DHIS 2 Tracker Implementation Guide

Applicable to master version

DHIS 2 Documentation team
August 2020
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August 2020

**Revision History**

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<td>master@f0cd089</td>
<td>2020-08-31 18:54:32 +0200</td>
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1 Target audience

The target audience for this guide are those who are wondering if DHIS2 Tracker is the right fit for their needs, and for those working with planning, budgeting, or managing a Tracker implementation. This includes prospective system owners, project managers, decision makers, and donors, as well as those responsible for configuration, training and support. The guidance in this document was derived from a number of existing use cases, which are referenced throughout. It should be referred to in conjunction with the rest of the documentation found at docs.dhis2.org.

Recommended changes and improvements to this guide can be made by following the process described in the DHIS2 github.
## 2 Introduction

Tracker is the app within the DHIS2 platform that enables the capture and use of individual, longitudinal data. The functionality of Tracker covers a wide spectrum of needs, from monitoring the quality and availability of water wells, to collecting student attendance in a classroom, to capturing patient data in a shared health record. For the purposes of this guide, many of the examples will come from health systems, although Tracker is widely used also for education systems, environmental systems, logistics, and more.

Many countries and programs are making use of increased network availability and the widespread presence of mobile devices and other hardware to push information systems closer to the level where primary data are generated. Individual-level data adds granularity and nuance to information systems, providing opportunities for ad hoc analysis, shifting indicators over time, and improving data quality. Beyond its usefulness for reporting and analysis, individual-level data can also be used to eliminate reporting redundancies, empower lower level staff with better decision-making tools, and place the client at the center of the information system. In short, individual-level data is the smallest data unit, and as such can be repurposed in many ways to satisfy the various competing needs in national information systems.

The purpose of this guide is to help determine if Tracker is the right fit for a potential use case, and provide practical guidance to help plan for successful implementations. The use of Tracker at a large scale introduces additional factors that should be planned for beyond what may already be in place for an existing aggregate DHIS2 instance. The opportunities and potential benefits from information systems increase as a system goes from aggregate data → tracked anonymous data → data from identifiable individuals → real-time patient data at the point of care. Those planning for a Tracker implementation should recognize that the challenges increase along with the benefits.

This implementation guide will provide recommendations to help you:

- determine if Tracker will address your needs
- evaluate the readiness of your setting for the introduction of individual-level data collection
- understand how implementing Tracker differs from DHIS2 aggregate
- appreciate the concerns specific to individual-level data systems, including privacy and security
- review lessons learned and best practices derived from real-world use cases
- plan for the introduction of your Tracker program(s) at the desired scale
- set in place the infrastructure that will maintain a Tracker program over time

The guide is broken into two basic sections:

- **Is My Project Ready For Tracker?** describes five important contextual factors that should be well understood for your setting before proceeding with planning a Tracker implementation
  - Institutional buy-in and support
  - Funding
  - Legislation and policies
  - Capacity and competence
  - Infrastructure

- **Building your Tracker Program(s)** provides specific guidance and recommendations for nine different aspects of a Tracker implementation
  - Determining scale
2 Introduction

2.1 What can Tracker be used for?

As with the rest of the DHIS2 platform, Tracker has a generic data model that allows it to be configured by the user for many different purposes. At its most basic, Tracker allows the user to define a particular kind of thing (person, commodity, lab sample, catchment area, etc.) that they want to follow over time (a tracked entity), define the data that they want to collect about this entity (data elements), place the data elements in a specific order and with any accompanying conditions or logic (program, program rules), and determine the analytics that should be produced (program indicators, event reports, data visualizations, etc.)

An example of a simple Tracker program could be a program for collecting malaria case information at the point of care. The tracked entity would be a person, defined by attributes such as first name, last name, date of birth, or village. The program would contain data elements such as symptoms, test used and result, treatment provided, etc. These data elements might have pre-configured options for possible responses, such as possible tests available, or logic helping to ensure data quality, such as possible minimum and maximum values for a given data element.

The data collected would be visible to the clinical user as a part of the malaria patient's shared health record, but could also be used to generate monthly reports required by the national malaria control program, provide decision support to the clinician, generate SMS reminders to the patient to promote adherence to treatment, or populate a clinic-facing dashboard containing key performance indicators. For all these purposes, the data were collected only once – during the patient visit – but were reused many times for different needs.

DHIS2 also supports the collection of individual data without longitudinal tracking, using the Capture and Event apps. Non-longitudinal tracking will be referred to throughout this documentation as well, and follows most of the same data model as tracker, with the exception of defining a tracked entity, which is not a required part of non-longitudinal tracking. An example of such an event program could be the reporting of the same malaria data from individuals as in the previous (tracked entity) program, but without linking these data to a specific patient. As such, the data would not become a part of a shared health record (or perhaps not used to generate SMS message reminders to the patient, or other features that rely on tracking an entity over time) but the various other uses of the data could still be utilized.

As can be seen from the examples above, Tracker and the collection of individual data are quite different from traditional aggregate reporting for Health Management Information Systems (HMIS). Only one of the potential uses described above are satisfied by aggregate data collection – that of monthly reporting – whereas the patient-, clinician-, and facility-facing uses only become possible through the collection of individual data.

Even with regards to routine reporting, the collection of individual data introduces opportunities for improved data interpretation and analysis, and – crucially – for action to be taken. For example, an aggregate report might show that overall immunization coverage is 80%, but lacks detail as to whether the remaining 20% reflects errors in reporting, unintentional exclusion of certain individuals (geographic or groups), or other factors. The aggregate numbers also do not allow for the specific identification of non-vaccinated children that could be followed up with...
through a targeted outreach program. The aggregate numbers in this example address a basic need of ministries of health to report national progress on a global indicator, but not the needs of immunization program managers or providers to take specific actions to improve coverage.

One inherent benefit to using Tracker as your individual level system is its alignment with the existing aggregate DHIS2 system, which is already used in most lower- and middle-income countries for their HMIS. Unlike a standalone Electronic Medical Record (EMR) or other application, Tracker encourages the collection of structured data that can natively aggregate upwards and be fed into the national HMIS, thus replacing secondary data entry and aggregation with primary source data.

As a core component of the DHIS2 platform, Tracker is updated twice annually along with the rest of the DHIS2 software. The driving inputs for improvements to Tracker come from real-country implementations, and are aligned with global recommendations, notably the WHO Guidelines on Digital Interventions for Health Systems Strengthening. Of the ten recommended interventions, Tracker has specific functionality to support the following:

- Birth notification
- Death notification
- Stock notification and commodity management
- Targeted client communication
- Health worker decision support
- Digital tracking of client’s health status and services combined with decision support
- Digital tracking combined with decision support and targeted client communication
- Digital provision of training and educational content for health workers

Taking full advantage of such features requires that the data collected are systematic and uniform. In health care, primary and public health services that are strongly driven by fixed guidelines and workflows are particularly suited for Tracker programs. For example in Antenatal Care (ANC), most countries have guidelines with algorithms for screening and patient management in response to test findings that can be incorporated in Tracker to follow a routine clinical workflow, supporting both the care provider and the reporting needs. In more complex areas of health care, with less documented and well-defined decision algorithms (such as in a referral hospital, for example) Tracker may be best used for simple data collection, allowing the clinician to determine the best use of the data for patient triage, and allowing the standardized data elements to be used for additional reporting or other purposes.

### 2.2 Example Tracker Use Cases

Throughout this guide, we will refer to example use cases to give real-world examples of planning principles, decision points, software and data utilization, common hurdles and issues, and lessons learned at different stages of the Tracker planning and implementation process. A short introductory summary of these individual use cases is provided here. Greater detail for some of the use cases can be found on www.dhis2.org.

#### 2.2.1 Pre-configured Tracker Packages

Under the WHO's Analysis and use of Health Facility Data toolkit, pre-configured Tracker programs have been created to cover a series of health topics. These packages are intended as the starting point for country programs, allowing for further configuration to match local context, while retaining global standards for indicators and practice. They can be added to existing DHIS2 systems, either together or individually. These packages can be accessed at the link above, as well as at who.dhis2.org. The current pre-configured packages cover the following topics:

- Adverse Events for Immunization
- Birth, Stillbirth and Death Notification for CRVS
- Cause of Death (including ICD-10 codes from the start-up mortality list)
2 Introduction

2.2.2 Botswana: Nutrition and Immunization Program

Botswana has created a combined nutrition and immunization program providing key services to young children receiving nutrition assistance, while ensuring that the children are hitting their growth indicators and receiving the full set of vaccines. Working with the Botswana team, the Tracker platform was enhanced to produce standardized z-scores providing quick assessment of weight-for-height, weight-for-age, and height-for-age.

2.2.3 Ghana: HIV/ART and other eTracker modules

Since 2012, Ghana Health Services has led a pioneering program in reporting patient-level data through DHIS2 Tracker programs (“eTrackers”). As of 2019, they were using 8 different eTracker modules. A prime example is their HIV/ART eTracker, which tracks individual patients through testing and treatment and makes it easier for health personnel to identify and follow up with defaulters, while also supporting the reporting flow for aggregate HIV data, which has been ongoing in Ghana since 2006.

2.2.4 Palestine: Maternal and Child Health eRegistry

Every woman in Palestine is assigned a primary health care clinic, and if that clinic does not provide the services she needs, she is asked to visit a higher-level clinic. This referral system requires an eRegistry that controls access to clinical patient files, supports the continuity of care across different healthcare sites, allows for data entry from several different points, and provides analytics to help drive decisions under Palestine's antenatal care guidelines. Our collaboration with Palestine started in 2014. The development and implementation of the maternal and child health (MCH) eRegistry included an iterative approach and dynamic dialogue between the developers, policymakers, public health officials and health care providers. This implementation features extensive use of automated SMS messages to communicate with patients, as well as quality improvement dashboards to measure performance of clinics and support the delivery of quality care.

2.2.5 Zimbabwe: National Malaria Control Program

The DHIS2 Android Tracker implementation in Zimbabwe started in 2014 as a collaborative project between the National Malaria Control Program (NMCP) and the University of Oslo, and has since been scaled to cover nearly half of the country's 60+ districts. This implementation features offline data collection, detailed location data, and near real-time data collection and analysis, and is an example of working with multiple stakeholders at a global level to develop a program with potential for expansion across geographic regions and disease areas.
3 Is My Project Ready For Tracker?

3.1 Readiness questions and key considerations

This section is intended to describe some of the key landscape conditions that should be well understood before proceeding with a Tracker implementation. Due to the fact that many of the countries where Tracker is being introduced are already using DHIS2 for the national HMIS or other aggregate purposes, it is important to highlight some of the key differences between DHIS2 Tracker and Aggregate systems, in order to plan appropriately for the changes that may need to be made around implementation and administration.

Tracker programs often expand the reach of the information system, extending it to users that were not previously using an electronic information system of any kind. Inherently, individual data requires additional considerations around data privacy and security. These two factors mean that Tracker implementations typically require:

- larger scale training efforts among cadres of workers that might also have high turnover rates;
- increased emphasis on user acceptance and mapping to existing work practices;
- additional hardware for data capture, including the management of that hardware over time;
- reliable network coverage and/or strategies to address intermittent connectivity;
- increased awareness of, and capacity for, privacy and security;
- greater capacity for IT support that can solve solve problems for a much larger user basis; distributed across a larger geography.

These and other recommendations will be discussed in greater detail in the sections below. The following series of questions can be helpful when initially assessing readiness for a new Tracker implementation. In particular, if your use case involves the collection of personally identifiable data (health-related or otherwise) you should review and reflect on the following questions before you begin.

- Is there political and institutional will to undertake implementation of point-of-service individual-level large-scale data collection?
- Is it feasible to provide a system for actual point-of-care data collection, without creating additional documentation burden for the care providers?
- What is the added value and meaningful use of patient-level data in this context? What are the specific questions that only this data can answer?
- How will the data be used to make substantive decisions, by care providers, managers, and policymakers?
- Are there laws, regulations in place for the collection, storage and use of individual-level and personally identifiable data? Alternatively, are there mechanisms for ensuring that such laws will be in place in the near future?
- Is there sufficient and sustained funding, resources and human capacity for design, implementation (computer and internet), training, maintenance, data management and monitoring of the system?
- Is there a way to uniquely identify clients in the health system setting?
- How are identifiable patient records currently collected and distributed on paper?
3 Is My Project Ready For Tracker?

Are there clinical guidelines/clinical interventions or at least some form of guidance for clinical practice? Are there a list of reporting items in the HMIS and their detailed definitions?

- How are facility-level and patient-level data currently collected, managed, and shared within the health system?

References:

1. mERA checklist: https://www.bmj.com/content/352/bmj.i1174
2. Principles of Digital Development

3.2 General considerations

3.2.1 Institutional buy-in and support

Ensure there is institutional buy-in and support from the outset of your project to create long term commitment. A tracker project ties closely work practice and data management and will take time, attention and resources. It will alter work practices at the ground level for the positive if done well and negatively if done poorly. Hence it is crucial that the project has solid support from key stakeholders such as program managers, IT units, heads of department, etc. From the outset, a diverse working group of the key stakeholders and users should be involved with designing the objectives and scope of the system, and this working group will be empowered to make decisions such as replacing some levels of paper reporting, or adapting supervision processes to respond to new key performance indicators made possible by the capture and analysis of individual level data.

Identify the division/department within the health organization of interest (such as Ministry of Health, public health institute, etc) with sustainable growth potential for housing a long-term core administrative development team. Engage relevant departments that should be involved, such as those working with data collection and management and IT, as well as health policy makers and implementers who can provide input on the workflows of health workers. Obtain agreement that the working group is not meant to dissolve at the end of scale-up, but rather should transform to the long term administrators and system managers.

Before committing to a large scale Tracker project, consider the funding landscape for the large and long term investments required for sustainability, particularly with device procurement, ongoing network costs, and training, both at the outset of the project, and routine training over time for new users. Are the goals and resource allocations from the funding mechanisms aligned with the group responsible for implementing tracker? Will the introduction of Tracker replace costs in other areas, such as printing reporting forms, that can be reprogrammed once the system is adopted and running well?

Consider how tracker could affect and potentially bring improvements to all levels, not just the end users. For example, a Tracker program that matches the clinical workflow for antiretroviral treatment could be designed to bring benefits to the person on treatment, through appointment reminders and a shared clinical record between ART sites. It could bring benefits to the care provider by automating some aspect of their reporting and providing decision support. It could add benefits to the supervisor by providing concrete information about performance and challenges based on data; and could bring benefits to program managers by adding not only real time data, but also introducing new types of indicators, such as those based on timeliness or quality, due to the opportunities presented by individual level data.

Designing for these outcomes not only greatly enhances the value of the system, it helps to ensure user uptake and satisfaction, and can bring significant improvements in the provision of
healthcare. These kinds of features can also help secure donor buy-in and cross-donor financing, as the system can satisfy multiple objectives.

References:

- Principles of Donor Alignment for Digital Health
- Principles for Digital Development

3.2.2 Funding

Ensure sustainable funding for development, implementation, training and continued support to last throughout the life cycle of the tracker projects. A tracker implementation requires funding in the following phases:

- Requirements gathering and development
- Training of the core IT team, administrative staff and program managers, particularly if they are only familiar with aggregate reporting
- Purchase and replacement of devices and backup solutions (alternative devices and paper)
- Roll out/scaling
- End user training, including per diem and workers salaries
- Connectivity (internet) and SMS costs, tracker may require investments in the infrastructure to sustain it in the field
- IT support at the end-user level
- Hosting
- Continued evaluation and maintenance of the tracker program
- Refresher training(s)

Experience from existing tracker implementations points to the initiation and rollout of Tracker projects to be the most resource intensive phase. A complex Tracker program modelling clinical workflows and replacing paper reporting can take a year to design and obtain proper buy-in and support. National trainings of thousands of users are resource intensive. Providing new hardware, such as Android devices or laptops, requires significant investment. Hiring and training additional staff in the IT unit to manage a large increase in users requires increased budgets.

As time passes the largest costs are related to refresher training and ongoing user support. To ensure a sustainable tracker implementation it is crucial that funding is secured not only through to scale-up, but also for covering routine costs in the future. Typically projects fail to be sustainable when insufficient funds are allocated for a sufficiently staffed IT team and/or ongoing maintenance and refresher training.

The costs associated with introducing individual systems can be somewhat offset by improved processes; reductions in budgets for printing and transporting paper forms; improved adherence to guidelines and referral mechanisms; etc. That said, digitizing current work processes is a long term investment and plans should be made from the beginning to see such projects as a change in routine practice, requiring ongoing support.

References:


3.2.3 Legislation and policies

Before deploying Tracker, it is important to review relevant privacy and data management legislation and policies at the local, national and international level. Collecting individual data is categorically different from aggregate data and requires more attention to privacy and security.
In the absence of clear national policies, data security and confidentiality guidelines - both technical and administrative - must be developed and agreed upon. The proper practices that must be clear and documented range from data access, to hosting requirements, to user practice.

Many types of individual health data have the potential for serious consequences if privacy is not protected. For example, in countries where it is illegal or culturally unacceptable to be an unwed pregnant woman, a breach of this information could lead to harm for the individual and family. If the client is not confident that his or her data will be properly protected, they may not be open with their care provider about their health concerns, lowering quality of treatment. Personally identifiable data can be mined for political purposes, or for identifying individuals in systematically marginalized groups.

There are several specific areas that should be reviewed during the planning phase of a Tracker implementation. As covered in the eRegistries Situation Analysis Tool, there are five areas to focus on:

1. understanding the legal landscape
2. existing governance surrounding health registries
3. guidance, legislation and current practices associated with data collection and storage
4. oversight and reporting requirements
5. potential and existing ethical and social implications

Policies can be drastically different between countries, and it is extremely important to assess these locally at the outset of each Tracker project. It is also critical to obtain local support for privacy policies. Experience has shown that even a well-crafted legal document developed externally, without local buy-in, can be shelved and not in use because the local organization(s) were not involved in its development and it was not translated to the local language. A Tracker implementation should consider the end user in all aspects – including legislation and policies.

Individual level data has significant value for future research and analysis, long after it is collected. A 2018 IMIA Yearbook of Medical Informatics article, it shows that the number of health record access requests is growing. To help ensure proper data management of sensitive data for the future, one should consider establishing procedures for data sharing agreements, if they are not already locally stipulated. This will help to maintain a systematic and fair approach to requests for information and their use – whether from a research organization, donor or other interested party. In situations where there is no or limited guidance, it is recommended to address the concerns outlined in the eRegistries Governance Toolkit and receive appropriate governmental buy-in for routine policies regarding data sharing and access.

Proper project planning will include time and resources for identifying essential policies, procedures and protocols for privacy and security. The eRegistries Governance Toolkit provides practical guidance on how to move forward through these steps. A thorough review with local stakeholders of what data will be collected and how it could be misused can help to drive the process forward. It is also important to identify a timeframe to revisit your privacy plan as policies change over time. Keeping informed of these changes will help you to better plan when navigating development, implementation and maintenance of Tracker.

Specific details about the Tracker software privacy features and guidance for proper configuration can be found in the DHIS2 user and implementation guides.

References:

- Governance guidance toolkit
- Situation Analysis Toolkit
- Frost MJ, Tran JB, Khatun F, Friberg IK, Rodriguez, DC: What Does It Take to Be an Effective National Steward of Digital Health Integration for Health Systems Strengthening in Low-
3.2.4 Capacity and competence

Given the increased reach of Tracker, both in terms of users and IT support, it is important to assess and ensure sufficient capacity and relevant competence to plan, design, develop, support and use the tracker program. It is possible that there are areas in the country where Tracker is suitable, and other areas where it is not, based on the capacity of the intended users and their access to appropriate hardware and network. In many cases it is beneficial to roll out Tracker in phases, rather than attempt to introduce it as a routine system in areas or with users that are not prepared. An assessment should be conducted before developing the rollout plan, to guide the scale-up and reach of the system based on appropriateness.

The key stakeholder working group described in the section on Institutional buy-in and support should be engaged early on to assess what cadre of users the system will be aimed at, determine which department will be responsible for long-term support, who will be tasked with providing training, both initially and over time, etc.

Additional training may be required for the IT unit, increasing their capacity to properly manage personally identifiable data, or provide support for any new hardware provided.

The tools and dashboards configured in Tracker should be designed with the intended users in order to ensure that they are appropriate and accepted.

Trainings for users may require not only specific curricula for the system, but also general training on the use, maintenance and troubleshooting of hardware and network access. Simple job aids and access to first-tier IT support should be developed and established in order to increase the number user needs that can be handled outside of the central level team.

References and Resources:

- The 2012 WHO and the International Telecommunication Union (ITU) National eHealth Strategy Toolkit http://apps.who.int/iris/handle/10665/75211
- The 2015 Roadmap for Health Measurement and Accountability https://www.who.int/hrh/documents/roadmap4health-measurement_accountability.pdf?ua=1

3.2.5 Infrastructure

It is important to ensure appropriate and sufficient infrastructure, which may be different for Tracker than for other existing digital systems. There are three groups of necessary infrastructure:

Electricity and network In areas where the network is stable, using Tracker through the browser of a laptop or desktop computer is appropriate. Data from the browser client are sent instantly to
the server, with no local storage outside of the browser cache. This ensures data fidelity and leverages the power of server-side computation. In areas of intermittent or low-connectivity, the DHIS2 Android app is required to make use of Tracker, as it creates a local copy of the database and allows the user to continue working without a direct connection to the central server. Android-based projects bring additional requirements with regards to access to electricity for charging; SMS and data costs; etc. Review the DHIS2 Android App Implementation Guidelines for more information.

**Servers and hosting** With the increase in numbers of users, the existing hosting solution for DHIS2 aggregate may not be adequate, and Android-based implementations bring even more strain on server resources. Whereas with monthly based reporting systems it is at times acceptable to expect low performing hosting options, Tracker programs that support daily work processes or clinical workflows require constant uptime and responsive IT support if problems arise. It is especially vital to establish a routine backup of Tracker data to a separate site, so that loss of critical data in the primary server can be quickly addressed. Conduct an evaluation of the current hosting approaches, including both hardware and available human resources, to develop an approach for your Tracker implementation. It is recommended that Tracker programs containing personally identifiable data be hosted in a separate environment from the aggregate system, in order to ensure greater security. Although many countries currently host local installations of DHIS2, it is worth considering a cloud-based hosting option for Tracker programs, where industry-standard hardware and technical support can be assured over time.

**Hardware for end users** Given the wide scale adoption of digital health projects, it is possible that the existing hardware available to targeted users is sufficient for a new tracker implementation. An assessment should be conducted to review the availability of computers and Android devices, and determine where additional hardware may be necessary. Long-term agreements for maintenance and replacement of hardware should be established in order to ensure the sustainability of the Tracker system past the life of the originally purchased hardware.

### 3.2.6 Security Considerations

Security is primarily about people. The people who are the subjects of data collected, the people who use the data, the people who are responsible for implementing technical measures and the people whose responsibility it is to manage the security of the particular tracker project.

It is not sufficient to assume that technical implementers will have made a best effort to make the system as secure as possible (though in general we hope that they will). In order to meet any level of regulatory compliance and avoid legal hazard it is usually necessary to be able to demonstrate that reasonable steps have been taken to secure the system. At a minimum this implies that:

1. There is a role defined in the organisation whose responsibility it is to be concerned with security related issues. This might be a chief security officer, a data protection officer or some other designation. The important thing is that there is an individual whose job it is to be concerned about, and to be accountable for addressing, security considerations. Ideally this is not a technical role, but one closer to senior management.
2. There should be some documented security plan around the tracker program. This is sometimes referred to as security posture. It should indicate the principles that are important to the organisation, the processes which are in place to identify, monitor and mitigate risk on an ongoing basis and various other artefacts and processes such as acceptable use policy (for employees), Non-Disclosure Agreements (for contractors), access policy, backup and disaster recovery plans, minimum standards for software deployment and configuration etc.

In some organisations the role of security officer is already established and well defined. In many others it is an evolving need which manifests itself in an environment characterised by the
absence of strong regulation, weak IT institutional and management structures and lack of appropriate training. There are existing standards and methodologies which can be useful in shaping such a role, such as the ISO27000 series (including useful free online material and templates). It is not an item frequently seen on funding and budget proposals, but security management training might well be one of the more important items to consider and budget for.

A non-exhaustive list of high priority tasks to consider: 1. Make sure the software setup is technically strong, documented and preferably automated. How to do that is a bit opinionated and there are different ideas of best practice. For system administrators, attending server academy is a good way of meeting peers and exchanging ideas. Also interact with the server admin community via the community of practice. There is also telegram group of system administrators (to join, email Lamin - laminbjawara@gmail.com ). 2. make sure you have a team (at least 2) of sysadmins that are responsible for the daily maintenance of the system. Depending on a single “technical” person is one of the biggest identified risks in many implementations. 3. As outlined above, somebody MUST be responsible for security. That role should: - report directly to management (not just a geeky thing) - manage overall risk (the risk register is your friend) - make sure that sysadmins are doing their job - be aware of local law, constraints and SOPs regarding data handling and privacy. In their absence, or where they are inadequate, develop and maintain good practice guidelines locally. 4. make sure there is a backup plan, including off site, which is regularly tested. Straightforward unrecoverable data loss has been the single most common security problem countries have faced, 5. make sure that systems get audited regularly (this can be “official” from auditor general, or peer-to-peer within our community). This is the best way for management to ensure that sysadmins are doing their job (above)
4 Building your Tracker Program(s)

The purpose of this section is to give a high level overview of the considerations that will lead to success in your Tracker implementation, grouped by topic and with links to specific tools.

This section will cover:

1. Scale
2. Design and Configuration
3. Real-time vs. Secondary Data Entry
4. Mobile vs. Web
5. Establishing a Core Team
6. Hosting
7. Training
8. Roll-out

4.1 Determining Scale

Because Tracker is aimed at the lowest levels of a system, Tracker systems can mean dramatically increasing the number of users, devices technical and organisational support requirements. Countries often have limited personnel that are qualified to do deployments and there are costs associated with the work.

Scale can refer to several dimensions; programmatic scale, functional scale or geographic scale to mention a few.

Scaling geographically can thus take time and resources. There are different strategies to geographical scale i.e. cover one region completely or start “small” in several regions at the same time and scale at a slightly slower pace in parallel.

When you start scaling things will happen faster; more people will work on it and need support. Hence, make sure that the team is rigged to handle an increased volume and speed by taking into consideration the following:

Finalize and pilot the tracker before scaling it

Gather evidence and demonstrate impact before attempting to scale. Consider reduced investment in features that do not demonstrate impact, or resource-intensive features that have limited impact. You should have a final design/configuration which is user tested and piloted and produces the targeted results in terms of information management and the wanted reports BEFORE you scale. When you start scaling, it is not the time for experimenting. In other words, test your design and set up with 100 rather than 5000 users.

Governance

Ensure there are solid governance processes and a clear distribution of responsibilities before you attempt to scale. Make sure you audit this process to ensure the governance process is followed. Proper governance is also key to ensure the flexibility and adaptability of your tracker project, for example routines for adding new option sets or new clinics. Who makes these decisions and how do you document them and how do you communicate them to the users?

Cost/financial considerations

Consider your funding model, including revenue-generation options, social business models, the cost per user and financial paths to sustaining the initiative. Scaling leads to increased operational costs in terms of support, devices and connectivity.

Scaling up infrastructure

With increased scale you have to handle more connections that in turn requires increased resources in memory, processing power, storage and connectivity.
Part of the scaling process makes sure you have a sound plan for speedy recovery because more people depend on the system.

**Revise the process from the pilot**
Scaling up can often not be done with the exact same tool and approach as is done in a pilot, particularly when it comes to the level of human resources and expertise needed in training and support to attain the level of use achieved in a pilot. Consequently, review your tool and implementation approach and consider what aspects can be redesigned and simplified to achieve your core goal.

**References:**

- Principles of Digital Development

**Tools:**

- Readiness Assessment

**4.2 Design and configuration process**

**Involve users closely in design and configuration of your Tracker program** to ensure that it improves and supports their work. In order to develop a Tracker program one needs to define what data to enter, define a workflow and define program rules. All of these definition decisions should be made in close collaboration with users, since they directly relate to – and can affect – how they do their work.

We recommend that you start the design process by asking the following questions to start discussions:

1. What is the purpose of the data you collect? How do you intend to use the data?
2. Who will benefit from the Tracker implementation?
3. How will the users entering data benefit from the Tracker implementation?
4. Do you currently collect this data today? How?
5. Are there data elements you currently collect that you do not need?

**DEFINE PURPOSE, AIM AND SCOPE**

A clear purpose and well-defined aims are the key to establishing a common understanding of the project's scope and limitations, and to being able to communicate the process of developing and running a Tracker program internally and externally.

- Define the primary and secondary purposes of the Tracker program.
- Identify the tracked entities, the scope of data collection, and the health cadres involved in data collection.
- Determine how to uniquely identify members of the target population, (e.g., use of unique identification numbers or a combination of attributes).
- Clarify initial expectations among the core team, as well as other stakeholders and system users.
- Brainstorm and discuss key issues and areas of concern to be addressed during the development phase.
- Prepare to conduct a development phase: Develop a timeline and incorporate contingency plans for unexpected events that incur delays. Articulate anticipated problems and discuss how to mitigate.

**FORMATIVE PHASE**

Gain a clear understanding of the health system (or other system that the Tracker program will cover, for non-health implementations) to understand the "pain points" of the current system,
identify opportunities for improvement, and ultimately develop a useful and suitable system that addresses these issues and opportunities. This includes understanding health workers, the data they collect, their clinical workflows, and their supervisory and reporting systems.

- Prepare and undertake field visits to map clinical workflows and supervisory and reporting demands with the participation of all cadres of health staff who would use the Tracker.
- Prepare and undertake stakeholder meetings to inform, explore and get feedback.
- Verify existing national (clinical) guidelines relevant to the scope of the Tracker.
- Map the existing documentation workflow: Document what workers currently do and ensure your design supports their work practices rather than making them more cumbersome.
- Map indicators and associated data points for reporting.
- Consider whether there is a need for revision of guidelines or reporting points. If so, make parallel plans for revision of guidelines and reporting.

DEVELOPMENT PHASE

- Get an overview of current clinical guidelines, interventions, indicators and algorithms.
- Based on current guidelines – as well as indicators and data points for reporting – formulate algorithms and data points for electronic tracking.
- Define the target groups and level of complexity of decision support. According to the level of workflow support, create rules for the support and communicate this to software developers in an agreed-upon requirements format.
- Enable an iterative review process to ensure that the developers’ translation is consistent with the health care providers’ needs.

CUSTOMIZATION AND TEST PHASE

This phase is an iterative process of working with stakeholders, software developers, implementers and users and incorporating their feedback.

- Establish a structured and easily accessible digital system for comprehensive and immediate feedback channels among the core working group.
- Ensure that content development is in line with the expectations of stakeholders, system users and funders.
- Maintain ongoing, open-minded discussions about translation, use of information buttons, etc., to avoid misinterpretation.
- Make sure that there are continuous, parallel processes that involve and promote information flow among all user groups in these phases.
- Define milestones for developers, implementers and users.
- Establish a structured and easily accessible online digital system for comprehensive and detailed feedback from end users.

Link to WHO package design documentation

4.3 Determining your M&E Framework

Intro
What does a mature tracker implementation look like?
Maintain and evaluate data collection
Maintain and evaluate data use practices
Maintain and evaluate keep up with new DHIS 2 versions
Maintain and evaluate user admin
Maintain and evaluate security
Maintain and evaluate hosting
Maintain and evaluate user support
Maintain and evaluate training
Real-time vs secondary data entry

Carefully evaluate whether the data should be entered real time as this has several implications for how you structure your project. Trackers are used to track individuals through defined programs with associated data elements and rules. The data can be captured by health personnel during the consultation (real time point of care), or at the end of the day (or when they have time to enter it). The two different approaches naturally have consequences for what the Tracker is used for: If the data is entered at point of care - during the consultation - it is possible to provide decision support and validate data and avoid double data entry. However, it also introduces challenges with regards to connectivity, usability, increased number of devices, etc.

Entering data in real time also requires that the setup of the Tracker matches the clinical (other domain) workflow. Hence it is critical to have clear SOPs for backup paper files, easy navigation to find clients and mechanisms to prevent errors (such as rules that make it impossible to enter a date in the future).

Link to WHO package design documentation

Mobile vs Web

Consider how and when the people doing data entry can access the Internet There are contexts or locations where accessing the online central DHIS2 server through a computer is challenging or even impossible. The DHIS2 Android Capture App has been designed and developed to respond to those situations. However, introducing mobile devices into a DHIS2 implementation will impact your project on many levels, so it is a decision that needs to be made in an informed and conscious manner.

Web or Mobile?
There are two main aspects that should be taken into account when considering a mobile component for your Tracker implementation: internet availability and the mobility of your health posts. A given Tracker implementation may need to address only one of these two aspects, or both at the same time. We will attempt to define them and help you analyse your situation in this section.

- **Mobility**: There are teams that provide their services in different locations through a mobile unit. In the locations visited by the mobile unit, there could be a facility with a proper work station for data collection, but sometimes data entry is done in a more dynamic environment or in the vehicle itself. In these cases it is not always easy to carry a laptop and it may be more suitable to use a mobile device instead.

- **Internet availability**: There are many locations where access to the Internet is challenging. The different possible scenarios can be summarized in two main cases: Internet connection is unstable or limited, and Internet connection is not available.

  - When the Internet connection is unstable or limited scenario is confined to certain moments in the day, it is possible to consider the use of either mobile or web for data entry. DHIS2 web data entry allows for the continuation of data entry when the Internet is interrupted. The data entered will be stored locally in the web browser cache, and the next time the user gets online the data, it will be automatically uploaded. Is important to note that this offline support depends on web browser storage and will only work while the browser window remains open. If a user is collecting data offline and closes the window where s/he is working while still offline, the data will unfortunately be lost. Offline support absorbs the impact of intermittent Internet connectivity interruptions to provide a smooth and stable work experience, but is not a full offline solution.
When Internet connection is not available, you should consider using the DHIS2 Android Capture App, which provides full offline support for data collection. This app can be used with both mobile devices and tablets, and it is also possible to run it on other devices such as Chromebooks. The Android Capture App can thus be suitable for those cases where you have Internet availability challenges but not challenges to mobility of the individuals doing the data collection.

Implications of the use of the Android App

The DHIS2 Android Capture App facilitates offline use of Tracker data collection, but also brings with it implications that must be considered from the early phases of the project. Having a mobile component in your implementation could impact your planning, budget, training, configuration and deployment strategy, among other aspects.

• **DHIS2 configuration:** When configuring Tracker for use with mobile devices you need to pay special attention to the configuration of mobile users, their access to data entry and organisation units. Mobile users are typically envisioned to be physically collecting data in the most remote and inaccessible areas, hence a mobile user is not expected to collect data from a high number of facilities, such as the organisation unit hierarchy of the entire country. While there is no maximum number of organisation units allowed in the App, large numbers can have impact in performance depending on the resources on the device (memory, processor). In general, below 250 organisation units should be safe, but that is still a very large number for a typical mobile use case. It is also very important to pay attention to the configuration of program rules and program indicators. The Android App aims to support all Tracker web functionalities, however some of them might behave slightly differently in Android, or be in the app development roadmap awaiting implementation. A detailed list of the behavior of program rules and program indicators in Android can be found in the Program Rules and Program indicators sections of the Android App documentation.

• **Visual representation of data collection:** The user experience of the Android App has been designed to be very visual and intuitive. Icons and colors can be used to configure the data entry forms and how they are displayed. Visual representation is configurable by the system administrator. There is an icon library of over four hundred images and a color palette, and both icons and colors are assignable to most metadata objects: Options, Data Elements, Attributes, Programs / Data Sets. More information for the visual configuration of DHIS2 can be found in the Visual Configurations section of the Android App documentation.

• **Testing:** Testing is a very important phase in any DHIS2 implementation. You should test the Android App in parallel with your server configuration, to make sure that all configuration made in the server is properly reflected and working in the app. This is especially important during the configuration of the program rules. More information on the different types of testing and how to plan testing phases for your project can be found in the Testing section of the DHIS2 Mobile Implementation Guidelines.

• **Security:** Depending on your Tracker configuration, you may be storing personal data on mobile devices, and there may be tension between the health system’s need for identifiable data, and the patient’s right to privacy. Ensuring that personal data is only accessible by authorized health staff is of utmost importance. Proper management of personal data is a critical component of user education, and it is vital to establish SOPs that describe the security measures to be applied, and to ensure these SOPs are shared with and followed by all users. System administrators also play an important role when configuring a user’s access level, by ensuring that data access is appropriate for each user and never unnecessarily excessive. Recommendations for an adequate security / privacy approach for any DHIS2 mobile implementation can be found in the Data Security and
Privacy section of the DHIS 2 Mobile Implementation Guidelines,
TODO; add link to security section in this document!

- **Purchasing mobile devices:** Mobile devices acquisition is a key aspect to a mobile deployment and needs to be considered for planning, budgeting and logistics. A good strategy is to get the best and newest devices that you can afford, such that they will last longer over the life of your project. In this sense, it is good practice to delay the bulk of the acquisition (in other words, any devices not required for initial testing and pilot phase) as much as possible, instead of purchasing all devices early in the planning process. Technology – and particularly mobile devices – evolves very rapidly. A given model is normally refreshed on an annual cycle, giving consumers access to significant technical improvements year-on-year at a similar price point. Specifications for mobile devices that can be used with the DHIS2 Capture Android App can be found here. When you have performed all testing and completed your pilot, you are ready to scale up your deployment with the acquisition of hardware and necessary services. You can find guidance for your mobile acquisition in the Scale Up section of the DHIS2 Mobile Implementation Guidelines. We summarize below the key aspects to consider in this phase:

1. Purchasing of devices vs BYOD (bring your own device): The advantage of BYOD is that it avoids the large initial cost for acquisition and reduces administrative costs and logistics considerations. On the other hand, using the BYOD model leads to the challenge of managing a very heterogeneous hardware environment, meaning different devices and Android OS versions, which can result in different end users having different capabilities for capturing and reviewing data, and can ultimately lead to challenges with upgrading the core Tracker instance, as newer versions may have limited backward compatibility with older app versions. The primary advantage of purchasing devices for end users is uniformity of devices and app versions, but this approach increases hardware costs and involves logistics challenges related to distributing the mobile devices, as well as maintaining and replacing them over time.

2. Distribution of the app: you can manually install the Android Capture App by using the APK available in Github or use the Google Play store. With Google Play it is easier to update the app on all your devices, however you are forced to automatically install all updates of the app. Installing the APK allows you to control when to update and to which version, but it requires a more complex process for updating all your devices and is not recommended for projects not using Mobile Device Management software (see next item).

3. Telecommunication contracts: The process of selecting and signing a contract with a mobile provider varies by country, and will also depends on the procurement procedures of your organization.

- **Management and Maintenance of devices:** Mobile Device Management (MDM) refers to software used for the administration of mobile devices. MDM software is necessary to support hundreds of devices, control the APK file distribution across all of these devices, provide tech support and enforce institutional policies. More information on the desirable features of an MDM, available options and guidance on the selection of the right MDM for your project can be found in the Mobile Device Management section of the DHIS2 Mobile Implementation Guidelines.

### 4.6 Human Resources and IT Support

No Tracker implementation will be successful over time without the right people on board. Before starting a tracker project it is important to make sure the right personnel with the right competence are available.
Here are a few considerations when building your team:

1. Aim for long-term engagement. The people that will maintain the Tracker implementation over time should be part of the project from the start.

2. In-country resources at all levels of the (health) system need to be involved from the very beginning. Handovers of project history, decisions and established routines from external consultants to permanent staff are often challenging.

3. If you already have an aggregate DHIS2 instance, remember that the people who are managing aggregate are not automatically “qualified” for the Tracker project, as Tracker is different from aggregate reporting.

<table>
<thead>
<tr>
<th>Role</th>
<th>Responsibilities/tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project manager</td>
<td>Manage the Tracker project</td>
</tr>
<tr>
<td>Config/development lead</td>
<td>Lead development work</td>
</tr>
<tr>
<td>Security manager</td>
<td>Responsible for security, policy ++</td>
</tr>
<tr>
<td>Training manager</td>
<td>Organize training</td>
</tr>
<tr>
<td>Test lead</td>
<td>Lead test work</td>
</tr>
<tr>
<td>Trainers</td>
<td>Conduct training with end users</td>
</tr>
<tr>
<td>Support lead</td>
<td>Lead support efforts</td>
</tr>
<tr>
<td>Distributed support staff</td>
<td>Receive requests for support and help users</td>
</tr>
</tbody>
</table>

4.6.1 IT support unit

Support should be available close to the user, which often requires creating a new IT support structure at the district or sub-district level. If Tracker is used in real time, technical support should always be available during business hours to resolve and report issues. If Tracker will support clinical decisions, the IT staff should understand clinical workflow, and its represented in the technical system. Therefore, the Tracker IT support team may have different skill sets and backgrounds than other health information officers, and may be an entirely new and different cadre of worker within your health system.

Team structure and administration

Each member of the IT support unit should be trained before the first end user, and must demonstrate a high level of knowledge of the system and how it works. Often, the IT support unit consists of the same people leading the end-user training. At the very least, support staff should be introduced to the end users during training to develop rapport and trust from the start. A large component of support staff work is “supportive supervision” on the job. Effective support staff must also be knowledgeable, respected, and respectful, but are generally not in a position of direct authority over the end user, as this might reduce a user’s willingness to ask technical questions and report problems with the system.

Once the team is in place, an internal working hierarchy can be established, from increasing technical ability up the hierarchy (e.g. system administrator at top of the hierarchy), and increasing access to the end users down the hierarchy (e.g. direct supervisor of end user, field support staff). During this staffing organization phase, standard operating procedures for reporting and responding to issues from end users needs to be developed.
Essential tools for any IT support unit

- Frequently Asked Questions (FAQ) document: A simple paper depicting in graphics and/or local language the standard operating procedures for data entry and what to do in case of bugs. A FAQ should be distributed during all trainings, and it should be regularly updated by the IT support unit and shared with end users as the Tracker system evolves.

- Mobile device management: To protect patient-level data, a separate case management system must be implemented for tracking which users have access to which device to identify lost/stolen devices and follow up the case. This system can be as simple as a spreadsheet, but in larger and more complex instances an enterprise-level MDM system can be used to track device location, and can wipe an individual device remotely if needed.

- User management: The IT support unit should be able to document and manage basic system administration tasks such as creating new user accounts, de-activating inactive user accounts, or resetting passwords.

- Monitoring platform to track key system indicators: These key indicators include new enrollments by organisation unit, inactive users, server downtime, etc. At a minimum, the IT support unit should have access to aggregated indicators in a dedicated DHIS2 dashboard, where they can view implementation progress by time and region.

- Case management platform for registering bugs and tickets: These platforms (e.g. JIRA) allows members of the IT support staff to enter, edit, assign, track, and resolve bugs and other tickets, and allow supervisors to have oversight over important service-related factors, such as number of open tickets and unresolved bugs, average response time, etc.

- Knowledge management platform: This is a repository where employees can learn from previous tickets (thus building a knowledge base). The IT support unit understands the user's real-world experience with Tracker better than any other implementer or system administrator, and their perspective can be invaluable to adapting Tracker to better meet the user's needs. A knowledge platform–either electronic, or regular meetings among staff–can share common experiences, frustrations, or ideas for potential improvements.

- Hotline to report bugs: This hotline can come in many forms. For example, it could be a phone number for support staff employees that is shared with each user, or an email address where users can send notes and screenshots. Regardless of format, there must be an SOP in place for entering bugs reported through the hotline into the case management platform mentioned above.

- Public chat groups: Many support teams find creating chat groups between staff and end users can support peer-to-peer learning (e.g. Whatsapp or Wechat to share screenshots, voice messages, or creative solutions for common problems).

References:

- Principles of Digital Development

4.7 Hosting

The tracker program itself and the collected data needs to be hosted on a server. This can be done locally (for example at the ministry), through a local professional service provider or in the cloud. The different options have pros and cons, e.g. hosting a tracker implementation in the cloud means administrator does not need to worry about server capacity, down time and so forth, but at the same time there might be legislative issues with hosting the data outside the country borders, unless you have a local provider. Regardless of hosting strategy - security is a key consideration. This entails identity management, authentication and authorization (restricting access to data or services) as well as protection of servers.
Additionally you have to decide if you want to configure the tracker in a separate or same instance as your aggregate system. A big advantage to having one instance is the possibility to directly generate your reports from tracker data. However, having the two in the same instance requires stricter SOPs for maintaining user accounts to ensure access to patient data is restricted properly.

10 principles for hosting and security

1. Operating system is a LTS (long term service edition)
2. There is an automatic process for applying OS security patches
3. Host based firewall configured allowing minimal access
4. Access is via ssh according to agreed policy - keys, no root access etc
5. DHIS2 version is not more than 3 versions behind latest release. Process exists to apply patch releases regularly.
6. Automated backup system is in place and regularly tested, including offsite.
7. Postgresql database access controls allow minimal access
8. Web-proxy server is properly (sslabs test A+) configured with SSL
9. Database data is on separate data partition (allowing encryption at rest, performance settings)
10. Monitoring and alerting system is in place (wide range of options depending on environment. eg. boombox might be fine with email + logwatch + munin )

Enough/stable electricity to charge devices
In case of Android - network with a certain amount of uptime in order to sync.
In case of web based - stable network

1. Servers/network/hosting
2. Hardware

Experience shows you need X number of devices per user

You need X % of devices for backup

Devices needs to rotate

- Database diagram (including virtual machines and physical networks)
- Minimum specifications for hardware...
  - Servers
  - PCs
  - Android / M### Hosting & Securityobile
  - Other connected devices (e.g. fingerprint readers)
- Other infrastructure
  - Network access
  - Electricity access
  - SMS and data costs
  - Shared resources with other projects or ministries (e.g. government contract with SMS gateway provider)
- Cloud-based vs Locally hosted: Depends on the regulatory environment of PII
- Management and sustainability of the IT systems.
- Documentation exists on security plans and protocols. Both at high-level (non-jargon, but stating the principles) as well as technical procedures. Especially critical for locally-hosted systems without a “security first” culture.
- One individual needs to be responsible of developing, maintaining and implementing the security plan. Another security manager committed to identifying and mitigating risks. Both roles require experience, capacity, and incentive.
- Ensure that there is a documented set of technical controls mandated
• Ensure that there is audit process against those controls
• SOP for operational, network, and physical security (locking PCs, strong passwords, data encryption, etc)
• SOP for monitoring and response if system is down or system breach
• Disaster recovery plan and routine drills
• Troubleshooting – process for “an external solution” in case of urgent crisis when situation cannot be resolved locally.
• What is process for granting database or ssh access to servers?
• Access control and rules
• Where should management of the IT system fall within the framework?

References:

• Security Guidelines for Country Implementers

4.8 Training and Rollout

Plan for high-quality, continual training. Capacity building is crucial for a Tracker program to succeed, and it must be both high quality and continue periodically throughout the lifetime of the program. It is not sufficient to provide user training only once – your training plan should provide for initial and refresher training over time. Frontline Tracker users are typically ground level health workers who may be less comfortable with technology than district staff who work more often with aggregated data. A strong emphasis on training will include time for familiarizing trainees with the tools as well as how to integrate Tracker into their workflow.

A key principle is to develop training material in collaboration with users. Working closely with users when you design the training material will allow you to understand what concepts are difficult for users to understand, so you can refine your material and timing for the training agenda. Do an initial entire training run with a group of real users to fine-tune your course.

Identify the appropriate training approach: There are multiple options for delivering your training (e.g. video, online test, on-site, meetings), which can be used individually or in conjunction with each other.

Involve health staff and not just IT staff in the trainings in order to explain and emphasise the health reasons behind the data entry processes. This is particularly relevant for configurations that involve decision support. Doing this helps end users to get a better understanding of why the Tracker program is significant, which can lead to more complete and accurate data entry, and thus a greater likelihood that the program will succeed in its goals. Revise the material based on feedback from those attending the course, or if there are revisions of the Tracker program that cause the old training materials to become inaccurate.

Logistics

Plan training of Tracker users as a series of training steps, such that they receive refresher training after some time. The refresher training schedule should ideally align with revision cycles of the Tracker software, to facilitate the introduction of end users to changes and new features in the program.

Note that training a large group of users (especially spread out over a large geographical area) will often require that you first train other trainers (at a Training of Trainers, or ToT) early on, to help scale your training capacity. Keep track of which Tracker users have been trained in spreadsheet, list, or other centralized database, and establish and SOP to update this list when new staff members join, or when existing staff members quit or are relocated. New/untrained staff members should be provided with training at the earliest possible opportunity. Choose a training venue with care. Training can take place either on site (at or close to the users’ work environment) or in centralized trainings that bring larger groups of users from various workplaces to one centralized location. Both approaches have positive and negative aspects.
Regardless of where the training takes place, the person responsible for planning the training will need to organize logistical details such as the venue, transport, food and drink, computers, Internet access, etc.

If possible, train users on the devices they will use in their work. Don’t underestimate the time it takes for people to log in and familiarize themselves with the device – it can take a significant amount of time at the beginning of the training program to get all participants ready from a technical standpoint. It is recommended to have several members of the training team available to help troubleshoot these issues as they arise. Schedule follow up regular/onsite training / refresher training.

**Training in low bandwidth settings**

If Internet connectivity is too slow, unreliable, or non-existent at your training location, you will need to install a local Tracker instance and configure it for training on a machine/local server, and set it up for the training such that participants can connect through a common local network environment, an IP address, or localhost client. Even in settings where Internet access is generally good, having a large number of users access the web-based Tracker instance through one WiFi network or Internet access point can lead to network issues. It is therefore generally advisable to have a training instance available as a backup in these cases.

### 4.9 Relating Tracker to your Aggregate Data System

**Make sure to cover the basic reporting requirements from the HMIS when designing the tracker to avoid double reporting.** The data entered into tracker forms a basis for generating aggregate numbers. E.g., 4 patient entries = 2 with condition X and 2 with condition Y. Tracker should support the aggregate system, rather than be an extra burden on data collectors. System design should take into consideration how to meet aggregate data requirements using the data entered through tracker.

There are different options to consider, either through automation or manually with the help of tools. You need a clear work flow, tools and governance model for data quality and completeness assurance and the data authorization process. In other words who can approve and process data from individual to aggregate data and how does this happen.

When you design the integration with the HMIS, make sure that the aggregation process is well thought through.

- review the indicators
- create the reports
- create a governance model for data quality and publishing
- ensure the data revision processes are working (who owns the process and the data and what happens if you discover faulty data after deadlines)

It is important to make sure that care providers understand the indicators and are able to input into how they are calculated. Involve Ministry/policy-makers in the process so that they understand the fundamental differences between how reporting happened before vs. now in a tracker or eRegistry.

**Feeding into the HMIS**
The data that is entered into tracker forms a basis for generating aggregate numbers. E.g., 4 patient entries = 2 with condition X and 2 with condition Y. Tracker should support the aggregate system, rather than be an extra burden on data collectors. System design should take into consideration how to meet aggregate data requirements using the data entered through tracker. In other words the workflow should avoid additional work for your health workers. They should not have to aggregate data manually and enter manually into the HMIS.
Difference between aggregate data collection system, where the final numbers are input into online reporting forms vs. a tracker/an eRegistry that does automated reporting

Significantly more effort in software design to cover all reporting and indicator needs

Important to define indicators and understand what is to be measured: what is the numerator, what is the denominator

Default denominator in an eRegistry: patients/clients

Removing traditional paper reporting can be time-consuming, behavior-change takes time

Important to make sure that care providers understand the indicators and are able to input into how they are calculated

Involve Ministry/policy-makers in the process so that they understand the fundamental differences between how reporting happened before vs. now in an eRegistry

References:
Venkateswaran M: Attributes and consequences of health information systems data for antenatal care – health status, health system performance and policy, PhD dissertation, University of Bergen