatient clinics	16			16
Rural health centers	552	15	11	578
Health houses	624	34	28	686
Health points	12			12
Grand Total	**1,390**	**51**	**40**	**1,481**
Percentage	**93.9%**	**3.4%**	**2.7%**	**100.0%**

Vaccine carriers, cold boxes, and ice/water packs

Cold boxes, vaccine carriers, and other insulated containers are used for the transport of vaccines. Cold boxes are normally used for collection and distribution of large quantities of vaccines from one level of the immunization supply chain to the other. Vaccine carriers are smaller and are mainly used to transport vaccines to the health facility providing immunization

services. Vaccine carriers are also used for the storage of vaccines during immunization sessions.

Cold boxes and vaccine carriers are designed to be used with ice/water packs, which can be used as conventional frozen ice packs, to ensure a cold environment for heat-sensitive vaccines; cool water packs to ensure a cool environment for freeze-sensitive vaccines, or warm water packs at room temperature to ensure a warm environment in freezing ambient temperatures.

WHO PQS allows three standard water-pack sizes: 0.3 L, 0.4 L, and 0.6 L. The correct size for each type of ice/water pack shall be used for a cold box or a vaccine carrier. Having an extra set of ice/water packs is recommended, so that one set can be frozen or cooled while the other set is in use. The additional set also covers the inevitable losses that occur over the lifetime of the box.

Findings:

Vaccine carriers and cold boxes (passive storage devices)
A total of 7,095 passive storage devices were recorded during the cold chain inventory, including 350 vaccine cold boxes (> 8 L) and 6,534 vaccine carriers (0–8 L). The total number of functioning passive storage devices is 6884 pieces; 211 (3,0 percent) were reported as unknown during the assessment.

Table 15a and Table 15b provide data on the availability of any passive storage device by type of facility.

Table 15a. Availability of passive storage devices by type of facility

Equipment models PQS equipment:	Vaccine carriers				Cold boxes			Un-known	Grand Total Passive devices	
	0 – 2 L	2 – 4 L	4 – 8 L	Total	8 – 16 L	16 + L	Total		Units	Col %
ADVC-24	1,192			1,192				26	1,218	17.2%
AICB-444L				0		14	14		14	0.2%
AIDVC-24	21			21					21	0.3%
AIVC-44	143			143				2	145	2.0%
AVC-44	34			34					34	0.5%
AVC-46		34		34					34	0.5%
BK-VC 1.7-CF	4,034			4,034				80	4,114	58.0%
BK-VC 2.6-CF		428		428				14	442	6.2%
Blowkings VDC-24CF			5	5					5	0.1%
CB-12-CF				0	53		53	1	54	0.8%
CB-20-CF				0		204	204	22	226	3.2%
CB-55-CF			426	426				61	487	6.9%
RCW12				0	68		68		68	1.0%
RCW25				0		11	11		11	0.2%
RCW4		27		27					27	0.4%
RCW8			7	7				2	9	0.1%
VDC-24-CF	183			183				3	186	2.6%
Total	**5,607**	**489**	**438**	**6,534**	**121**	**229**	**350**	**211**	**7,095**	**100.0%**

Out of a total number of the passive storage devices, 2,428 units (34.2 percent) were found in rural health centers, and 2,671 units (37.6 percent) were found in health houses. The most common types of cold boxes and vaccine carriers recorded during the inventory were ADVC-24 with 1,218 units (17.2 percent) and BK-VC 1.7-CF with 4,114 units (58 percent). Further information on distribution of vaccine carriers and cold boxes is provided in Table 15b.

Table 15b. Availability of passive storage devices by type of facility

Facility type	ADVC-24	AICB-444L	AIDVC-24	AIVC-44	AVC-44	AVC-46	BK-VC 1.7-CF	BK-VC 2.6-CF	BLowkings VDC-24CF	CB-12-CF	CB-20-CF	CB-55-CF	RCW12	RCW25	RCW4	RCW8	VDC-24-CF	Total
National vaccine warehouse	0			6			4					6						16
Regional vaccine warehouses	10						139				60	23		1				233
District vaccine warehouses	43	7		28	5	4	152	8	5	1	41	76	2	1	20	3	15	411
City health centers	69	1		29		17	568			1	16	51					12	764
District health centers	8			14		4	80	5			4	6					5	126
Family medicine centers	33						26			1		3				3		66
State maternity hospitals or departments	38		1	3			177	20			5	7			1		9	261
Family medicine outpatient clinics	6	1		2			68	2				7						86
Rural health centers	465	4	17	30	17	4	1,220	170		46	63	264	55	9	1	1	62	2,428
Health houses	545	1	3	33	12	5	1,652	237		5	37	42	11		5	2	81	2,671
Health points	1						28					2					2	33
Grand Total	1,218	14	21	145	34	34	4,114	442	5	54	226	487	68	11	27	9	186	7,095

Table 15c.Distribution of passive cold chain equipment per healthcare facility

Healthcare facilities	Total number of passive CCE	Total number of HCFs	Number of passive CCE per facility
National vaccine warehouse	16	1	16.0
Regional vaccine warehouse	233	6	38.8
District vaccine warehouse	411	65	6.3
City Health Center (CHC)	764	44	17.4
District Health Center (DHC)	126	38	3.3
Family Medicine Center (FMC)	66	13	5.1
State Maternity Hospital or Ward	261	207	1.3
Family Medicine Outpatient Clinic	86	19	4.5
Rural Health Center (RHC)	2428	895	2.7
Health House (HH)	2671	1728	1.5
Medical Point (MP)	33	25	1.3
Grand Total	**7095**	**3041**	**2.3**

In general, a large number of passive storage devices are available in Tajikistan (Table 15c). Each equipped facility has on average 2.3 vaccine carriers or cold boxes. Regional warehouses have on average 38.8 units and district vaccine warehouses have on average 6.3 units per facility accordingly. At the service provision level, the lowest number of available devices per facility (1.3) are in state maternity hospitals and medical points. The Family medicine centers and family medicine outpatient clinics have an average of 5.1 and 4.5 passive storage devices accordingly. The rural health centers have on average 2.7 units and health houses have on average 1.5 units per facility. The larger facilities like the city health centers reported on average 17.4 passive storage devices per facility.

Ice/water packs

Ice/water packs are widely available in Tajikistan. A total of 9,063 are standard PQS ice/water packs (0.4 L and 0.6L sizes).

Each health facility that provides routine immunization services should have at least two vaccine carriers, and each health facility that provides outreach services should have at least two additional vaccine carriers. The number of vaccine carriers and ice packs do not meet the needs of routine immunization services.

The average number of ice/water packs per facility is 3.0, and the average number of ice/water packs per passive storage device is 1.3, with important variation by facility type. For details see Table 16.

The presence of non-PQS/PIS cold boxes and vaccine carriers was documented in health facilities. Since this type of equipment does not have a documented holdover cold time, it may not provide adequate protection for vaccines. Such equipment requires replacement or testing and assessment of its performance in order to provide specific guidance on its effective packaging and use.

Table 16. Availability of ice/water packs by type of facility

Facility type	Number of HCFs (A)	Number of ice packs (B)	Number of existing passive CCE units (C)	Number of ice packs needed: 4 per passive CCE unit (D)	Gap (B-D)
National vaccine warehouse	1	188	16	64	124
Regional vaccine warehouses	6	280	233	932	-652
District vaccine warehouses	65	456	411	1644	-1,188
City health centers	44	564	764	3056	-2,492
District health centers	38	184	126	504	-320
Family medicine centers	13	13	66	264	-251
State maternity hospitals or departments	207	331	261	1,044	-713
Family medicine outpatient clinics	19	23	86	344	-321
Rural health centers	895	2,652	2,428	9,712	-7,060
Health houses	1728	4,350	2,671	10,684	-6,334
Health points	25	22	33	132	-110
Grand Total	**3041**	**9,063**	**7,095**	**28,380**	**-19,317**

A spare stock of cold boxes, vaccine carriers, and ice/water packs shall be established at each district warehouse, and a replacement policy shall be in place. The non-PQS/PIS cold boxes, vaccine carriers, and ice/water packs shall be replaced, in addition to all those that are worn out.

Temperature monitoring devices

Temperature monitoring devices include thermometers, freeze indicators, temperature recorders, data loggers, and event loggers for monitoring temperatures at all levels in the cold chain. They also include alarm systems. Table 17a summarizes the recommended use of each type of temperature monitoring devices:[6]

[6] WHO/IVB/11.08 WHO PQS Devices Catalogue: E006 Temperature monitoring devices

Table 17a. WHO recommended use of different types of temperature monitoring devices

Device category	PQS spec	International shipping	Primary store	International store	Health facility	Internal distribution	Equipment commission	Cold chain studies	Note
Acoustic / visual	E 06/AL01		X	X					Used with E06/TH02 & E06/TR04
Cold Chain Monitor (CCM)	E 06/IN02	X							
Freeze indicator	E 06/IN03		X	X	X	X		X	
Vaccine vial monitor (VVM)	E 06/IN05	X	X	X	X	X		X	
Electronic Thermometer	E 06/TH01						X	X	
Fixed dial thermometer	E 06/TH02		X	X					Typically used as a back-up device
Stem thermometer	E 06/TH03		X	X	X				
integrated thermometer	E 06/TH06		X	X	X				Maybe supplied with fridge or freezer
Event logger systems	E 06/TR03		X	X					For Large well-managed stores, includes alarm system
Pen recorder	E 06/TR04		X	X					For smaller cold or freezer rooms where E06/TR03 inappropriate
Temperature data logger	E 06/TR05						X	X	
Electonic fridge logger	E 06/TR06			X	X				
Shipping indicator	E 06/TR07	X							

A total of 2,212 temperature monitoring devices were recorded in the inventory. The most commonly reported type of temperature monitoring equipment is arrow thermometers (898 or 40.6 percent), followed by 30-day electronic devices (643 or 29.1 percent), column thermometers (634 or 28.7 percent), and electronic thermometers (37 or 1.7 percent).

Table 17b. Distribution of temperature monitoring equipment by type

Types	Not working	Working	Unknown	Total	Percentage
30-day electronic device		643		643	29.1%
Arrow thermometer		898		898	40.6%
Column thermometer		634		634	28.7%
Electronic thermometer	1	12	24	37	1.7%
Grand Total	**1**	**2,187**	**24**	**2,212**	**100%**

It is recommended that 30-day electronic temperature recording (30DTR) devices be provided for each refrigerator. Since the devices' battery lasts for two to three years, a systematic supply

program and stock management of 30DTR devices is required to promptly replace devices that come to the end of their life. A safety stock policy for 30DTR devices (as for vaccines) may be required to prevent stockouts and interruption of continuous temperature monitoring.

Table 17c. Availability of temperature monitoring devices by type and location

Location	30 day electronic device	Arrow thermometer	Column thermometer	Electronic thermometer	Grand Total
Dushanbe	36	1	40	1	78
DRS	90	118	182	5	395
Rasht region	67	77	19	2	165
GBAO	75	39	65	3	182
Bokhtar region	144	220	106	3	473
Kulyab region	88	230	103	19	440
Sughd region	143	213	119	4	479
Grand Total	**643**	**898**	**634**	**37**	**2212**
Percentage	**29.1%**	**40.6%**	**28.7%**	**1.7%**	**100.0%**

Table 17d. Availability of temperature monitoring devices by type and health care facilities

Facility type	30 day electronic device	Arrow thermometer	Column thermometer	Electronic thermometer	Total temperature monitoring devices
National vaccine warehouse	9				9
Regional vaccine warehouses	18	23	4	2	47
District vaccine warehouses	110	51	25	5	191
City health centers	29	11	17		57
District health centers	5	13	11	1	30
Family medicine centers	2	10	2	2	16
State maternity hospitals or departments	23	59	40	3	125
Family medicine outpatient clinics	4	1	10		15
Rural health centers	108	325	231	9	673
Health houses	329	397	294	15	1,035
Health points	6	8			14
Total	**643**	**898**	**634**	**37**	**2,212**
Percentage	**29.1%**	**40.6%**	**28.7%**	**1.7%**	**100.0%**

Table 17f. Availability of temperature monitoring devices by number of refrigeration equipment units and temperature monitoring devices

Facility type	Number of refrigeration equipment units	Total temperature monitoring devices	Percentage
National vaccine warehouse	11	9	81.8%
Regional vaccine warehouses	66	47	71.2%
District vaccine warehouses	275	191	69.5%
City health centers	78	57	73.1%
District health centers	46	30	65.2%
Family medicine centers	16	16	100.0%
State maternity hospitals or departments	192	125	65.1%
Family medicine outpatient clinics	21	15	71.4%
Rural health centers	962	673	70.0%
Health houses	1,427	1,035	72.5%
Health points	21	14	66.7%
Total	**3,115**	**2,212**	**71.0%**

Transportation

Immunization programs require transportation means to distribute vaccines, supplies, and equipment; to carry out supervision and maintenance operations, and to provide outreach immunization services.

A total of 118 vehicles, including 8 refrigerated trucks, 3 non-refrigerated trucks, and 107 cars and mini-vans were reported to be engaged in vaccine transportation in the country. About 66 (63 percent) are small, 4x4, general purpose vehicles (mainly VAZ NIVA); 26 vehicles (24 percent) are common purpose, small passenger vehicles (mainly VAZ models); and 15 (13 percent) are Tangem minivan, Lada, Hyundai, and other models.

In most cases, the available transportation means are intended for use by all programs, not just for immunization services. About 62 percent of the time, transport means are used to transport vaccines; however, that percentage varies by facility from 1 to 100 percent.

Generators

WHO and UNICEF recommend that all primary vaccine warehouses should be fitted with a standby generator with automatic start-up, regardless of the reliability of the main power supply.[7]

In addition, installing standby generators may be considered in the following situations:[8]

- At large, intermediate vaccine warehouses, equipped with cold rooms.

[7] World Health Organization, WHO-UNICEF Effective Vaccine Store Management Initiative: Modules 1-4, WHO/IVB/04.16-20 (World Health Organization, 2005), https://apps.who.int/iris/handle/10665/68993.
[8] WHO/IVB/11.08 WHO PQS Devices Catalogue: E001.2 Standby generators

- At other subnational warehouses where the main power supply is sufficiently unreliable to compromise the performance of ILRs, even when they are fitted with voltage regulators.

In all other situations, if power cuts are a chronic problem, alternative solutions shall be reviewed, such as ILRs fitted with voltage regulators, photovoltaic equipment, or equipment that runs on kerosene or bottled gas. The decision to purchase a standby generator should be carefully considered since a generator involves an investment of several thousand dollars, together with significant maintenance and training costs.

A total of 125 autonomous power generators were documented (refer to Table 18). Most of the power generators were more than 10 years old (put into service in 2009-2013). Out of the total, 109 (87.2 percent) units were reported as working well, while 9 (7.2 percent) were not working, and 3 (2.4 percent) needed maintenance. The working status of the rest is unknown.

Table 18. Distribution of generators by facilities and working status

Facility type	Not working	Working	Working but needs maintenance	Unknown	Grand Total
National vaccine warehouse		**1**			**1**
Regional vaccine warehouses	3	8			11
District vaccine warehouses	5	28	1	4	38
City health centers		9			9
District health centers		1			1
Family medicine centers					0
State maternity hospitals or departments		9			9
Family medicine outpatient clinics					0
Rural health centers	1	35	1	1	37
Health houses		18	1	1	19
Health points					0
Grand Total	**9**	**109**	**3**	**6**	**125**
Percentage	**7.2%**	**87.2%**	**2.4%**	**4.8%**	**100.0%**

Backup power generators represent an expensive source of energy in the long run. Procurement and allocation of power generators to support vaccine storage equipment will be based on the following approach:

- Provide backup power generators for facilities equipped with vaccine cold rooms; namely, the national vaccine warehouse, regional vaccine warehouses, and a few eligible district vaccine warehouses. The power of supplied generators should be chosen based on analysis of power needs in each facility.
- All of the district-level vaccine warehouses reported power supply for more than 8 hours a day and will be equipped with ILRs. Therefore, they do not need power generators.
- Health facilities providing immunization services do not require backup generators for vaccine storage either: facilities with grid power supply more than 8 hours a day would

benefit from installing ILRs; those facilities that have access to grid power supply less than 8 hours a day will be equipped with solar direct drive refrigerators.

Voltage regulators and back-ups

Fluctuations in the electricity supply can cause the premature failure of motors, compressors, and other electrical and electronic components. Wherever voltage fluctuations exceed ±7 percent of the rated voltage at the supply point, WHO recommends that refrigeration equipment be connected to the main supply via a voltage regulator.[9] This applies to cold rooms, freezer rooms, vaccine refrigerators, and vaccine and ice pack freezers at any level in the cold chain. Associated electronic temperature monitoring equipment and computers should also be connected to a voltage-regulated circuit; these types of equipment are particularly sensitive to voltage fluctuations and to lightning-induced power surges.

The most common model is Andeli SVR (1000VA) – 402 units (28.4 percent); Heise HVC-1000 – 398 units (28.1 percent), Sollatek SVS 0422 (1500VA) – 300 units (21.2 percent). It is followed by Goldsource SVC (1000VA) - 102 units (7.2 percent), Jonchn AVR (1000VA) - 75 units (5.3 percent) and other less prevalent models.

Table 19a. Distribution of voltage regulators by model and working status

Model	Not working	Working	Working but needs maintenance	No status recorded	Grand Total
AST4000		1			1
AST5000		1			1
AVR - 1000W	11	62	0	2	75
AVR-1500W		2			2
AVR-500w		1			1
bb 111	1				1
BB-211		4			4
BLUEBIRD		6			6
DT2000VA		1			1
DT-2000VA		1			1
GBW 22		1			1
Goldsource		1			1
HBC - 1000		27		6	33
HBS -1000		2			2
HSW-1000		1			1
Huebird		1			1
HVC-1000	4	363	2	29	398
MERKURY		1			1
SDR-1000 VA		1			1
SGR-1500VN		1			1
Sollatek	2				2

[9] WHO/IVB/11.08 WHO PQS Devices Catalogue: E001.3 Voltage regulators for larger vaccine stores

Model	Not working	Working	Working but needs maintenance	No status recorded	Grand Total
SVC-1000	9	92		1	102
SVR	2				2
SVR - 500VA		4			4
SVR-1000VA	41	346		15	402
SVS-1500VA		8			8
SVS	35	240		17	292
SVS - 3000VA		1			1
SVS-1000	5	56		2	63
SVS-12	2				2
SVS-2000VA		1			1
SVC-1000VA		1			1
TCO	2				2
TCO-1KS		1			1
TH2500 DC TIGER		1			1
TOTAL	**114**	**1,229**	**2**	**72**	**1,417**
Percentage	**8.0%**	**86.7%**	**0.1%**	**5.1%**	**100.0%**

The assessment recorded 1,417 voltage regulators; 114 (8 percent) of them were not working (see Table 19b).

Table 19b. Distribution of voltage regulators by the health care facility and working status

Type of facility	Not working	Working	Working but needs maintenance	Unknown	Grand Total
National vaccine warehouse	3	8			11
Regional vaccine warehouses	5	35			40
District vaccine warehouses	48	187		13	248
City health centers	9	37		1	47
District health centers	5	22			27
Family medicine centers	1	8			9
State maternity hospitals or departments	3	41	1		45
Family medicine outpatient clinics	1	12			13
Rural health centers	22	302		15	339
Health houses	17	571	1	43	632
Health points		6			6
Grand Total	**114**	**1,229**	**2**	**72**	**1,417**
Percentage	**8.0%**	**86.7%**	**0.1%**	**5.1%**	**100.0%**

Considering the documented 1,417 voltage regulators and 3,115 refrigerators and freezers in the immunization supply chain in Tajikistan, the existing voltage regulation equipment is enough to protect only half of vaccine refrigerators and freezers from power outages.

The percentage of non-working voltage regulators is high in Tajikistan, which may be an indicator of the reliability of the power supply and of the need to safeguard CCE from potential power variations. Voltage regulators should be made available (bundled) for all newly procured refrigerators and freezers in Tajikistan.

4. Cold Chain Rehabilitation and Maintenance Plan

Strengthening National, Regional, and District Vaccine Storage

At the national vaccine warehouse, vaccines are kept in five cold rooms with 30.7 m3 gross storage volume each: two installed in 2008; two in 2013, and one installed in 2016. All cold rooms were procured through UNICEF SD. In the period 2018-2022, with GAVI HSS and GAVI CCEOP funding, about seven cold rooms and 1,129 refrigerators were procured and delivered to Tajikistan through UNICEF SD.

Key areas of action:

The identified gaps will require the following actions to be addressed:

- Increase the cold chain storage capacity to store a minimum of 2 months' stock.
- Remove all domestic refrigerators and replace them with ILRs.
- Replace all ILRs and freezers older than 10 years of age (i.e., manufactured before 2008) by 2025.
- Provide WHO prequalified ILRs and freezers equipped with voltage regulators.
- Consider procuring standby generators for the few areas equipped with vaccine cold rooms. In addition, make voltage regulators available for all newly procured ILRs and freezers in Tajikistan.
- Electronically monitor the storage temperature (using 30DTRs).
- Implement freeze indicators (freeze tags) to monitor exposure to freezing during transportation of vaccines from district warehouses to immunization delivery sites.

Equipment allocation:

a) 4 on-grid ILRs (up to 130 L) to equip district vaccine warehouses – all have power supply >8 hours (to expand storage capacity and replace obsolete and inadequate equipment)

b) 5 on-grid freezers (up to 200 L) to equip district vaccine warehouses and replace obsolete equipment

c) 450 units of 30DTR devices (for new and existing equipment) to establish continuous temperature monitoring and replenish the device stock every 3 years;

d) 650 units of FreezeTag freeze indicators to monitor exposure of vaccines to sub-zero temperatures during vaccine distribution

e) 450 column thermometers to be used as backup temperature monitoring devices

f) 38 power generators (20 kW) to equip district warehouses (considering the short cold life of cold rooms);

Strengthening the Immunization Service Provider Level

Based on the results of the CCE inventory, 1,481 equipment units are domestic refrigerators. All refrigerators that do not comply with WHO PQS recommendations (i.e., all domestic refrigerators) need to be replaced. All WHO PQS ILRs with more than 10 years in service and obsolete equipment (573 units) are recommended for replacement.

Wherever voltage fluctuations exceed ±7 percent of the rated voltage at the supply point, WHO recommends that refrigeration equipment should be connected to the main supply via a voltage regulator. This applies to cold rooms, freezer rooms, vaccine refrigerators, and vaccine and ice pack freezers at any level in the cold chain.

Equipment allocation criteria:

a) 2,467 on-grid ILRs up to 60 L (VLS200A or similar) for facilities with power supply > 8 hours a day, of which:

- 413 units – newly equipped PHC facilities that have power supply >8 hours a day;
- 1,481 units – to replace domestic refrigerators in PHC facilities that have power supply 8-16 hours a day;
- 573 units to replacing obsolete ILRs more than 10 years old

b) 90 on-grid ILRs up to 100 L (Vestfrost VLS300A or similar) for facilities with a birth cohort > 800 children under one, which have power supply more than > 16 hours a day (to expand the capacity and replace inadequate equipment)

c) 2,467 voltage regulators to be provided bundled with new CCE

d) 2,800 units 30DTR devices, of them 1,315 units provided bundled with newly procured equipment and 1,485 units procured additionally to establish continuous temperature monitoring and replenish the device stock

e) 3,041 Freeze indicators for monitoring vaccine transport (1 per facility)

f) 1,500 Backup thermometers (column, stem, dial, or electronic) – plus 2,467 to be supplied with new refrigerators (either integrated or standalone)

g) 2,000 Vaccine carriers, 1.7 L (to provide the second carrier for facilities having one vaccine carrier only)

h) 1,000 Cold boxes, 7 L (to address expanding vaccine volume needs in medium and large (65) facilities with vaccine volume >10 L

i) 65 cold boxes, 20 L (to address expanding vaccine volume needs in large (65) facilities with vaccine volume >36 L

Equipment selection criteria:

Equipment selection was based on the following principles and considerations:

- WHO prequalification and/or compliance with CCEOP technology guide
- Fit to the grid power supply (i.e., SDDs for facilities with access to power supply <8 hours, ILRs for others)

- Fit to the required storage capacity
- Holdover time >48 hours
- Energy consumption < 0.6 kW/24h
- Equipment unit cost
- Previous positive experience with same equipment brand or model
- Standardizing/limiting the number of brands and models to facilitate use and maintenance