



DHIS2 Tracker Rapid Troubleshooting Toolkit

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Abbreviations

BPMN	Business Process Model and Notation
COVID-19	coronavirus disease 2019
CPU	central processing unit
DHIS2	District Health Information System 2
Global VAX	Global COVID-19 Vaccine Access
HISP	Health Information Systems Program
ICT	information and communications technology
MOH	ministry of health
TEI	tracker entity instance
USAID	United States Agency for International Development

DHIS2 Tracker Rapid Troubleshooting Toolkit

During the COVID-19 pandemic, many countries experienced data backlogs in their emergency response efforts. A root cause analysis found that server configuration and performance were limiting factors for some programs' ability to effectively capture and report COVID-19 data. As a result, this toolkit has been developed to help organizations quickly assess their DHIS2 Tracker configurations and identify potential problems.

The toolkit includes the following resources:

- A [list of common challenges](#) found during COVID-19 response use of Tracker, along with recommended solutions.
- A [facility-level troubleshooting flowchart](#) to help assess the cause of issues.
- A [checklist for Tracker performance at scale](#).

For a more comprehensive approach to understanding challenges with DHIS2 Tracker, we also offer a troubleshooting guide that includes personas, business process maps, and the toolkit tools. This guide can help administrators and technical teams understand the challenges of using Tracker in a variety of settings.

How to Use This Toolkit

This toolkit is designed to be quickly deployed to identify problem areas and recommended solutions. To get started, follow these steps:

1. Review the list of common challenges to see if any of them apply to your organization.
2. Use the facility-level flowchart to assess the cause of the issues you are experiencing.
3. Review the Tracker Performance at Scale checklist to identify any potential performance problems to correct.
4. If you need more help, refer to the more comprehensive Troubleshooting Guide for Common DHIS2 Tracker Issues.¹

¹ USAID/PATH (2023). Troubleshooting Guide for Common DHIS2 Tracker Issues.

List of common challenges

Through multiple interviews and observations (n=136) with management teams and facilities in Kenya, Tanzania, and Senegal, we diagnosed various problems for the data backlogs caused by DHIS2 and Tracker. Eleven common challenges were identified through structured interviews and ordered by the level of severity and prevalence, shown in Table 1. High-level recommendations are listed with further references for resolution. The first two challenges may be resolved at the facility level while others may require system administrator intervention.

Table 1. Common challenges summary

#	Description	Severity	Prevalence	Possible Resolution
1	Slow application <i>[validated by testing the overall network speed]</i>	High	High	Check for network issue. Close other running applications on the client. Restart client. Determine if server is having issues. Free up storage space for the client.
2	Freezing of application <i>[documented by client issue report]</i>	High	Medium	Check if network is still available. Close other running applications on the client. Restart client. Determine whether server is having issues. Free up storage space for the client.
3	Server issues: high CPU/load, low memory, disk I/O, disk space, network <i>[documented through server-monitoring software]</i>	High	High	Use multiple servers with load balancing, if possible, and increase resources allocated to the application instance. Check computer or web application firewall for dropped connections or system issues. Review DHIS2 recommendations .
4	Latency or other network issues between hosted instance and client <i>[validated by ping, tracert, or network-testing application]</i>	High	Medium	Check with cloud provider for options. Attempt alternative connection method if available (e.g., alternate mobile operator, use of Wi-Fi). [See challenge 7 re: concurrent usage]
5	Database misconfiguration <i>[documented through query monitoring]</i>	High	Low	Check server and table configuration to make sure the database is optimized for required performance. Ensure caching is enabled in the DHIS2 configuration so that repeated requests for the same analytics resources are served from the cache and database queries are skipped. If the database is on the same server as the application, split to a separate server.
6	Incorrect landing page configuration <i>[documented by long application load times]</i>	High	Low	Minimize use of program indicators in dashboards. Limit access to dashboards that use program indicators as the landing page upon logging into DHIS2.

#	Description	Severity	Prevalence	Possible Resolution
7	Inability of server to handle concurrent usage during certain times of day <i>[documented by client issue report]</i>	Medium	High	See if data entry can be spread throughout the day instead of clustered.
8	Transaction and reporting on same server	Medium	High	Split reporting to a separate server.
9	Lack of option for off-line data entry	Medium	Medium	Add this as an option if network issues are insurmountable. Off-line data entry requires additional storage on the client device and may lead to a greater incidence of challenges 2 and 4.
10	Aggregate and Tracker data on same server	Medium	Low	Split applications to separate servers.
11	Lack of synchronization between Tracker and aggregate data	Low	Low	Run this process during low-usage times.

Abbreviations: CPU, central processing unit; DHIS2, District Health Information System 2.

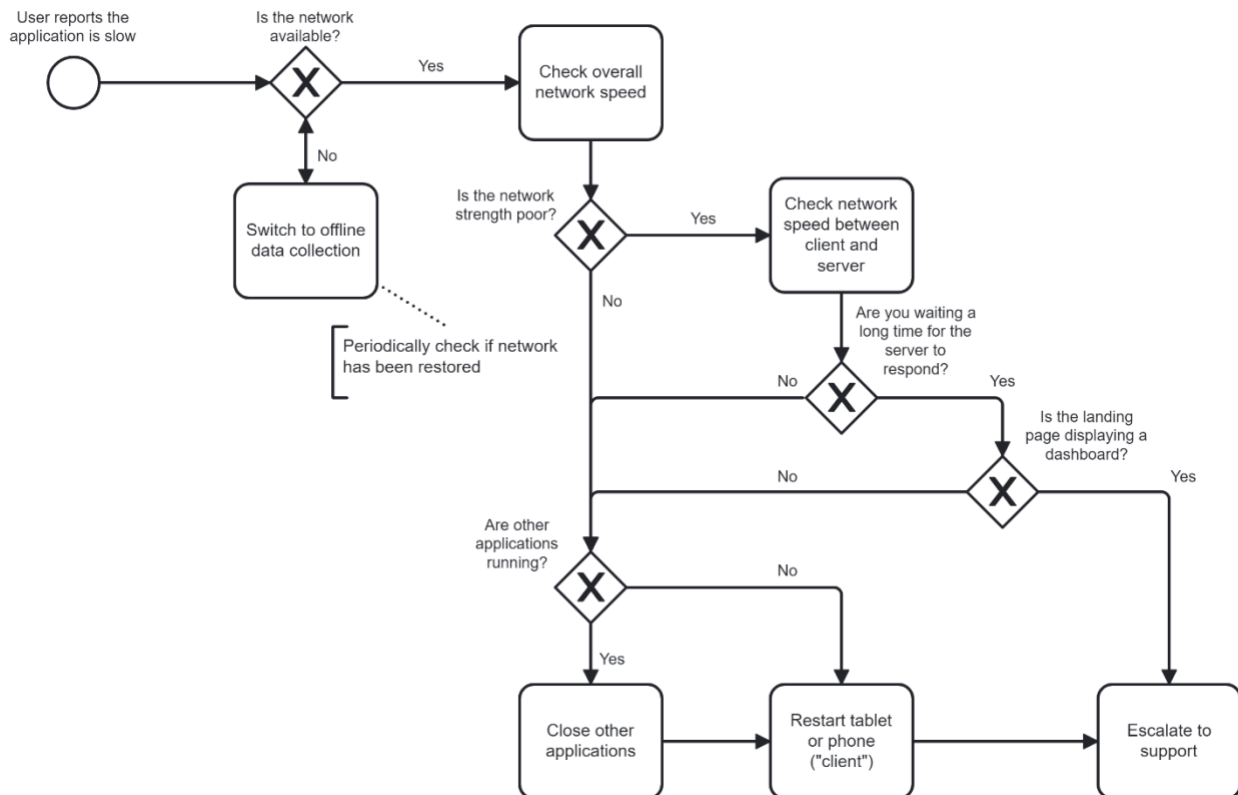
Note: "Client" refers to a tablet or phone.

Facility troubleshooting flowchart

Facility flowchart preconditions are as follows: To support troubleshooting on issues reported by facilities, it is necessary to validate that the DHIS2 Tracker hosting environment is configured for performance at scale, as well as see that server monitoring software is running to further investigate issues corresponding with the same date and time. Ideally, the individuals on-site at the facility have the hosting support team's contact phone number to explore server-side conditions when they need to "escalate to support."

Figure 1 provides a flowchart/decision tree of steps a user can use to identify local application and network challenges.

Figure 1. Troubleshooting flowchart for facilities



Tracker performance at scale checklists

The following checklists and flowchart have been adapted from DHIS2 documentation and from interviews with system administrators creating high-availability environments.

The checklist is intended for use by system administrators supporting MOHs with their national plans for COVID-19 vaccine delivery or other high-volume activities, and the previous flowchart (Figure 1), by subnational Information and Communication Technology and Health Information Officers supporting issues reported by facilities.

Figure 2 through Figure 4 provide guidance associated with server technical specifications, supported software application versions, and recommended configuration of the DHIS2 Tracker application.

Key	Within recommended system specifications
	Software version may not yet be fully supported or is below speed recommendations for peak performance
	Below system recommendations

Figure 2. Server sizing (for Global VAX, at least the following)

CPU cores	<input type="checkbox"/> Less than 32	<input type="checkbox"/> 32 or greater	
Memory/RAM	<input type="checkbox"/> Less than 32 GB	<input type="checkbox"/> 32 GB or greater	
SSD/fast disk read speed	<input type="checkbox"/> Less than 150 MB/s	<input type="checkbox"/> Between 200 to 300 MB/s	<input type="checkbox"/> Greater than 350 MB/s
Fast/stable Internet and connectivity Latency/Round trip time (RTT)	<input type="checkbox"/> RTT greater than 200ms	<input type="checkbox"/> RTT between 20 and 200ms	<input type="checkbox"/> RTT less than 20ms
Packet loss	<input type="checkbox"/> Greater than 5% packet loss	<input type="checkbox"/> Between 1% and 5% packet loss	<input type="checkbox"/> 0% packet loss
Jitter	<input type="checkbox"/> Request Timed Out, Transmit Failed, or Destination Host Unreachable	<input type="checkbox"/> No network errors received	
Is the server in a shared environment?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If in shared environment, verify does the server have the specified resources needed?	<input type="checkbox"/> No	<input type="checkbox"/> Yes	
Dedicated server for database/PostgreSQL?	<input type="checkbox"/> No	<input type="checkbox"/> Yes	

Abbreviations: Global VAX, Global COVID-19 Vaccine Access; CPU, central processing unit.

Key	Within recommended system specifications
	Software version may not yet be fully supported or is below speed recommendations for peak performance
	Below system recommendations

Figure 3. Software (appropriate software versions are used)

Java Development Kit	<input type="checkbox"/> 10 or lower	<input type="checkbox"/> 11*	<input type="checkbox"/> 12 or higher
PostgreSQL	<input type="checkbox"/> 11 or lower	<input type="checkbox"/> 12 or 13*	<input type="checkbox"/> 14 or higher
DHIS2 version	<input type="checkbox"/> 2.34 or lower	<input type="checkbox"/> 2.35 or later*	
Latest patch installed†	<input type="checkbox"/> No	<input type="checkbox"/> Yes	
Server monitoring is set up	<input type="checkbox"/> No	<input type="checkbox"/> Yes	
Sever monitoring software	<input type="checkbox"/> No	Yes: <input type="checkbox"/> Glowroot <input type="checkbox"/> Munin <input type="checkbox"/> Other (enter name):	

* Denotes recommended versions as of April 7, 2023. Several performance improvements were made in the DHIS2 2.35 release.

† See DHIS2 Downloads page for latest patch.

Abbreviation: DHIS2, District Health Information System 2.

Figure 4. Configuration

Program indicators appearing on dashboards?	<input type="checkbox"/> No	<input type="checkbox"/> Yes*
Dashboards used as “landing page”?	<input type="checkbox"/> No	<input type="checkbox"/> Yes†
Access to dashboards used for program indicators limited?	<input type="checkbox"/> No	<input type="checkbox"/> Yes‡
Analytics cache enabled?	<input type="checkbox"/> No	<input type="checkbox"/> Yes
Continuous analytics used?	<input type="checkbox"/> No	<input type="checkbox"/> Yes
“Display front page list” check in the program details disabled?	<input type="checkbox"/> No	<input type="checkbox"/> Yes
Database indexes for frequently searched TEI attributes applied?	<input type="checkbox"/> No	<input type="checkbox"/> Yes
System-generated attributes use random pattern?	<input type="checkbox"/> No	<input type="checkbox"/> Yes

* As an alternative, establish serving tracker analytics through the aggregate data model. See strategies described in [Tracker performance at scale](#) on DHIS2 Documentation website.

† As an alternative, set up a text-only / information-landing dashboard that excludes tracker analytics.

‡ Limited dashboards based on program indicators only for those users or user groups who need them for analytical purposes (e.g., not for general data entry users).

Abbreviation: TEI, tracker entity instance.

Note: Checklists adapted from: DHIS2 Documentation website. [Tracker performance at scale](#) page. Accessed January 19, 2023.

General recommendations

Bob Jolliffe from the DHIS2 Integration team has stated that “the most important requirement is human.” With the DHIS2 Tracker implementations at the scale necessary for full-population vaccination, a country needs a large cadre of users performing the data entry, a team of individuals providing and maintaining the mobile devices and data plans, a strong relationship with the ministry overseeing the programmatic use to identify the data bottlenecks, and skilled hosting providers ensuring a high-availability environment.

The pandemic brought volumes of data much higher than previously experienced which led to constrained systems and data backlogs as a result. This guide and the tools included are designed to provide system administrators processes and advice to address these challenges and prepare against future burdens. Four key recommendations to address and avoid performance issues with DHIS2 tracker are below:

- 1. Consult with DHIS2 teams and HISP network on sizing hosting environment.**
Begin by consulting with the DHIS2 teams and HISP network and size the infrastructure according to current best practices for the population and vaccination events expected. However, countries should be prepared to monitor the server environment and adjust accordingly.
- 2. Consider procuring dedicated hosting resources vs. a shared environment.**
For high-performance applications, purchasing dedicated resources vs. shared ones may be better. If working with a local data center, validate the service-level agreements and provide evidence to the provider regarding resource allocation. Over-provisioning and throttling are common. If you do not have good monitoring in place, you will not be able to make the argument that changes are needed.
- 3. Document support processes with contact information and plan for hardware and network outages**
Mapping the process flows and associated roles is key to troubleshooting when the system is down or underperforming, as well as knowing whom to call to repair/fix the problem.
- 4. Provision facilities with data entry resources (human, hardware, and network) to prevent data backlog.**
The burden of data entry may be overwhelming when the number of cases reaches a certain threshold at a facility. The tendency to capture data on paper and then later transfer them to Tracker creates a time-consuming and burdensome process as well as reducing data quality and accuracy because of an inability to verify. The best case on how to handle a surge of data entry is to provision the server and the facilities with the resources needed to prevent a data backlog in the first place.

There are significantly fewer routine immunization sites with adequate equipment and connectivity—and if the information reported by users is any lesson, the burden of data entry is significant, and these same facilities often do not have the luxury of a data entry clerk.

As the world begins to look beyond the COVID-19 pandemic and determine how the lessons can be applied for other vaccinations and challenges, ministries will need to continue to take into account the needs of the users, data size, and data use demands. While this toolkit was designed in response to COVID-19 emergency response needs, the framework and tools can be applied to routine immunization as well as preparation against the next medical emergency.