Afghanistan Polio Management Information System (APMIS)

Technical guide

May 2022

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1. Introduction

Simplifying and improving the quality of Supplementary Immunization Activity (SIA) data in Afghanistan is a priority for the polio eradication program. High quality campaign data is essential to provide accurate and timely information for programmatic decision making.

The Afghanistan Polio Management Information System (APMIS) is an online data system and dashboard developed in collaboration with Global Polio Eradication Initiative, WHO, UNICEF, and the National Emergency Operations Center (NEOC) of Afghanistan.

APMIS is meant to improve SIA data quality through the streamlining of data input, management and analysis, including a dashboard of key indicators. APMIS provides tools for management of campaigns, web data entry which match the structure of field data, insight to aggregated data analysis by pre-defined indicators via a configurable dashboard, and timely input of data from the field using a mobile app.

The system is accessed via the URL: https://**afghanistan-apmis.com**

2. Features Summary

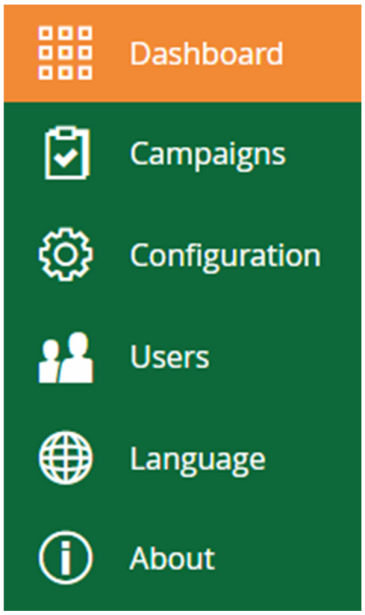
The following features are in APMIS:

- **Dashboard** with predefined indicators on Supplementary Immunization Activities (SIAs) with filters for campaign attributes and tabs for different categories of data.
- **Campaigns** section to view data, define campaign forms and dashboard design, summarize campaign statistics, enter campaign data by form type, and export or import campaign data
- **Configuration** section to define administrative units or import/export list
- **Users** section for admins to centrally manage all system users and roles
- **Language** section to set user-preferred system language between English, Pashtu and Dari
- **About** section to display system version and have link to online reference material

3. APMIS Feature description

The list of APMIS features can be seen on the left side of the screen and include Dashboard, Campaigns, Users, Configuration and About.

APMIS Navigation Menu



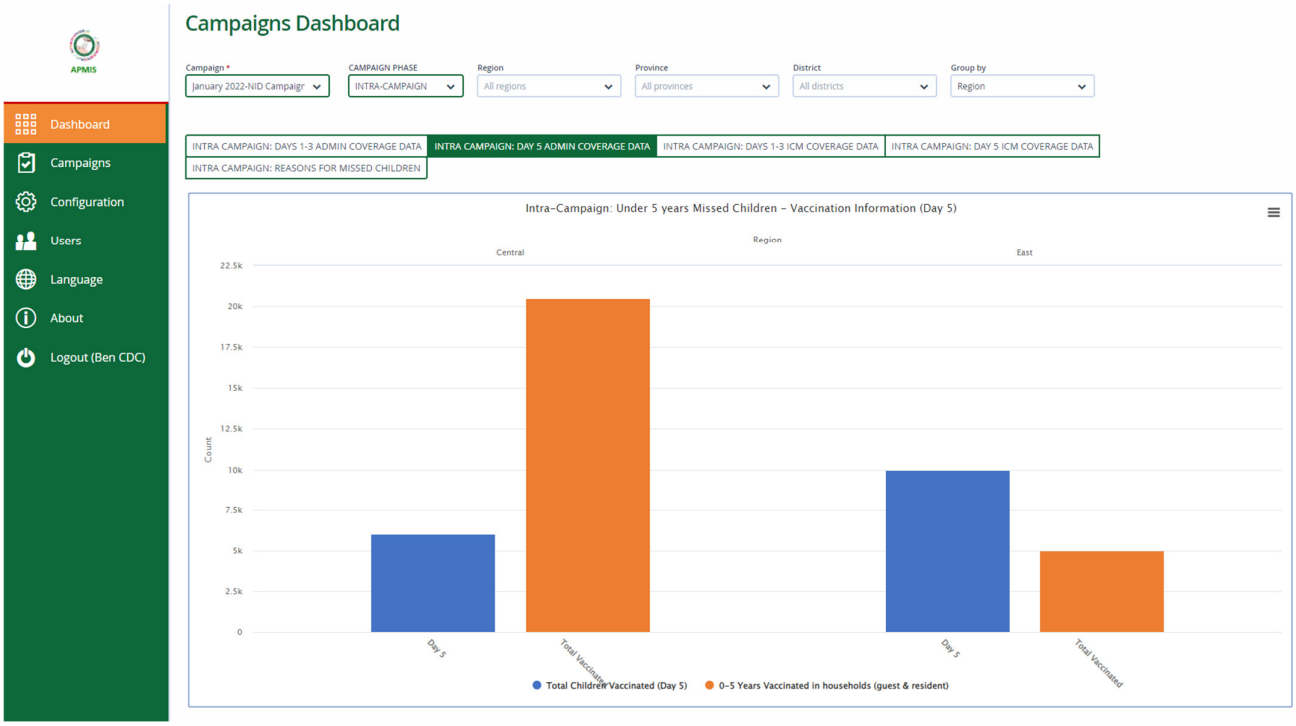
The summary of the system features is described in the sections below.

4. Dashboard

The APMIS dashboard shows charts based on indicators defined for the system. The dashboard allows filtering by campaign, geographic level, and indicators to view the data. Exporting the selected chart data in .svg, .png or jpeg formats is also possible. A summary of the main features of the dashboard is listed below:

- View indicators by category (tabs for different types of data)
- Customize charts while viewing by clicking on a series
- Swap between column and bar charts
- Export underlying chart data as csv data table

APMIS Dashboard



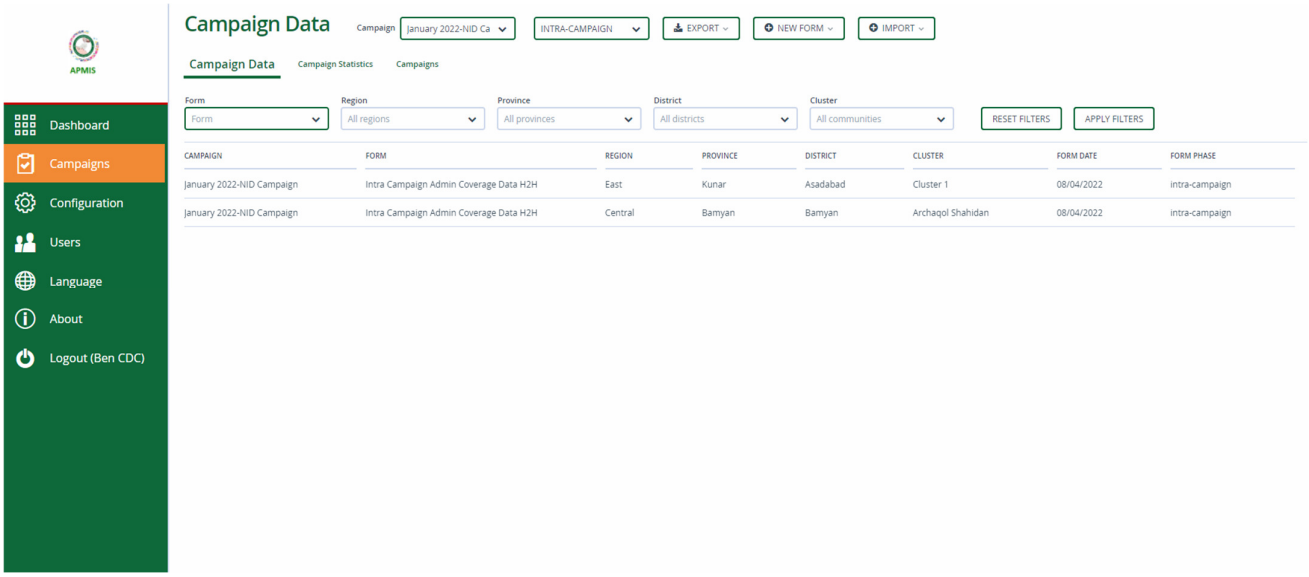
5. Campaigns

In this section, users can view, search, edit, validate and create campaigns, as well as export campaign data. Some of the functions can only be done by admin users, as specified on Table 1.

Campaigns features:

- Create, edit, validate and delete campaigns (admin users)
- Input of campaign form data using web browser
- List, filter, and review entered data forms for a campaign
- Import campaign data using formatted csv file
    - Error checking is performed on inputted csv data
- Export of campaign data to csv, including listing of campaigns and submitted data

APMIS Campaigns



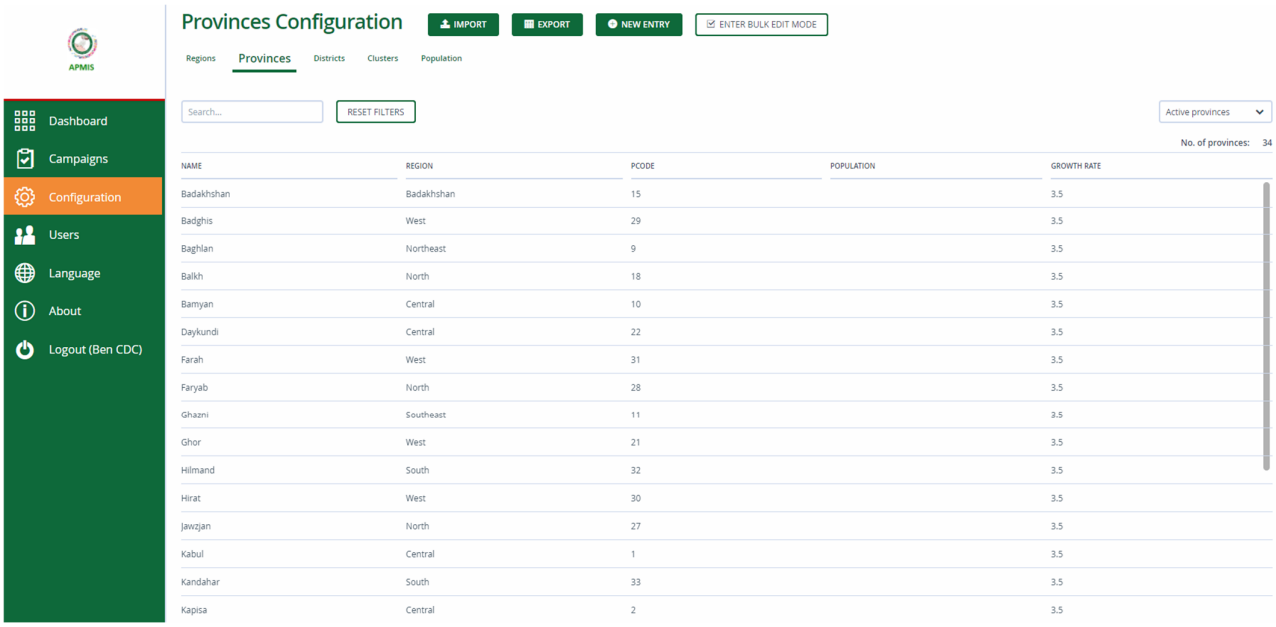
6. Configuration

In configuration, admin users can view and set up infrastructure data including administrative units (Regions, Provinces, Districts, Clusters), as well as population data, which informs the denominator in analyses. By default, a list of units and their attributes (e.g., Pcode) are displayed. Clicking on a row will open that record for viewing or editing.

Configuration functions:

- List and filter administrative units (e.g., districts)
- View and edit the unit's details, including code and name
- Add or archive an admin unit
- Multiple selection actions through bulk edit mode
- Import and export unit and population data

APMIS Configuration

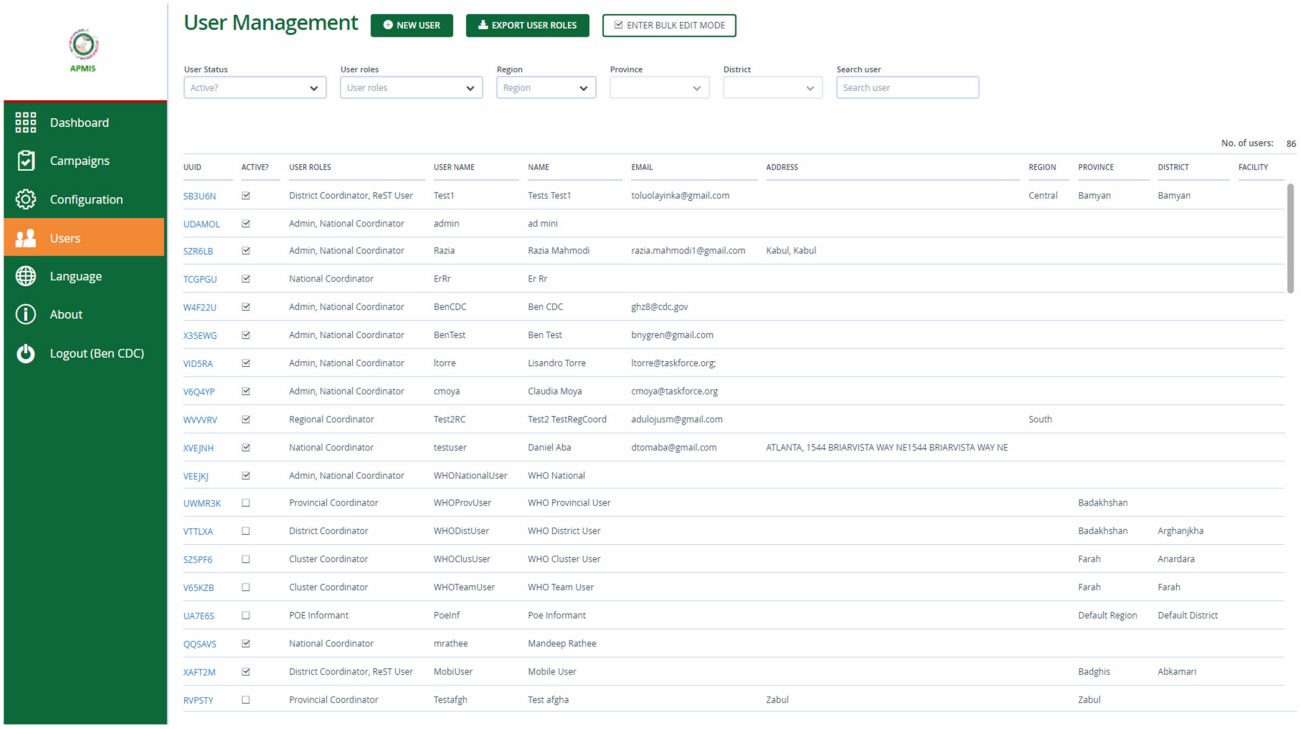


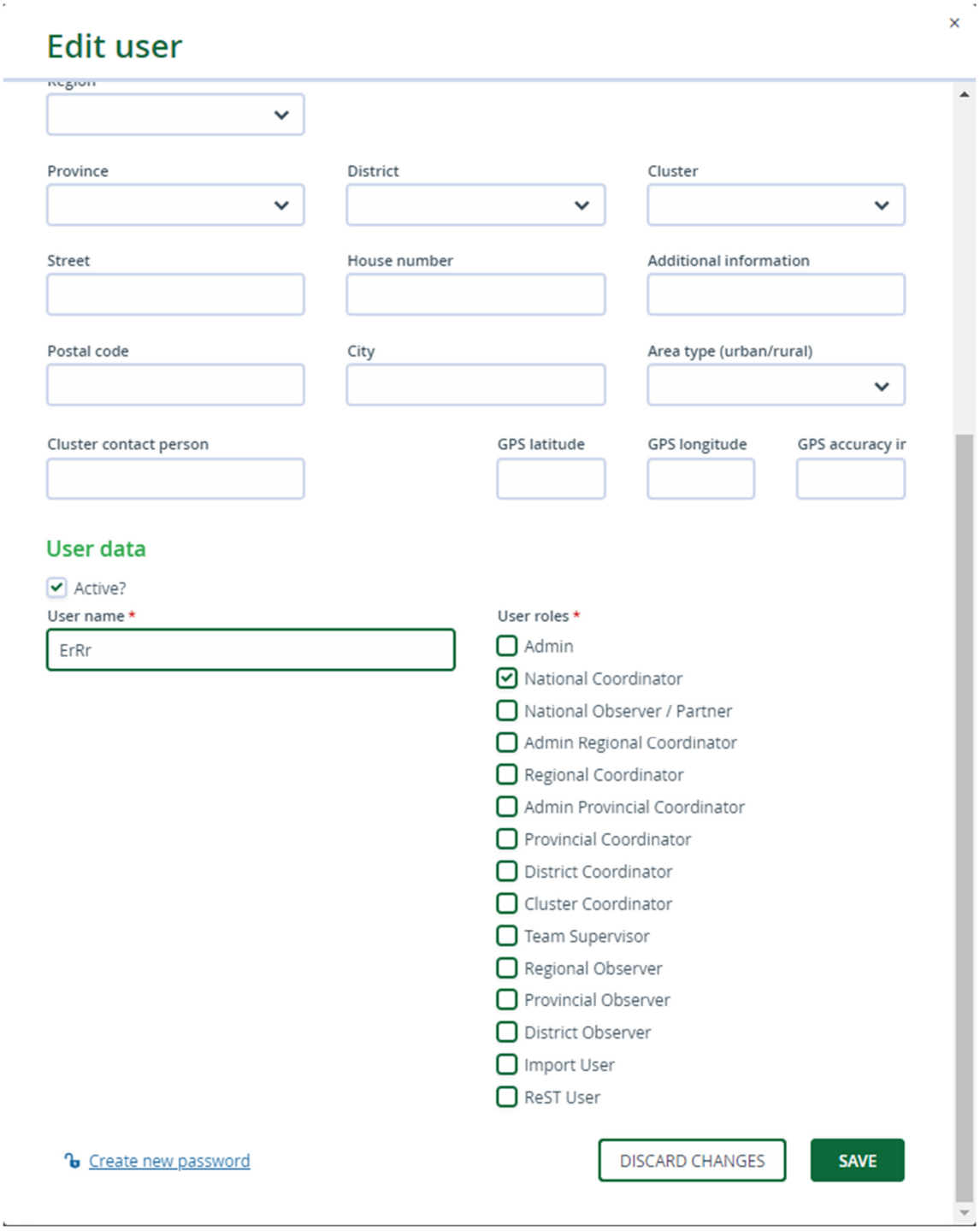
7. Users

7.1 Overview

User Management is only accessible for Admin users and allows the administration of system users. This includes the creation, inactivation (archiving) of users, modifying user roles and resetting passwords. Clicking on a user row, open that user's detail.

APMIS User Management




Edit user
Region
Province
District
Cluster
Street
House number
Additional information
Postal code
City
Area type (urban/rural)
Cluster contact person
GPS latitude
GPS longitude
GPS accuracy ir
User data
Active?
User name *
ErRr
User roles *
Admin
National Coordinator
National Observer / Partner
Admin Regional Coordinator
Regional Coordinator
Admin Provincial Coordinator
Provincial Coordinator
District Coordinator
Cluster Coordinator
Team Supervisor
Regional Observer
Provincial Observer
District Observer
Import User
ReST User
Create new password
DISCARD CHANGES
SAVE

7.2 User Types

In APMIS, users are associated with 1) a role; and 2) an administrative unit (e.g., a specific province).

For roles, APMIS has several options that can be configured but primarily there are admins who can configure the system and non-admin (standard) users who either view or enter data. Admins have additional options enabled including the ability to create, edit and remove campaigns and other users. These options are not available to standard users. Standard users may request admin tasks be done by admin users or that their user be designated an admin.

For administrative units, if a user is assigned to a particular unit and not given national access, they may view just the data for their unit (e.g., their region). They may not view data for another admin unit (e.g., another region). All users may view all subunits within their admin unit (e.g., a province within their region). APMIS currently supports national-, regional-, provincial-, and district-level users. The system was built for data entry of cluster-level data with known differentials in pattern of data entry across the country. It is also possible to import data via a batch or bulk upload (described in detail later in the document).

Table 1 shows detailed level of access and functionalities for each of user.

APMIS Users and Roles

User roles	Role in the system	APMIS version used	Main tasks in the campaign	Data level access	Language	APMIS forms used
Admin	Admin tasks & Data view	Web	• Create/Edit campaign • Dashboard defaults • Import/export historic data • Import/edit infrastructure data • User management • Validate forms • Data analysis via csv	all	English	
Partner	Data view	Web	• View data at national level	All	English	
National coordinator	Data view	Web	• Review data from all areas using the dashboard • Access to all data campaign levels • Export data • Data analysis via csv	all	English	all
Regional coordinator	Data view	Web	• View data from all provinces in region • Export data to csv • Data analysis via csv	own region	English	all
Province coordinator	Data view and entry	Web	• View data from all districts in province	own province	Pashtu/Dari/ English	all

			• Provincial data entry clerks will enter compiled data • Export data to csv • Data analysis via csv • Format paper data to excel and import as csv			
District coordinator	Data entry	Mobile /Web	• View district-level data • Enters data on paper or on the mobile APMIS • Export data to csv	own district	Pashtu/Dari/ English	District level data compilation sheet
Cluster coordinator	Data entry	Mobile /Web	• Enters data on paper (compilation tally forms) or on the mobile APMIS	mobile/Web	Pashtu/Dari/ English	Cluster data compilation sheet
Sub-cluster / village coordinator	Data entry	Mobile /Web	• Enters data on paper (compilation tally forms) or on the mobile APMIS	mobile/Web	Pashtu/Dari/ English	Sub cluster data compilation sheet
Teams	Data entry	Mobile /Web	• Enters data on paper (tally forms) or on the mobile APMIS	mobile/Web	Pashtu/Dari/ English	Tally sheet

8. Technical Background on Campaign Diagram and Form Definitions

The Campaign module of APMIS supports basic diagrams that can be displayed on the Dashboard. As with campaign form definitions that will be discussed in the next section, there is currently no user interface to insert these diagrams (add new forms directly) into the database.

As a result, these values are inserted into the “campaigndiagramdefinition” table in the database using a formatted text file to register the form definition in the database. Similarly, the Campaign module of APMIS also supports forms that can be defined using JSON and are dynamically built to display based on these definitions. To save these definitions for APMIS, they need to be manually added to the “campaignforms” table in the database.

It is the role of technical partners to assist users in modifying forms as needed by updating JSON templates. Typically this this involves providing an updated excel sheet or other document with the data fields identified by the APMIS users, which is then formatted into a JSON for uploading into the SQL database. It then will be available as a campaign data entry form.

9. Overview of Technical Design

APMIS is a secure web-based data system with accompanying mobile client. It is developed as an open-source system using the Vaadin 10 framework, JAVA EE Server (Payara) and PostgreSQL Database,

utilizing components from the SORMAS public health-oriented open-source tools. Further technical specifications and features of the system include:

- Secure access through Secure Socket Layer (SSL/https)
- SQL database
- Application Programming Interface (API) connectivity (for external applications)
- JSON form definitions (updated through direct database access)
- Mobile app (Android) option
- Dari and Pashtu language support
- User management by admins

The software source code, feature requests, backlogs and specifications are managed and documented open access under GitHub (https://github.com/xlg8/APMIS-Project).

The system is accessed via the url: https://afghanistan-apmis.com

Specific hardware and software requirements for optimal performance of the system include:

- Desktop
    - Modern Web Browser - Google Chrome or Mozilla Firefox Browser (recommended)
    - Windows Operating System (recommended)
    - Monitor capable of 1200x800 minimum resolution
    - Reliable Internet connection (minimum of 3 Mbps)
- Server
    - UNIX System Server (UBUNTU LTS 16) with 16GB RAM, and 500GB HDD
    - Central Processing Unit (CPU) with 64 bit (x86-64) CPU which can also run the 32-bit (x86) version of APMIS if necessary)
    - Vaadin Web Client (vaadin.org)
    - JAVA EE Server Payara
    - PostgreSQL Database (pgadmin)
    - CRONJOB Backup
- Mobile
    - Android OS 7 and above (for mobile application only)
    - Large screen mobile devices (tablets, laptops)
    - Occasional internet access (e.g. via data sim, hotspot)

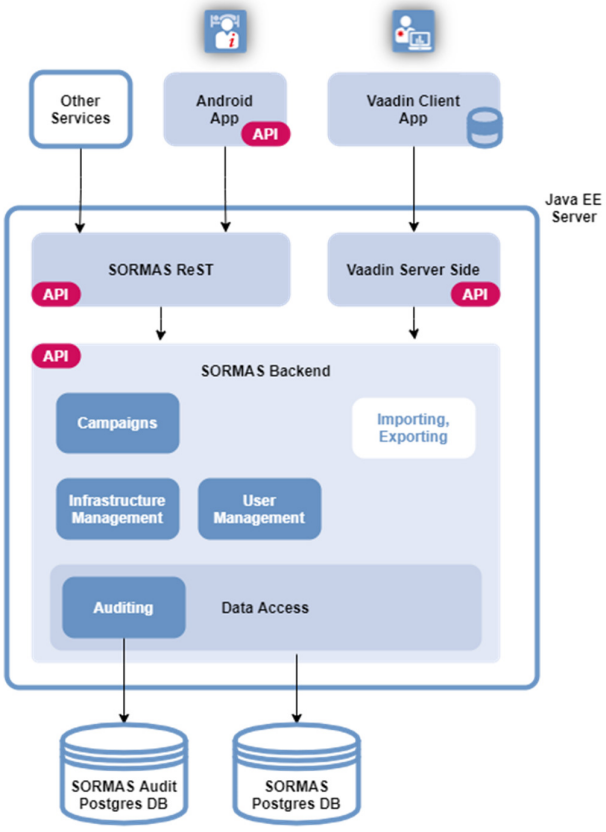
10.Technical details

Software Architecture

APMIS is a server-based system written primarily in Java and Javascript, based on the open-source SORMAS platform, a public health focused platform. The SORMAS architecture is divided into three layers:

1. the access layer with the frontends and the ReST interface, which gives access to the mobile app and external systems,
2. the business logic, which groups the different functionalities into domains, and
3. the access to the database.

In the access layer, there is a web application for the users, which was implemented with the Vaadin framework, and an Android app. Both are described in more detail below in the section "Web application" and "Android app". The web application is run on a Java Enterprise Application Server together with a ReST interface and the SORMAS backend.



The SORMAS API library includes the complete description of all data in the system and access to the business logic implemented by the SORMAS backend. It also includes translation, which is used in the web application and the Android app and can also be used by external systems.

The business logic is located in the SORMAS backend. It consists of a set of domains that cover the core functionalities of SORMAS (e.g. Campaigns) and are complemented by management and configuration components (e.g. Infrastructure Management). These are described in more detail in the section "Business Logic". In the data layer, a relational Postgres database is used. Access to it is via the Java Persistence API, which is implemented by Hibernate.

Hardware Architecture

The APMIS system is run on a server, e.g. hosted by a trusted hosting company or a public authority. The server may be a dedicated or a virtual server and should have a CPU with 2 or more cores at least 4GB RAM and 200+ GB hard disk.

The APMIS web application can be accessed on any device that supports a recent browser. The application is regularly tested using the latest versions of Chrome and Firefox.

The APMIS mobile app requires an Android device with Android version 7 or newer. Tablets with 7-10 inch displays are recommended, but smaller or bigger displays are supported.

API Interoperability with other systems (UNICEF, Hub Dashboard, XSmart, DHIS2)

The SORMAS ReST API (feature development is currently in process) can be used to connect other systems to SORMAS. It gives read and write access to the SORMAS infrastructure data and to the production data, e.g. the campaign data. It comes with an OpenAPI specification that can be accessed with Swagger-UI and other tools.

General Setup (Server configuration and installation of APMIS)

SORMAS comes with an automatic setup script for Linux systems. We recommend the latest Ubuntu LTS version. As prerequisite JDK 11 and PostgreSQL 10 are needed. Detailed server setup instructions are given in SORMAS GitHub.

The update of the database with all changes made and the migration of existing data is done automatically, as the system has its own versioning mechanism for the database schema.

Security

Users

A user account is needed to get access of any kind to APMIS. Users have one or more user roles, which in turn define a set of user rights and a scope of responsibility (e.g. a district or province).

APMIS has a standard set of user roles with predefined permissions. These permissions can currently be reconfigured in the database.

Authentication

- APMIS uses a combination of username and password for authentication.
- The password is generated (salted) based on a SHA-256 algorithm.
- Passwords are automatically generated by the system both when users are created and when they are reset
- Users may reset their password via the login page but must provide the username and email associated with the user, and then are sent a reset link
- If users do not know these values, an administrator will need to reset their password

Audit log and history tables

Two auditing mechanisms are currently used in APMIS. The first mechanism is an auditing log that documents every time data is changed or deleted, when this was done by which user and which fields changed in detail.

The second mechanism is the use of Postgres History Tables. These automatically create a copy of the previous status each time a database entry is changed and provide it with a validity period. This makes it possible to query the status of the data at any time in the past with simple SQL queries.