

# Sudan DHIS2 implementation eLMIS technical advisory

Last update 04.10.2023

HISP Centre University of Oslo

eLMIS team

---

**TABLE OF CONTENTS**

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Audience	5
1.2	Purpose	5
1.3	Project objectives	5
<b>2</b>	<b>Current situation</b>	<b>6</b>
2.1	Country information	6
2.2	National health services	6
2.3	National HMIS and DHIS2 implementation	6
2.4	National supply network	6
2.5	National eLMIS - <i>[for round two]</i>	5
2.6	Stock replenishment at the health facility level	19
<b>3</b>	<b>Advice for use of DHIS2 at health facility level</b>	<b>20</b>
3.1	Stock data collection	20
3.2	Collected data points	20
3.3	Means of data collection	22
3.4	Advice for future projects	23
<b>4</b>	<b>Advice on DHIS2 configuration</b>	<b>24</b>
4.1	Category option	24
4.2	Data element	24
4.3	Data set	24
4.4	Indicator	25
4.4.1	Stock coverage time	25
4.4.2	Stockout count	25
4.4.3	Stock availability	26
4.5	Indicator type	28

---

4.6	Legend	28
4.6.1	Stock coverage time / Max = C x 2	28
4.6.2	Stock coverage time / Max = C x 5	29
4.6.3	Stock days count	29
4.6.4	Stock availability	29
4.7	Predictor	30
4.7.1	Opening balance	30
4.7.2	Closing balance	30
4.7.3	Monthly average consumption	31
4.7.4	Stock max limit	31
4.7.5	Quantity required	32
4.8	Predictor group	33
4.9	Validation rule	33
4.9.1	Negative transaction values	34
4.9.2	Number of stockout days	35
4.9.3	Negative "Closing balance"	35
4.10	Scheduler	36
4.11	Advice for future projects	36
<b>5</b>	<b>Advice on DHIS2 integration with national ERP - [for round two]</b>	<b>37</b>
<b>6</b>	<b>Advice on stock replenishment at the facility level</b>	<b>39</b>
6.1	Order-up-to-level calculations	39
6.1.1	Monthly orders with "C x 2"	40
6.1.2	Monthly orders with "C x 5"	41
6.1.3	Quarterly orders with "C x 5"	41
6.2	Advice for future projects	41
<b>7</b>	<b>Advice on performance management</b>	<b>42</b>

---

7.1	Proposed LMIS metrics	42
7.2	Recommended analytics and metrics at the health facility level	42
7.2.1	Stock coverage time	42
7.2.2	Stockout	43
7.2.3	Stock availability	43
7.2.4	Stock losses	44
7.2.5	Stock discrepancy	45
7.2.6	Possible additional metrics	46
7.3	Recommended visualizations at the facility level	46
7.3.1	Overview of visualizations at health facility level	46
7.3.2	Stock data visualizations at health facility level	47
7.3.2.1	Stock data summary	47
7.3.3	Stock coverage time visualizations at health facility level	47
7.3.3.1	Stock coverage time	47
7.3.4	Stock availability visualizations at the item and health facility level	48
7.3.4.1	Number of stockout days / month / table	48
7.3.5	Stock availability visualizations at the product group and health facility level	49
7.3.5.1	Number of products in out of stock / month / table	49
7.3.5.2	Number of products in out of stock / mont / bar chart	49
7.3.5.3	Stock availability in % / month / table	50
7.3.5.4	Stock availability in % / month / bar chart	51
<b>7.4</b>	<b>Recommended performance metrics at the Locality level</b>	<b>51</b>
<b>7.5</b>	<b>Recommended performance metrics at the State level</b>	<b>51</b>
<b>7.6</b>	<b>Recommended performance metrics at the National level</b>	<b>52</b>
<b>7.7</b>	<b>Recommended performance management framework</b>	<b>52</b>
7.8	Advice for future projects	52
<b>8</b>	<b>Summary of advice for future projects</b>	<b>53</b>

8.1	General recommendations	53
8.2	Recommendations on data collection at the facility level	53
8.3	Recommendations on DHIS2 configuration	53
8.4	Recommendations on integration with national eLMIS	53
8.5	Recommendations on inventory control	53
8.6	Recommendations on analytics and visualizations	53

## 1 INTRODUCTION

This advisory refers to the "Functionality\_specification\_DHIS2\_Sudan.docx" titled:

"Specification of DHIS2-LMIS functionalities for Sudan"

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

with the objective to use DHIS2 at the locality level (round one) and later at health facility level (round two) for collecting stock data with the intention to, eventually, integrate DHIS2 with the existing ERP system.

### 1.1 Audience

The advisory is addressed to members of the project team and any other stakeholders seeking technical advice on logistics and supply chain management related issues.

### 1.2 Purpose

This document intends to serve the following purposes:

- document the concept on configuration for which HISP Centre UiO was responsible
- provide advice relevant to the project which was accepted by the project team
- provide additional advice on best practices which were not implemented but should be considered for future phases and/or future projects in Sudan.

### 1.3 Project objectives

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

## **2 CURRENT SITUATION**

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### **2.1 Country information**

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### **2.2 National health services**

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### **2.3 National HMIS and DHIS2 implementation**

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### **2.4 National supply network**

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### **2.5 National eLMIS**

[This draft chapter will be edited in case round two is implemented]

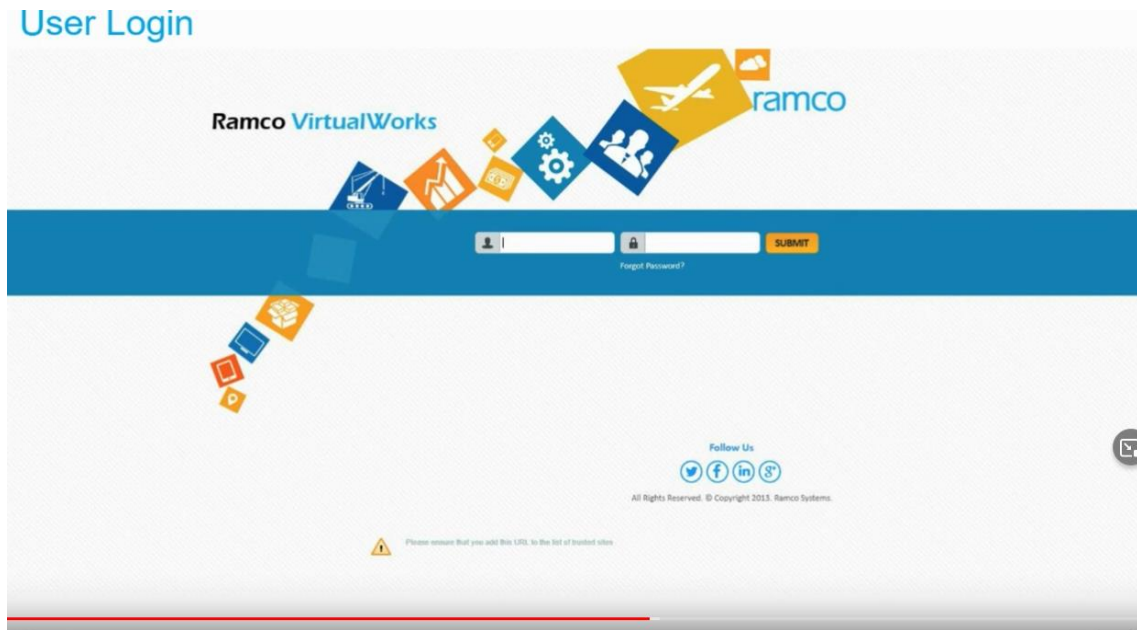
The ERP is developed by Ramco VirtualWorks an Enterprise cloud computing platform.

<https://www.ramco.com>

<https://www.ramco.com/products/erp-software/>

- Finance & Accounting

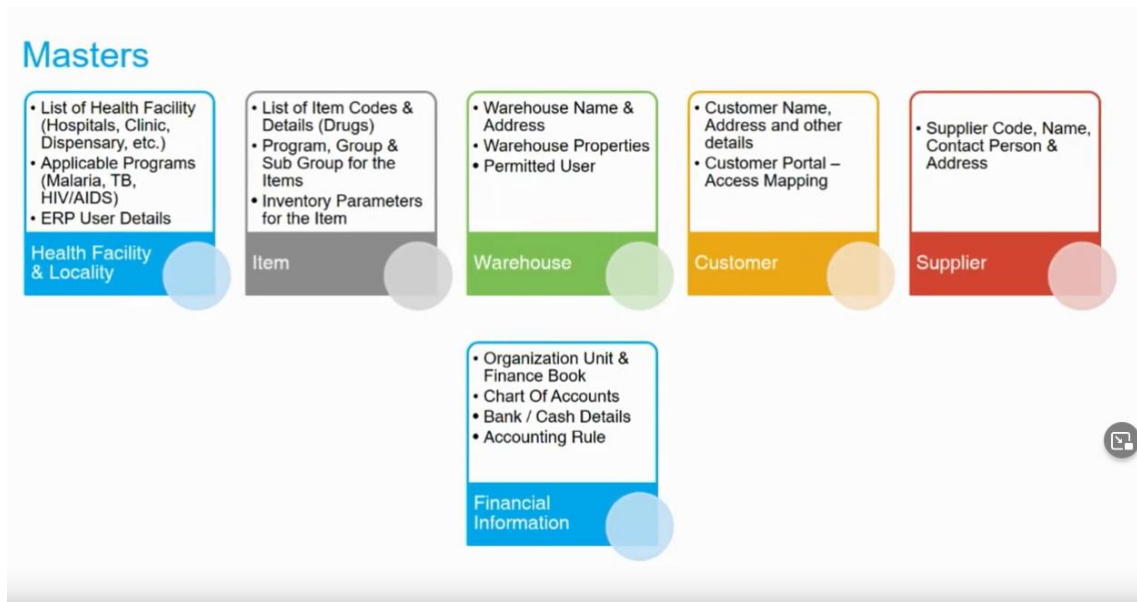
- Supply Chain Management



Xx

### Functionality

Xx

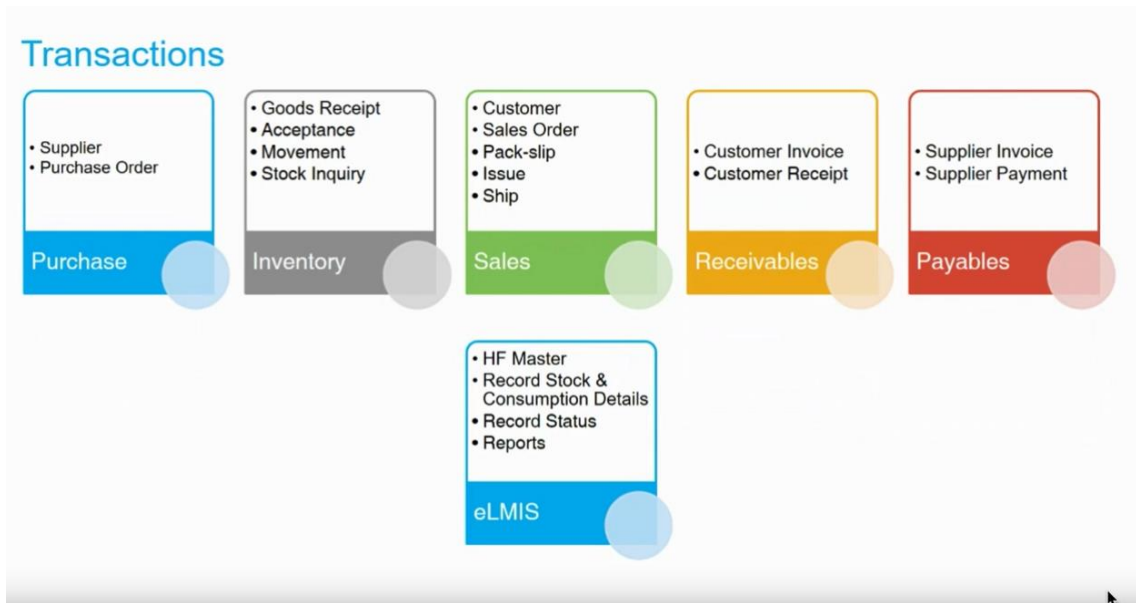


Xx





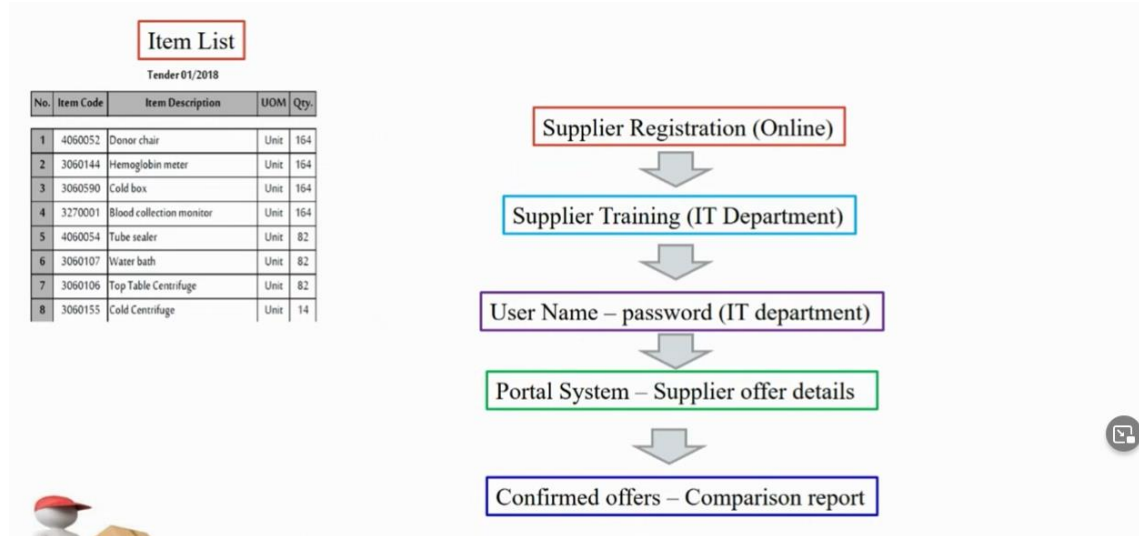
Xx



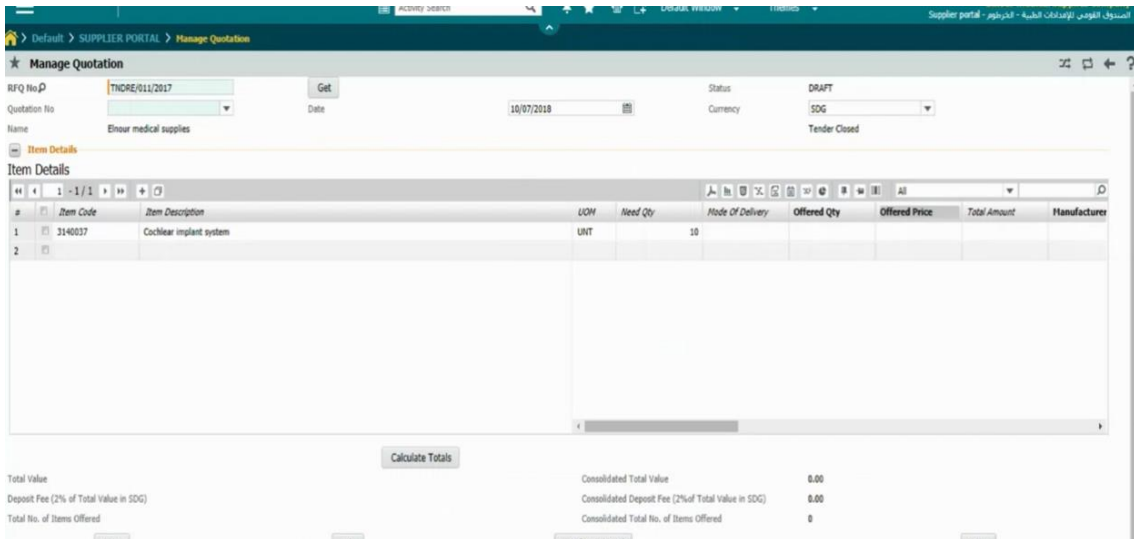
Xx

Supplier portal

Xx



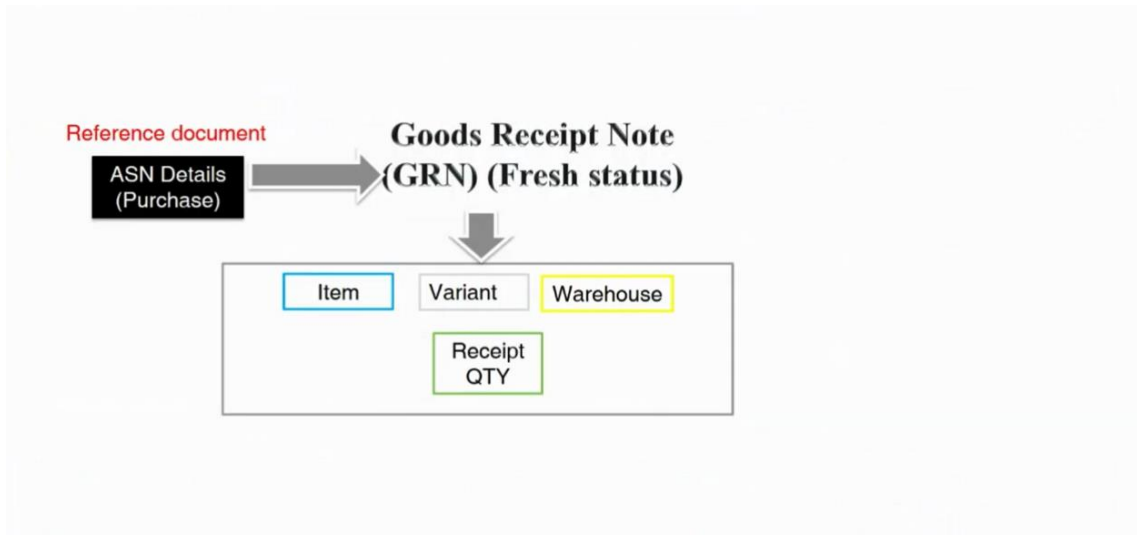
Xx



Xx

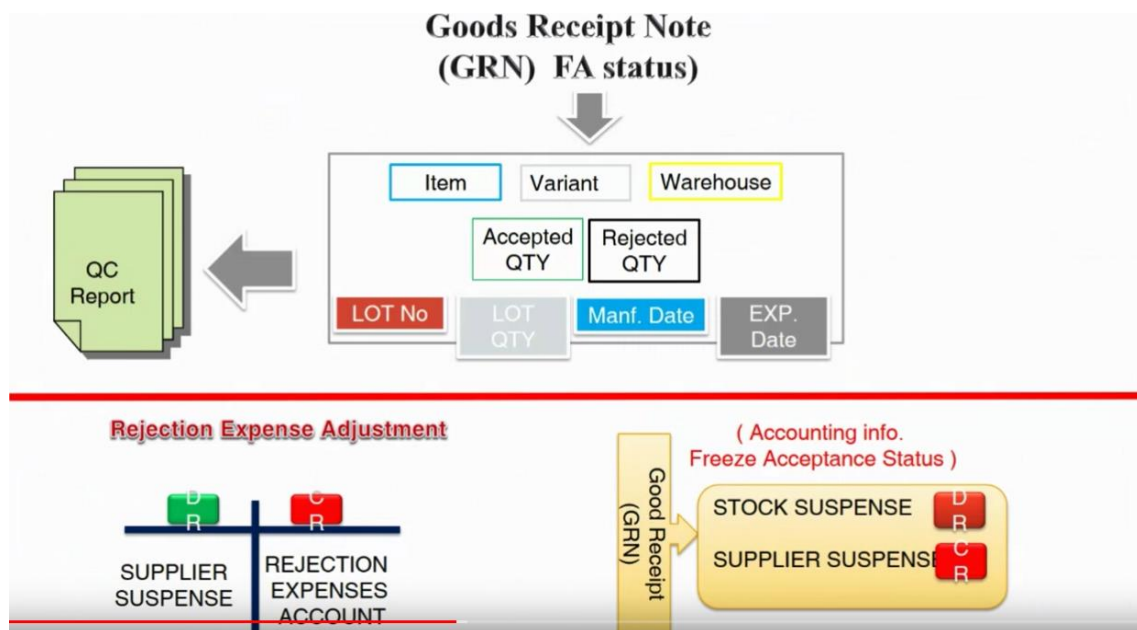
**Clearance**

Xx



Xx

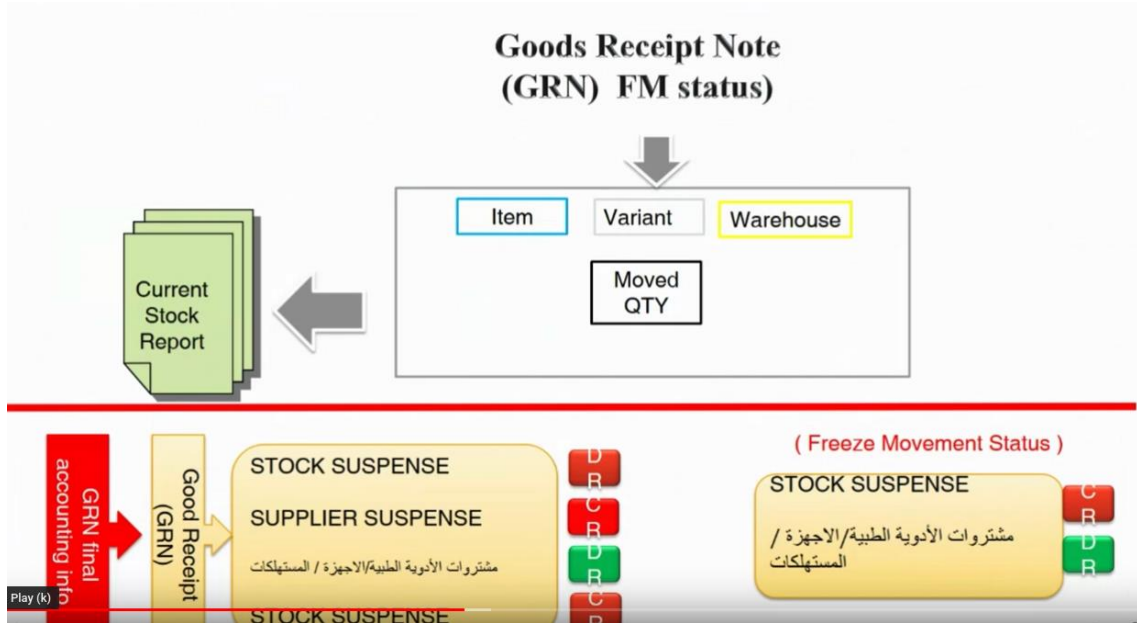
Quality control



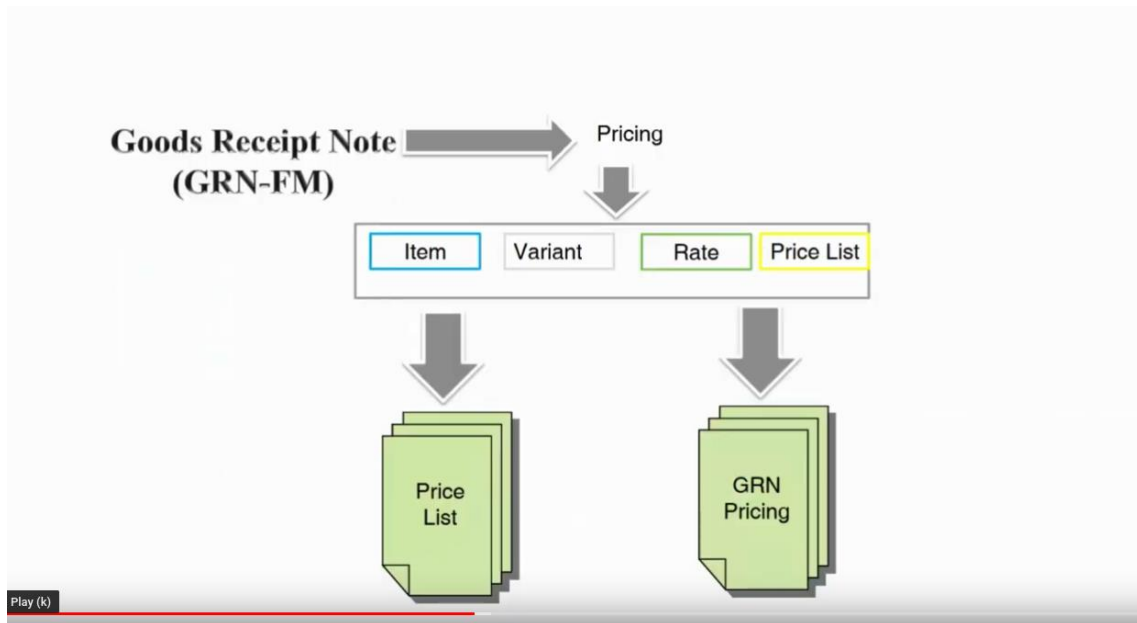
Xx

Goods receipt

Xx



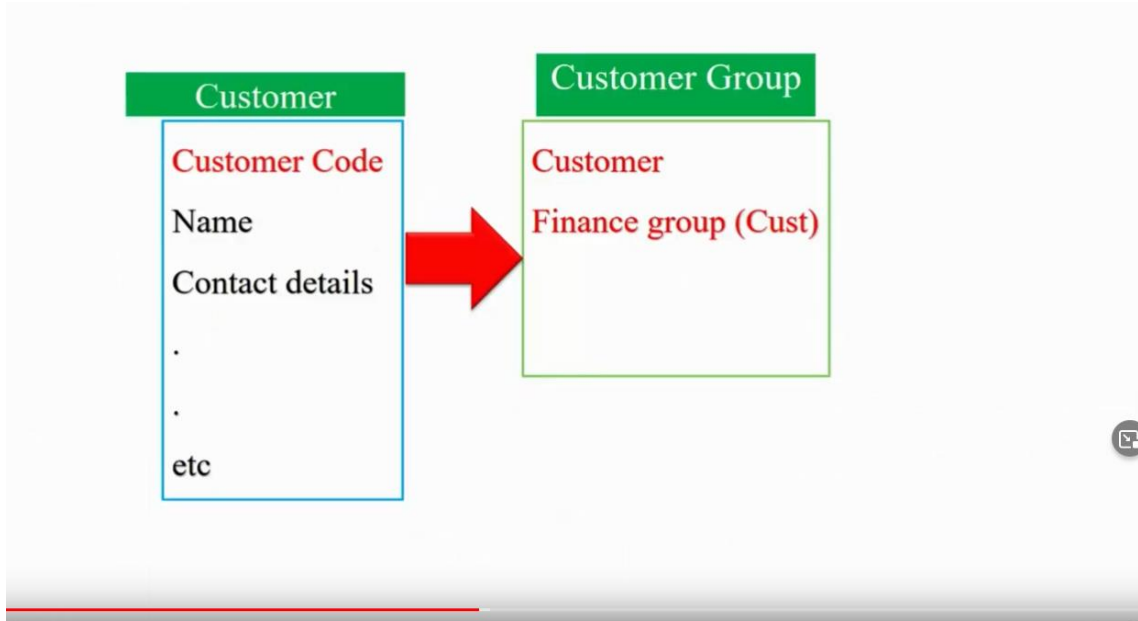
Xx



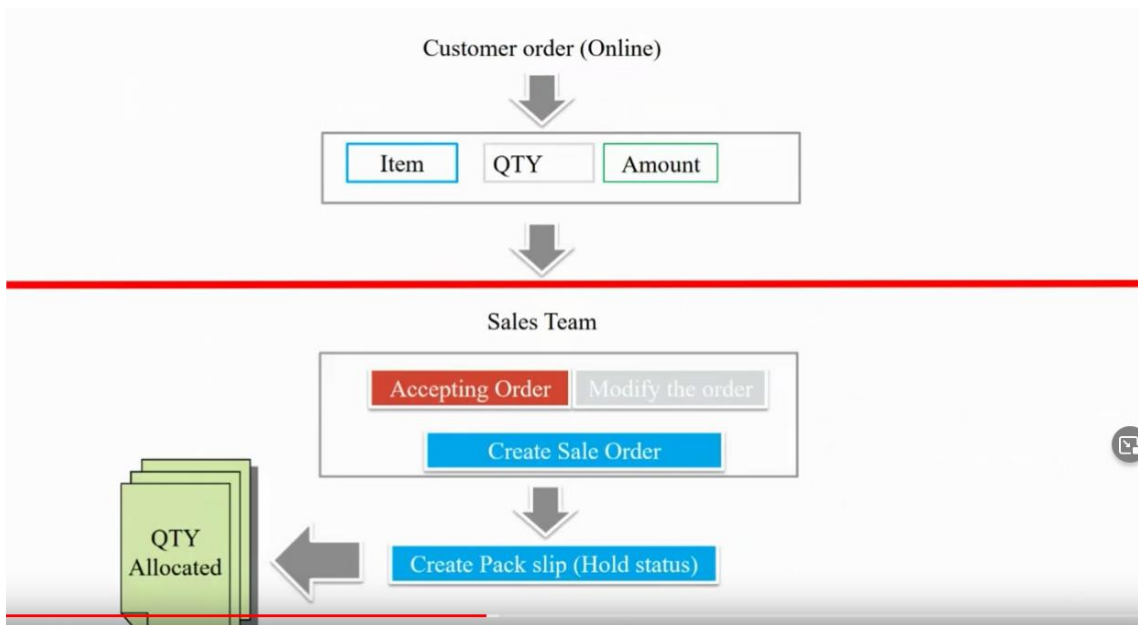
Xx

**Distribution**

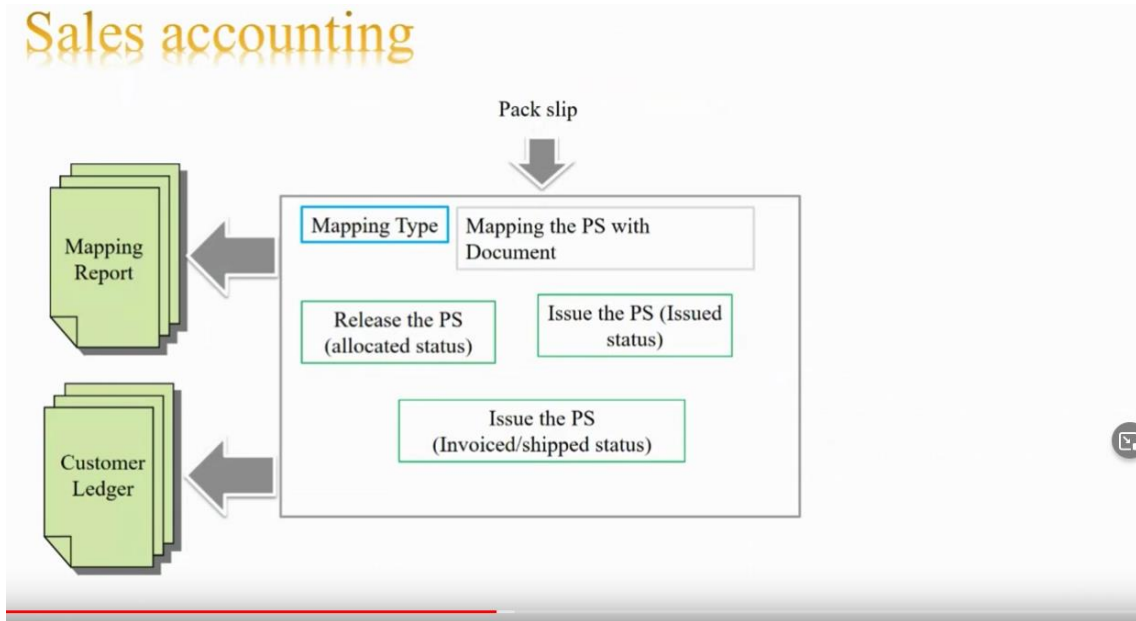
Xx



Xx



Xx

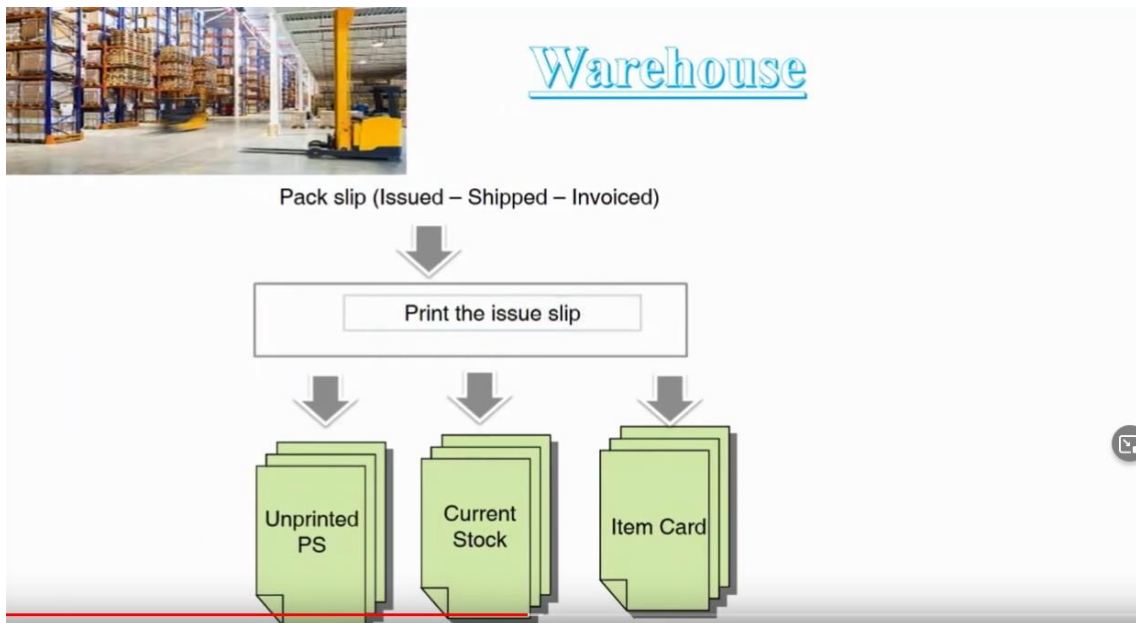


Xx

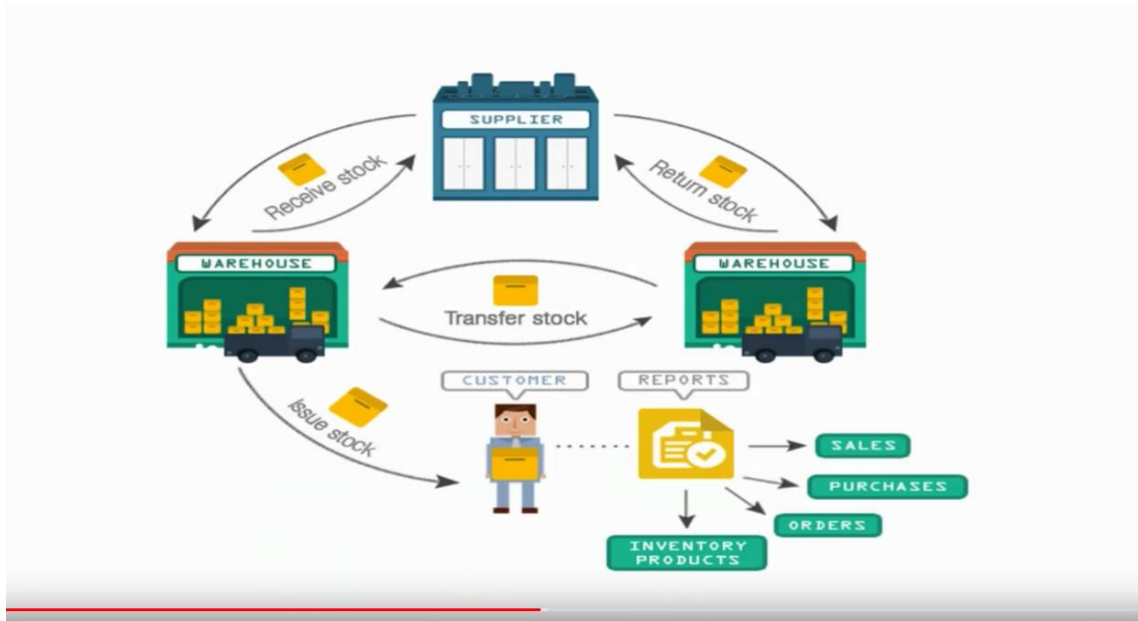
Any user, down to the health facility level, can place orders as long as they have Internet access and a user account in the ERP system.

### Warehouse management

Xx



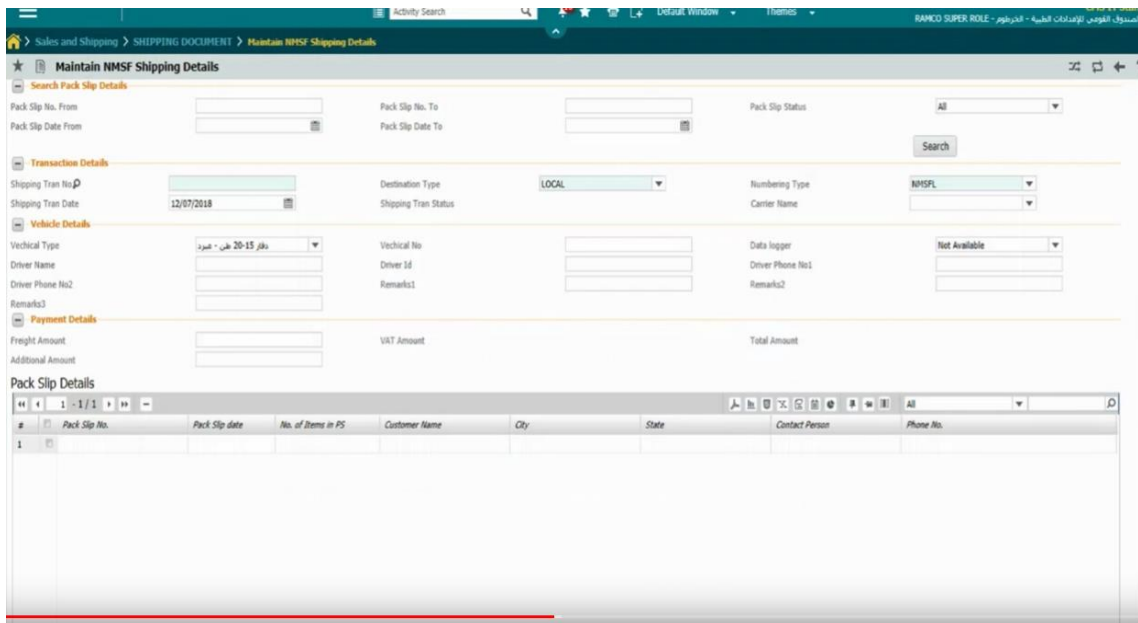
Xx



Xx

### Shipping

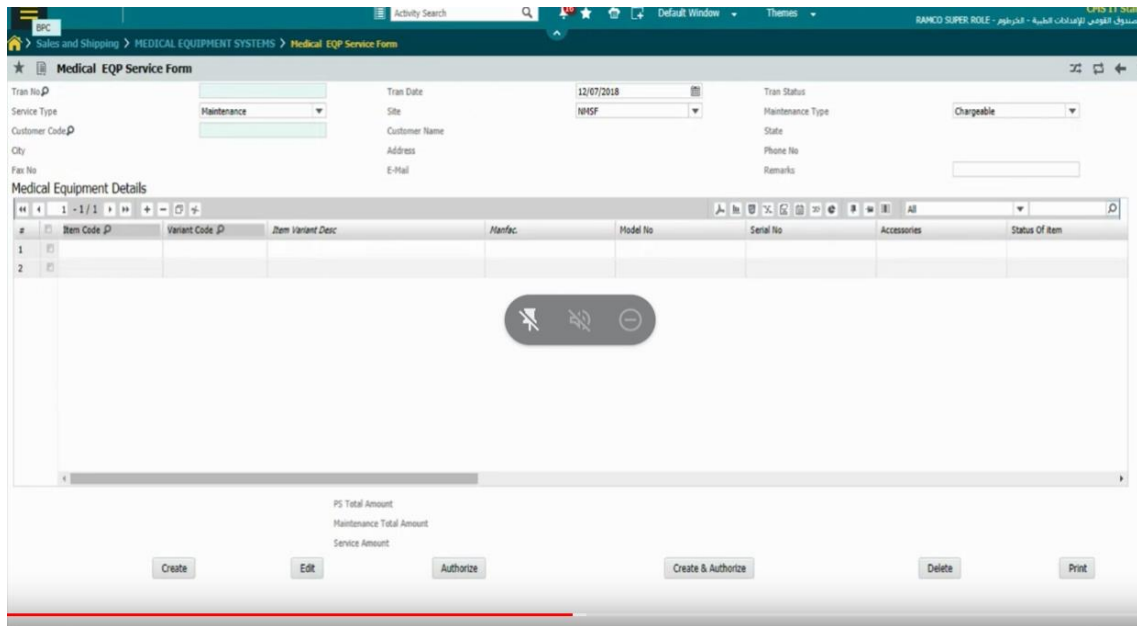
Xx



Xx

Biomedical equipment management

Only used a central level.

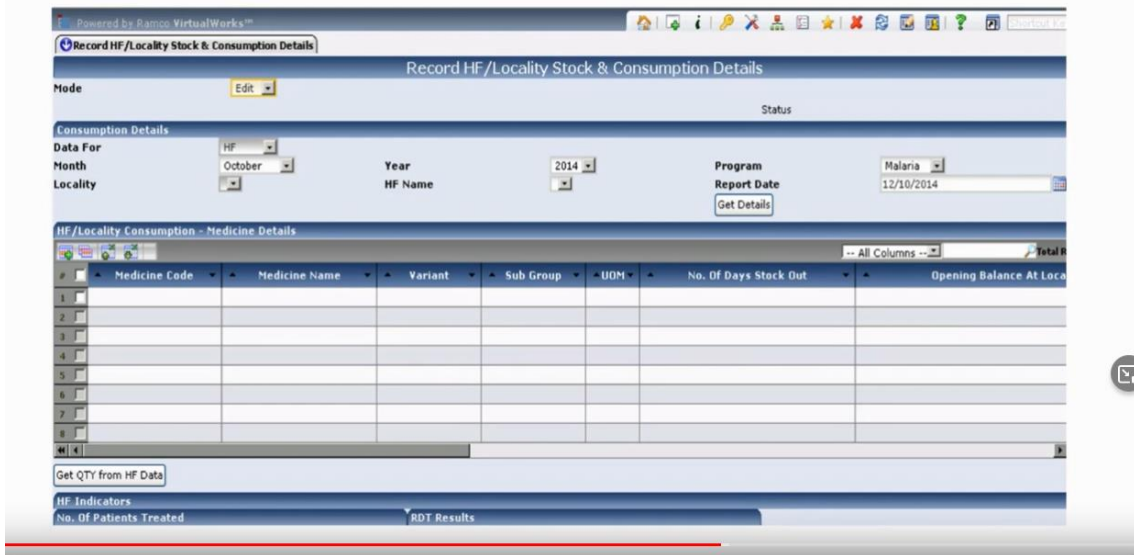


Xx

**Locality Stock & Consumption Details**

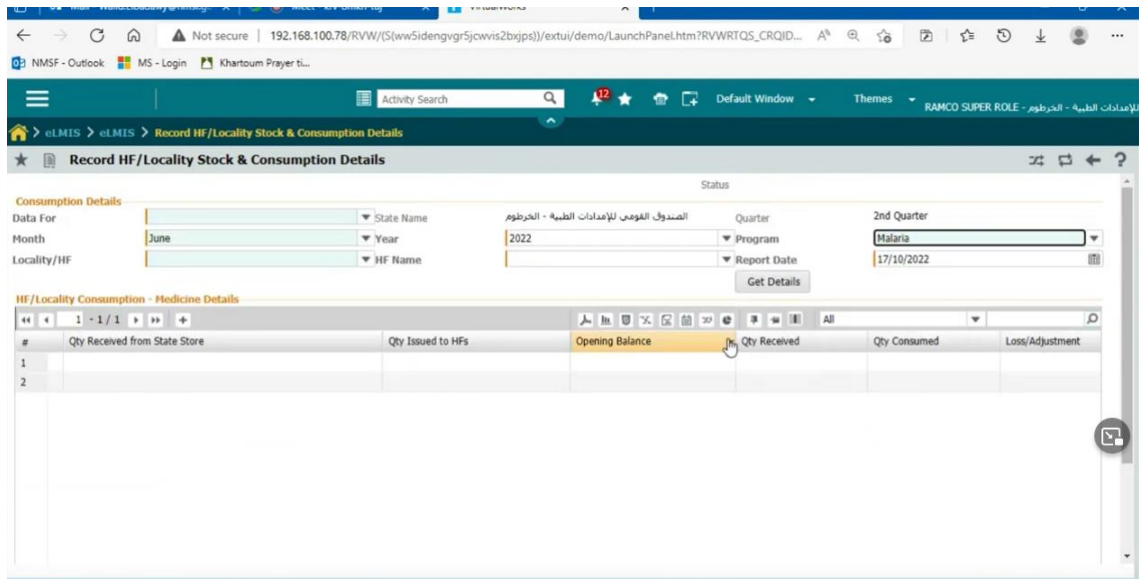
Xx

**Record HF/ Locality Stock & Consumption Details.**



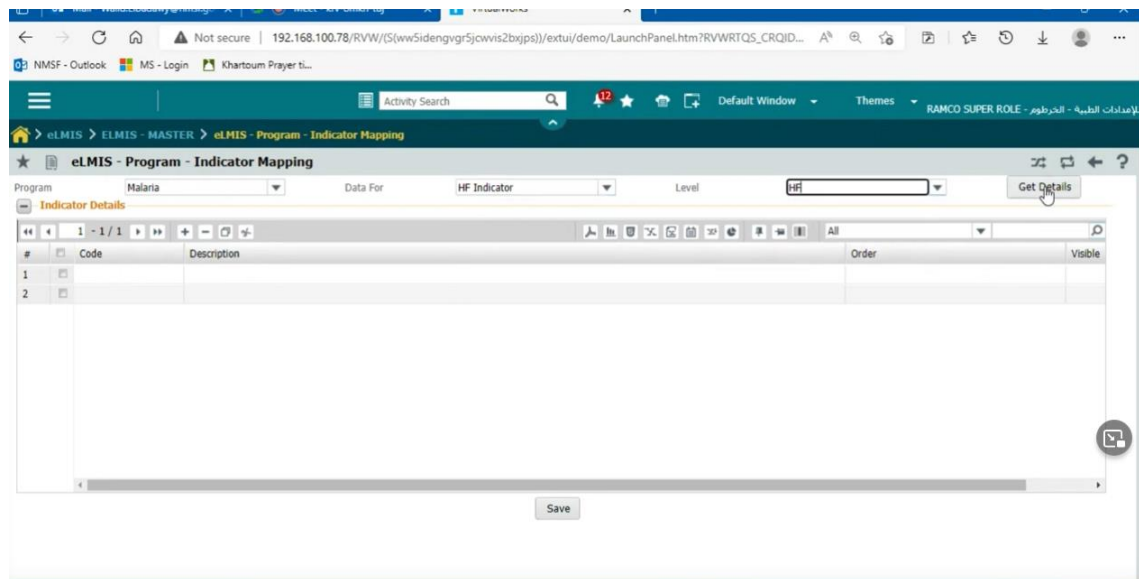
X



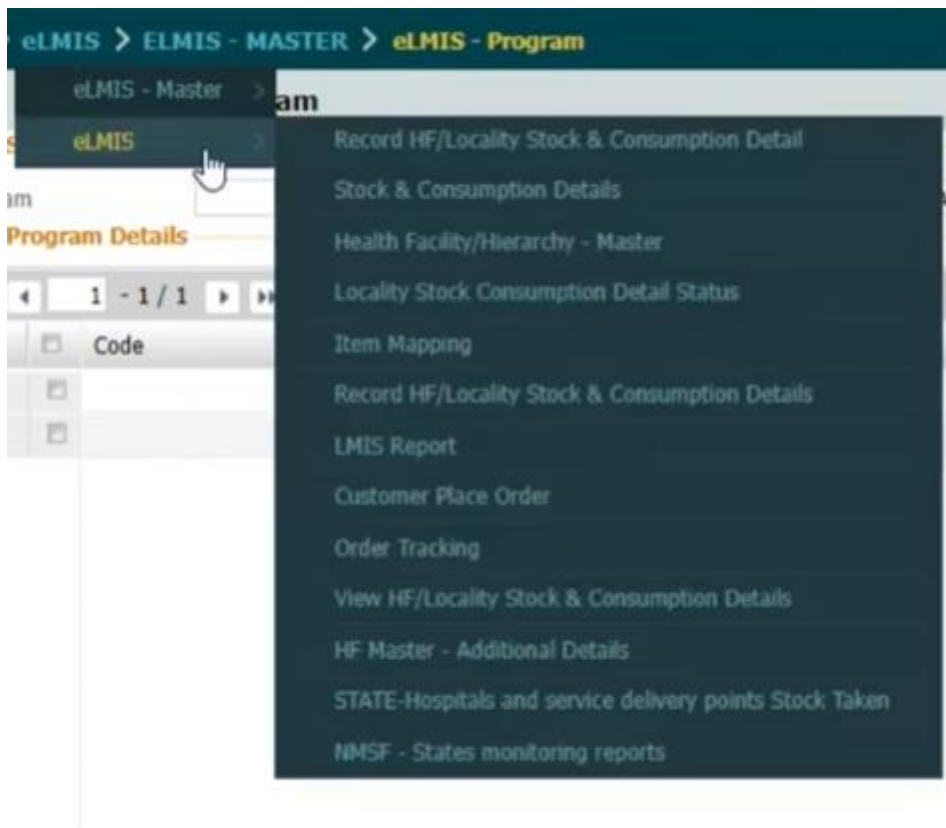


Xx

### Indicator mapping



Xx



Xx

Notes from Breno:

### 17.10.22 Sudan LMIS - NMSF ERP System

**Blaise, Dider, Mustafa, Walid, Breno**



- NMSF has 17 branches
- Conducting process in a centralized database
- Purchase, PR, quotations, supplier submit offers online, comparative lists, selection of items electronically

- Inventory including barcoding, distribution system, for all medicines, consumables and equipment
- **After 2018, no official support from the vendor, only support from the internal developers/IT staff**
- Multiple warehouse managed within the system, reports can be generated by item across warehouse... simplified reporting and work process... year end stock count and reporting for example

### Benefits

- An Integrated ERP System, Transactions will flow from one function to other function (Supply Chain Management)
- Facilitate to capture the Stock & Consumption data from Health Facility, Locality & States
- Helps to improve the stock monitoring at all levels
- Timely and accurate submission of reports and orders
- Reduced Stock Outs and visibility

- Biomedical engineering model, running at central level only

### eLMIS Module

- Full ERP functionality to be used at State Level
- In 2014-2015... attempted to use an Excel based tool to capture locality data... All localities given PCs... this is not in use... the situation now needs review... "is it working now or is it stopped, we need to review..." -Walid
- **State focal person using the eLMIS to enter the locality data, which is summarized from HFs**
- 

### Q/A

- What are the shortcomings? What would you like to improve?
- Who is the ERP vendor?
- Is the use of the ERP covering L1 and L2, capital to the 18 states?
- How many total users?
- Where are the Purchase Requests generated?
  - Any user, down to HFs, can generate orders, as long as they have internet access and have a user setup in the NMSF system
  - How about those without internet?
- How does the stock control system work? (What is the replenishment methodology used?)
- \*\*\* Facility level data... paper report to Localities, aggregation and reporting to state, which enters into the system? \*\*\*
  - Covering the 3 GF programs, HTM
  - User needs to define if the data is from HF or Locality
  - Localities, some do not have mobile coverage, no data transfer
  - HFs, there is an even greater challenge with connectivity
  - What is the completion rate and delays for reporting?

- What reports can you currently view with data from HF or Localities?
- Master Product List?
  - API?
  - What is the WHO standard coding system?
- What is the logistics metadata for the different products?
- MFL/OU, how is, or will, these facilities be aligned?
- ERP is in English? DHIS2 is in Arabic?
  - Yes
- **Main challenges**
  - (Walid) Capturing all information in ERP, automate the data from different branches/entities
  - Lower level data, lack of accuracy, timeliness
- (Walid) State MSF manager conducting all ordering and replenishment, then distributing to localities and HFs
  - All programs, free medicines, emergencies
- Master Facility List
- 

## 2.6 Stock replenishment at the health facility level

Please refer to the project documentation:

[https://docs.google.com/document/d/1rI9FIweiw2I\\_9sb85wkJ5PvFWRb1ituK/edit](https://docs.google.com/document/d/1rI9FIweiw2I_9sb85wkJ5PvFWRb1ituK/edit)

### 3 ADVICE FOR USE OF DHIS2 AT FACILITY LEVEL

Although in "Round 1" data will still be collected in manual records at the "Locality" level the facility level data will actually be entered into DHIS2 and in "Round 2" data collection at the facility level will be piloted. In any case, the same Data entry form will be used, regardless of whether facility level data is entered at the "Locality" or facility level.

#### 3.1 Stock data collection

Every health care facility will collect the following data for all health care products once a month (ideally on the last day of the month).

Note for all data points: for the sake of convenience for entering data by users, all data values (except for "Losses / Adjustments") are recorded as positive values although actually only stock receipts and positive adjustments increase stock on hand while stock issues and negative "Losses / Adjustment" actually decrease stock on hand. However, since it would be very cumbersome to request users to enter many "-" symbols, all calculations are adjusted to consider whether data points increase or decrease stock on hand.

It is important to note that the "Stock on hand", the most important data point which all stock reports must calculate, is not being recorded. This must be corrected in future revision of forms as soon as possible. In the current system, stock calculations are based on mathematical formulas without checks and balances. Users are able to record "Losses / Adjustments" but any logistics data collection system demands users to carry out a physical stock count which is not the case with this data collection system. It is therefore inevitable that mistakes will not be noted and perpetuated by theoretically correct calculations for months or even years without being noticed. This poses a significant risk that stock replenishment calculations are based on false high stock levels which will inevitably lead to shortages and stockouts, even if reporting is regular and "accurate".

Instead, the "Stock on hand" must be collected and the "theoretical calculations" can be used for checking data quality and the accuracy of stock management.

In general, some collected data points are redundant, DHIS2 is not suitable for inventory control calculations and several are unnecessary if the stock replenishment calculations are (eventually) completed in the national ERP system. Only the following data points are essential and should be collected:

- Stock on hand (based on a monthly complete physical stock count)
- Monthly stock issues ("Consumption")
- Stock corrections ("Losses / Adjustments")

Eventually, the implementation of the DHIS2-RTS (real time system) will require recording only of stock issues, stock discarded and stock corrections.

#### 3.2 Stock data collection

The following data points are configured, in different combinations, in DHIS2:

##### "Stockout days"

Calculated by hand from manual records and entered into a paper form which is then entered into DHIS2.

This data point is cumbersome to collect, not very accurate and could be dropped as more reliable metrics for measuring stock availability or available. It is not clear how this data is collected and doubts in the accuracy have been confirmed. No clear definition is available. Obviously a stockout day is calculated if a healthcare product was out of stock for the entire day but it is not clear how health care products are counted which stock out or are restocked during the day.

This metric can be automatically calculated in real-time if the DHIS2-RTS is implemented.

The recommendation is to remove the data collection and the field from any paper or digital reporting forms as soon as possible.

### **"Opening balance"**

The "Opening balance" represents the stock on hand on the first day of the month.

Calculated with a Predictor which "copies" the closing balance from the previous month (no need to re-enter identical values).

This data point is entirely redundant as it is identical with the "Closing balance" at the end of the previous month and should be removed from the forms and the data collection.

### **Quantity received**

Calculated by hand from manual records and recorded.

This data point is redundant with data from the ERP system and should be removed as soon as the integration of DHIS2 with the national ERP is completed.

### **Quantity consumed**

The correct term is "Quantity issued" as compresses, sutures, disinfectants etc. are not "consumed" and since after handing over healthcare products to wards and services it is unknown whether those products are used, expire, damaged or lost. In terms of professional and academic logistics terms this quantity represents the customer demand.

Calculated by hand from manual records and recorded.

### **Losses / Adjustments**

Calculated by hand from manual records and recorded.

These values can be goods removed from stock because of expiry or damage or represent stock corrections (either missing stock or "found in stock").

The value of the "Correction" must follow the same logic as the stock transactions of issuing stock in that a positive value corresponds to a decrease of stock on hand and a negative value to an increase in stock.

### **Closing balance**

Value calculated by a Predictor:

Opening balance + Quantity received - Quantity consumed + Correction

I recommended that "missing" stock is indicated as a negative value and "excess" stock is indicated with a positive value. Note that neither of the solutions (adding or subtracting) stock corrections is intuitive. Strictly speaking all transactions increasing stock (stock receipts and "positive corrections" should be positive and all decreasing stock (all others) should be negative. But it is not convenient to ask users to enter a large number of negative values and would be an endless source of mistakes.

### **Monthly average consumption**

The average monthly "consumption" (stock issues) is calculated by adding the "consumption" from the next to last month, the "consumption" from the previous month and from the current month and dividing the sum by 3.

The order of the simple moving average (that is whether the calculation of average demand is based on one, two, three or six months etc.) is absolutely critical for inventory control and should be carefully considered and documented.

The indication "AMC = C/3" is wrong (as "C" is equal to the "Quantity consumed" of a single month) and should be changed to "AMC" (or "AMC = avg C").

### **Stock max limit**

The correct term is "order-up-to-level". The term "Stock max limit" is not a professional or academic term and not clearly defined.

The value calculated by a Predictor, depending on the product group, by multiplying "average monthly consumption" with a factor specific to the product group:

- Average monthly consumption (AMC) x 2 (Only OIs, STIs drugs and HIV kits form)
- Average monthly consumption (AMC) x 5

### **Quantity required**

The correct term is "(required) order quantity". The value is calculated by a Predictor: "Stock max limit" - "Closing balance".

Note that this calculation is incorrect as stock on order is not being considered.

## **3.3 Means of data collection**

Currently and in "round one" all stock is recorded in pre-printed paper forms which are sent to the locality level where the data is entered into DHIS2. This system has several very significant disadvantages:

- unnecessary duplication of data recording and management
- delay caused by sending paper forms to the locality level
- significant risk of errors due to re-typing of data

Therefore, this paper-based system should be replaced by digital data collection on mobile devices at the medical store in the healthcare facility as soon as possible.

Although only planned for round two, a user profile has been created for ensuring that the Data entry forms are visible and editable on mobile devices:

User name: data

Password: [provided by the Sudan team on request]

### **3.4 Advice for future projects**

Xx

- Stock data should be collected directly at the health care facility level on mobile devices (rather than being recorded on paper and being entered at the district level)
- Stop recording "Stockout days" (cumbersome for staff to collect, inaccurate and alternative metrics for stock availability are available)
- Collect only distribution quantities ("Quantity consumed"), stock on hand, stock corrections and stock on hand
- Drop "Opening balance" (not needed), "Stock received" (redundant with national LMIS), "Closing balance" (not needed), "Monthly average consumption" (not needed), "Stock max limit" (not needed), "Quantity required" (not needed, should be calculated by national LMIS)
- Pilot and eventually implement a transactional stock reporting system (DHIS2-RTS)



## 4 ADVICE ON DHIS2 CONFIGURATION

According to the project plan, HISP Rwanda and the Sudan team are in charge of all of the DHIS2 configuration. However, in order to meet a very ambitious timeline, HISP Centre UiO assisted with some of the metadata configuration which is therefore documented below.

### 4.1 Category option

The Category option descriptions should be kept as short as possible in order to minimize the width of columns, particularly when using mobile devices.

The "Opening balance (A)" of the current month is redundant with the "Closing balance (E = (A+B-C +/-D))", unnecessary and should be removed in future.

"Monthly avg consumption (AMC = C/3)" is wrong and should be changed to AMC = avg C).

### 4.2 Data element

The option "Store zero data values" must be selected for all Data elements in order to show stock on hand and stock issues ("consumption") of zero to distinguish from data fields where no data has been entered. Moreover zero values are critical for some calculations. For example Predictor calculations do not consider empty fields and yield no results.

For consistency, all or none of the descriptions should include the Arabic translation.

The "Value type (\*)" should be set to "Integer" for all Data elements as the Predictor calculations for the "Stock max limit" and "Quantity required" will then be rounded (by definition, health care products can only be recorded and replenished in positive integer quantities).

Note that any Predictor calculations depending on another Predictor output will be calculated based on the round Predictor output field. For example, if the average "consumption" is 10.33 then the "Stock max limit (C x 5) will be  $5 \times 10 = 50$  and (not  $10.33 \times 5 = 51.66$  which would be rounded to 52). However the maximum difference for the "Stock max limit" is 2.5 which is a small quantity. However, if this ever becomes an issue (for items with very low demand), this inaccuracy can be removed by repeating the calculation in the "Stock max limit (C x 5) column" and only rounding the final number.

Best practices require that all item description for finished drug products feature at least the following details:

- INN (international non-proprietary name) of all active pharmaceutical ingredients
- the strength (concentration of API per unit dose)
- presentation (tablet, capsule, lozenge, ampoule etc.)

Single use medical devices must also be described accurately such as indicating the volume of syringes or details of diagnostic tests.

### 4.3 Data set

The health care products in all Data entry forms are displayed in arbitrary order which is unworkable for any properly organized medical store. Best practices requires that all health care products are stored in the following order:

- by type of products (oral drug products, injectable drug products, diagnostic tests etc.) and within each of these product groups

- in alphabetical order of non-proprietary name.

In other order, such as first line, second line treatment or other systems are not suitable as they are not relevant for and maybe unknown to storekeepers.

#### 4.4 Indicator

Indicators were created for calculating the following three logistics metrics:

- Stock coverage time by item (Data element)
- Stockout count by product group
- Stock availability by product group

##### 4.4.1 Stock coverage time

The stock coverage time is calculated by dividing the stock on hand ("Closing balance") at the end of the month by the stock issues ("Quantity consumed") of the same month and present the number of months stock can be issued provided the monthly stock issues in the future do not vary from the current month and provided that no stocks are supplied, expired or damaged.

Note that in case stock issues ("consumption") is zero the calculation does not return any valid mathematical result as division by zero is not meaningful. One could argue that if there is no demand, stocks will last forever. But if demand is zero forever, then it is not meaningful to maintain any stocks.

All indicators are configured in the same way, for example:

`#{yD2omRpwdgO.q4nUkyLO4i8} / #{yD2omRpwdgO.fvhhGVRUGZ3}`

HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/- D)) / HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Quantity consumed

##### 4.4.2 Stockout count

This indicator counts the number of healthcare products with a "Closing balance" of zero in the respective month and across one of the following product groups:

- ART
- MALARIA
- OI
- STI
- TB

The indicator is calculated by an if statement which returns "1" in case of a stockout and "0" if stock on hand is available for each item in the respective product group and then simply calculating the sum. For example ART Stockout count:

```
if(#{yD2omRpwdgO.q4nUkyLO4i8}==0,1,0) +
if(#{H8dprYadM7u.q4nUkyLO4i8}==0,1,0) +
if(#{sC1OsytImGV.q4nUkyLO4i8}==0,1,0) +
if(#{J9HnmvKmvnA.q4nUkyLO4i8}==0,1,0) +
```

if({xbW7MJBpzsP.q4nUkyLO4i8}==0,1,0) +  
 if({eR9YUwacfW6.q4nUkyLO4i8}==0,1,0) +  
 if({tcVsfRfuYa3.q4nUkyLO4i8}==0,1,0) +  
 if({wqax0HZ8j8C.q4nUkyLO4i8}==0,1,0) +  
 if({aZ5bYol8eGJ.q4nUkyLO4i8}==0,1,0) +  
 if({zfOIPV4Xsi4.q4nUkyLO4i8}==0,1,0) +  
 if({l4bK7nexBzO.q4nUkyLO4i8}==0,1,0) +  
 if({Zlvp0H691Ql.q4nUkyLO4i8}==0,1,0) +  
 if({mm0V0sUTjNd.q4nUkyLO4i8}==0,1,0) +  
 if({cx2PPIYDfrQ.q4nUkyLO4i8}==0,1,0) +  
 if({yCKmQ6SkZwV.q4nUkyLO4i8}==0,1,0) +  
 if({q63BfVrtFT0.q4nUkyLO4i8}==0,1,0) +  
 if({ucUqa4cZfzZ.q4nUkyLO4i8}==0,1,0)

if(HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Abacavir/ Lamivudine (60/30) mg tab Ped, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Abacavir/ Lamivudine (600/300) mg tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Efavirenz 200 mg tab, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Efavirenz tabs 600mg, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Lamivudine 10mg/1 ml 100ml/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Lopinavir/ Ritonavir (Kaletra) (200/50 mg) tabs, 120 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Lopinavir/ Ritonavir (Kaletra) (100/25 mg) tabs, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Nevirapine 50 mg/5ml syrup, bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Nevirapine Tabs 200mg, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Tenofovir/Lamivudine (Tenolam) (300/150)mg tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Tenofovir/Lamivudine/Efavirenz (Atripla) (300/300/600)mg tab. (1E), 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Zidovudine 50mg/5ml, 30 bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Zidovudine/ Lamivudine (60/30mg) (Zedolam- ped) (4C), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Zidovudine/ Lamivudine/ Nevirapine (60/30mg/50mg) (Zidolam-N ped) (4D), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Zidovudine/ Lamivudine/ Nevirapin (Zidolam-N Adult (300/150/200) mg tab.(1D), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + if(HIV-ART-Zidovudine/Lamivudine (300/150)mg tab (Zidolam) (1C), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0)

#### 4.4.3 Stock availability

Stock availability is defined as the percentage of healthcare products of the respective product group which have a positive (non-zero) "Closing balance" in the respective month.

As indicator calculations cannot be based on other indicators, the calculation of the stockout count has to be repeated and the stock availability is calculated as follows:

$$([\text{number of products in the product group}] - [\text{number of stockouts in the product group}]) /$$

[number of products in the product group] \* 100

For example for HIV-ART Stock availability:

(18 -

(if({yD2omRpwdgO.q4nUkyLO4i8}==0,1,0) +  
 if({H8dprYadM7u.q4nUkyLO4i8}==0,1,0) +  
 if({sC1OsytImGV.q4nUkyLO4i8}==0,1,0) +  
 if({J9HnmvKmvnA.q4nUkyLO4i8}==0,1,0) +  
 if({xbW7MJBpzsP.q4nUkyLO4i8}==0,1,0) +  
 if({eR9YUwacfW6.q4nUkyLO4i8}==0,1,0) +  
 if({eR9YUwacfW6.q4nUkyLO4i8}==0,1,0) +  
 if({tcVsfRfuYa3.q4nUkyLO4i8}==0,1,0) +  
 if({wqax0HZ8j8C.q4nUkyLO4i8}==0,1,0) +  
 if({aZ5bYol8eGJ.q4nUkyLO4i8}==0,1,0) +  
 if({zfOIPV4Xsi4.q4nUkyLO4i8}==0,1,0) +  
 if({l4bK7nexBzO.q4nUkyLO4i8}==0,1,0) +  
 if({Zlvp0H691Ql.q4nUkyLO4i8}==0,1,0) +  
 if({mm0V0sUTjNd.q4nUkyLO4i8}==0,1,0) +  
 if({cx2PPIYDfrQ.q4nUkyLO4i8}==0,1,0) +  
 if({yCKmQ6SkZwV.q4nUkyLO4i8}==0,1,0) +  
 if({q63BfVrtFT0.q4nUkyLO4i8}==0,1,0) +  
 if({ucUqa4cZfzZ.q4nUkyLO4i8}==0,1,0))) / 18 \* 100

(18 - (if(HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Abacavir/ Lamivudine (60/30) mg tab Ped, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Abacavir/ Lamivudine (600/300) mg tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Efavirenz 200 mg tab, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Efavirenz tabs 600mg, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Lamivudine 10mg/1 ml 100ml/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Lamivudine 10mg/1 ml 100ml/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Lopinavir/ Ritonavir (Kaletra) (200/50 mg) tabs, 120 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Lopinavir/ Ritonavir (Kaletra) (100/25 mg) tabs, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Nevirapine 50 mg/5ml syrup, bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Nevirapine Tabs 200mg, 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Tenofovir /Lamivudine (Tenolam) (300/150)mg tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Tenofovir/Lamivudine/Efavirenz (Atripla) (300/300/600)mg tab. (1E), 30 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Zidovudine 50mg/5ml, 30 bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Zidovudine/ Lamivudine (60/30mg) (Zedolam- ped) (4C), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))==0,1,0) + if(HIV-ART-Zidovudine/ Lamivudine/ Nevirapine (60/30mg/50mg) (Zidolam-N ped) (4D), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-

$D))=0,1,0) + \text{if}(\text{HIV-ART-Zidovudine/ Lamivudine/ Nevrapin (Zidolam-N Adult (300/150/200) mg tab.(1D), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0) + \text{if}(\text{HIV-ART-Zidovudine/Lamivudine (300/150)mg tab (Zidolam) (1C), 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D))=0,1,0)) / 18 * 100$

The indicators for the remaining product groups are calculated likewise and consider the different number of products in each product group:

ART:  $(18 - (\text{if}([\text{Data element}].\text{Closing balance})=0,1,0) + \dots) / 18 * 100$

MALARIA:  $(23 - (\text{if}([\text{Data element}].\text{Closing balance})=0,1,0) + \dots) / 23 * 100$

OI:  $(22 - (\text{if}([\text{Data element}].\text{Closing balance})=0,1,0) + \dots) / 22 * 100$

STI:  $(15 - (\text{if}([\text{Data element}].\text{Closing balance})=0,1,0) + \dots) / 15 * 100$

TB:  $(30 - (\text{if}([\text{Data element}].\text{Closing balance})=0,1,0) + \dots) / 30 * 100$

#### 4.5 Indicator type

A single indicator type is created:

Name (\*): "Factor 1"

Factor (\*): "1"

#### 4.6 Legend

Three legends were created:

- Stock coverage time / Max = C x 2 (only OI product group)
- Stock coverage time / Max = C x 5 (ART, MALARIA and TB group)
- Stockout days count

In addition, a legend should be applied to the "Stock availability" indicator but no ranges were provided.

##### 4.6.1 Stock coverage time / Max = C x 2

The ranges are based on the correct consideration that:

- stock on hand should not fall below the safety stock level
- stock on hand should fluctuate between the safety stock level (minimum bound) and safety stock level plus working stock (upper bound) which is demand during the review period (one month of demand)
- stock on hand should not exceed the safety stock plus working stock

Therefore the ranges were configured as follows:

- Stockout: 0 months
- Understock: 0-1 months
- Adequate stock: 1-2 months
- Overstock: above 2 months stock.

#### 4.6.2 Stock coverage time / Max = C x 5

Therefore the ranges were configured as follows:

- Stockout: 0 months
- Understock: 0-2 months
- Adequate stock: 2-5 months
- Overstock: above 5 months stock.

The lower limit is chosen arbitrarily and not consistent with the upper limit. As monthly reports are made a review period of one month is assumed. Therefore, stock on hand should be fluctuating between 4 and 5 months (and not 2 and 5 months).

#### 4.6.3 Stock days count

As no ranges were provided, weekly time buckets were configured as these seem more intuitive (a healthcare product was out of stock for one or two weeks) than percentages:

- "0": 0
- "1 - 7": 0 to 7
- "7 - 14": 7 to 14
- "14 - 21": 14 to 21
- "21 - 31": 21 to 31

This is an initial suggestion which can easily be modified.

#### 4.6.4 Stock availability

During the meeting on 19.09.2023 initially the consideration is that any value below 100% is deficient and it is therefore confirmed that no legend is needed. However, later during the day, another suggestion is made by Ismail Kareem on What'sapp which is implemented:

- "0-20": 0 to 20
- "21 - 40": 21 to 40
- "41 - 60": 41 to 60
- "61 - 80": 61 to 80
- "81 - 100": 81 to 100

#### 4.7 Predictor

As a general comment, the use of Category options and Category combinations requires configuring any calculated value which needs to be displayed in the Data entry form as Predictor as Indicators do not have "Output category option combo" to assign calculations to. Moreover, indicators do not allow using data values from previous time periods which is required for calculating the average monthly consumption.

Unlike indicators, Predictors need to be run "manually" or through the Scheduler app every time any data used in the calculation is changed.

By default, Predictors will return decimal values which are not meaningful as stock replenishment quantities can only be integer and the large number of decimals is overwhelming to users. Therefore the "Value type (\*)" of all Data elements needs to be set to "Integer" which (also) prevents entry of non-integer values by users and prompts the Predictor to round calculated decimal values to the nearest integer value.

#### 4.7.1 Opening balance

The "Opening balance" is identical with "Closing balance" from the previous month. In order to prompt the Predictor to use data from the previous month, the use of "avg" (or "sum" etc.) is indispensable. Example for the configuration of one Predictor:

"Name (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle - Opening balance - PR

"Output data data element (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle

"Output category option combo": "Stock - Opening balance (A)"

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator": avg({yD2omRpwdgO.q4nUkyLO4i8})

avg(HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/-D)))

"Sequential sample count (\*)": 1

This Predictor calculates the "Opening balance" of the current month as "average" "Closing balance" from the previous month.

#### 4.7.2 Closing balance

The "Closing balance" is calculated by adding the Stock receipts and the "Losses / adjustments" to the "Opening balance" and deducted the stock issues ("Consumption"). Example for the configuration of one Predictor:

"Name (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle - Closing balance - PR

"Output data data element (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle

"Output category option combo": "Stock - Closing balance (E = (A+B-C +/-D))

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator": {yD2omRpwdgO.KQA4LimW0sZ}+#{yD2omRpwdgO.aCixivwLTGT}-#{yD2omRpwdgO.fVhhGVRUGZ3}+#{yD2omRpwdgO.SN3pOZggqut}

HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Opening balance (A)+HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Quantity received (B)-HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Quantity consumed (C)+HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Correction (D-/+)

"Sequential sample count (\*)": 0

Note that the "Sequential sample count (\*)" of "0" is used as all data values from the current period are used and therefore no avg (sum, max, etc.) is needed in the Predictor calculation.

### 4.7.3 Monthly average consumption

The "average consumption" (issued stock quantity) is calculated by adding the "consumption" from the next to last month, the "consumption" from the previous month and from the current month and dividing the sum by 3. Example for the configuration of one Predictor:

"Name (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle - AMC - PR

"Output data data element (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle

"Output category option combo": "Stock - Monthly avg consumption"

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator": (sum({yD2omRpwdgO.fVhhGVRUGZ3})+#{yD2omRpwdgO.fVhhGVRUGZ3})/3

(sum(HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Quantity consumed (C))+HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Quantity consumed (C))/3

"Sequential sample count (\*)": 2

Note that this Predictor uses data from two previous periods (invoked by the "sum" and "Sequential sample count" of 2 as well as the current period invoked by the second term (without any "avg" etc.) and dividing the total (of three months) by three.

For the "monthly average consumption" for the quarterly reporting forms, the "average monthly consumption" is calculated simply by dividing the quarterly "consumption" by 3.

### 4.7.4 Stock max limit

All "Stock max limit" calculations are based on the past three months of average stock issues ("Consumption"). If the "AMC" is already available as a calculated field (Category option) the "Stock max limit" is calculated simply by multiplying by 2 or 5 accordingly. If the "AMC" is not available, then the same calculation as used for the "AMC" is reproduced in the "Stock max limit" field (Category option) and then multiplied with 2 or 5 accordingly.

The "Stock max limit" is calculated by multiplying the "Monthly average consumption" (available only in some Data entry forms) or calculating the "Monthly average consumption" (see above) and multiplying the result either with the factor of 2 (only for product group OI) or 5. Example for the configuration of one Predictor where the "AMC" is already available:

"Name (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle - Stock max limit - PR

"Output data data element (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle

"Output category option combo": "Stock - Stock max limit (C x 5)"

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator": #{yD2omRpwdgO.RbCeO1B2914}\*5

HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Monthly avg consumption (AMC = C/3)\*5

"Sequential sample count (\*)": 0

Example for the configuration of one Predictor where the "AMC" is not yet "pre-calculated":

"Name (\*)": "STI-Benzathine Penicillin 2.4, Vial - Stock max limit - PR"



"Output data data element (\*)": "STI-Benzathine Penicillin 2.4, Vial"

"Output category option combo": "Stock - Stock max limit (C x 2)"

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator":  $(\text{sum}(\#\{\text{Eph2qKZ9XSZ.kjI3u0kkrwl}\}) + \#\{\text{Eph2qKZ9XSZ.kjI3u0kkrwl}\}) / 3 * 2$

$(\text{sum}(\text{STI-Benzathine Penicillin 2.4, Vial Stock - Quantity consumed (C)}) + \text{STI-Benzathine Penicillin 2.4, Vial Stock - Quantity consumed (C)}) / 3 * 2$

"Sequential sample count (\*)": 2

#### 4.7.5 Quantity required

The "Quantity required" (suggested order quantity) is calculated by subtracting the "Closing balance" from the "Stock max limit". Note that the stock on order is not considered and this calculation is only correct in the absence of any backorders. As order quantities by definition can only be positive, an if statement returns 0 for any calculations resulting in negative values. Example for the configuration of one Predictor:

"Name (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle - Quantity required - PR

"Output data data element (\*)": HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle

"Output category option combo": "Stock - Quantity required (G = F - E)"

"Period type (\*)": "Monthly"

"Organisation unit levels": "Health facility"

"Generator":  $\text{if}(\#\{\text{yD2omRpwdgO.a4jqI7WiptW}\} - \#\{\text{yD2omRpwdgO.q4nUkyLO4i8}\} < 0, 0, (\#\{\text{yD2omRpwdgO.a4jqI7WiptW}\} - \#\{\text{yD2omRpwdgO.q4nUkyLO4i8}\}))$

$\text{if}((\text{HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Stock max limit (C x 5)} - \text{HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/- D})) < 0, 0, (\text{HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Stock max limit (C x 5)} - \text{HIV-ART-Abacavir 60 mg dispersal tab, 60 tablet/bottle Stock - Closing balance (E = (A+B-C +/- D))}))$

"Sequential sample count (\*)": 0

Note that only data points from the current period are used and therefore no "avg" etc. is needed and the "Sequential sample count (\*)" is 0.

#### 4.8 Predictor group

The calculation of Predictors depend on the calculation result of other Predictors in the following way:

Data entry fields	Opening balance	Monthly avg consumption (AMC = C/3)	Closing balance (E = (A+B-C +/-D))	Stock - Stock max limit (C x 5)	Quantity required (G = F - E)
-------------------	-----------------	-------------------------------------	------------------------------------	---------------------------------	-------------------------------

Stockout days (SO)					
Quantity received (B)			X		
Quantity consumed (C) / current and previous two months		X	X		
Correction (D-/+)			X		
Closing balance / Previous month	X				
Opening balance			X		
Monthly avg consumption				X	
Closing balance (E = (A+B-C +/-D))					X
Stock - Stock max limit (C x 5)					X
Predictor - Cascade A					
Predictor - Cascade B					
Predictor - Cascade C					

Accordingly all Predictors are grouped into three "cascades":

"Stock calculation - PR - Cascade A - Opening / AMC"

"Stock calculation - PR - Cascade B - Closing / Stock max"

"Stock calculation - PR - Cascade A - Quantity required"

Cascade A has to run first, then Cascade B and then Cascade C. Note that if historic data is uploaded, the three cascades (A, B and C) all have to be run for each month for which data has been uploaded.

#### 4.9 Validation rule

Validation rules do not prevent users from entering certain values or provide real-time feedback but allow users to check all concerned values "on demand".

##### 4.9.1 Negative transactional values

Since users must be able to enter negative values "Losses/adjustments" and the Data element allows only a single "Value type" across all Category options, users are also able to enter negative values for all other data points although they are not meaningful. As a check and balance, a single Validation rule is configured which checks for any negative values in all columns (other than the "Losses/adjustments").

In order to avoid creating three validation rules for each of the 136 Data elements, three validation rules, one for each transaction, is configured using the "least" condition. Therefore if any value is less than zero (even a single value), the Validation rule will be prompted.

least(

least(

{yD2omRpwdgO.HHowRfJra8n},{H8dprYadM7u.HHowRfJra8n},{sC1OsytlmGV.HHowRfJra8n},{J9HnmvKmvnA.HHowRfJra8n},{xbW7MJbPzsP.HHowRfJra8n},{eR9YUwacfW6.HHowRfJra8n},{tcVsfRfuYa3.HHowRfJra8n},{wqax0HZ8j8C.HHowRfJra8n},{aZ5bYoi8eGJ.HHowRfJra8n},{zfOIPV4Xsi4.HHowRfJra8n},{l4bK7nexBzO.HHowRfJra8n},{Zlvp0H691QI.HHowRfJra8n},{mm0V0sUTjNd.HHowRfJra8n},{cx2PPIYDfrQ.HHowRfJra8n},{yCKmQ6SkZwV.HHowRfJra8n},{q63BfVrtFT0.HHowRfJra8n},{ucUqa4cZfzZ.HHowRfJra8n},{ynLHeei6YBr.ao0KjRCfKnu},{NaIaojz4VaS.ao0KjRCfKnu},{tcgprTnX3rb.ao0KjRCfKnu},{MGPZ6EazmrS.PRv2clZcZDD},{eTHNxWDnP21.PRv2clZcZDD},{Sv5xzOqMdCC.PRv2clZcZDD},{DS6kPu3oxF0.PRv2clZcZDD},{enYHOx39ITv.PRv2clZcZDD},{mO3OnKIA5iY.PRv2clZcZDD},{yVTkXhb6lwn.PRv2clZcZDD},{HpDTXA2UF28.PRv2clZcZDD},{Pb4HWMRnEe9.PRv2clZcZDD},{Bodhc4qt0Id.PRv2clZcZDD},{JwFdL71tWgm.PRv2clZcZDD},{rMpliqBDJ7I.PRv2clZcZDD},{UjmLrrNpsiW.PRv2clZcZDD},{r9gVgpYpGwT.PRv2clZcZDD},{uygrAMW8ZUC.PRv2clZcZDD},{uygrAMW8ZUC.PRv2clZcZDD},{lppYZlk6P4g.PRv2clZcZDD},{t2atbAD94F1.PRv2clZcZDD},{O7YKEnk9FrR.PRv2clZcZDD},{IRBupUIGBI3.PRv2clZcZDD},{HElvcMeQmY.PRv2clZcZDD},{Ouo7qwgEmkF.PRv2clZcZDD},{dKXhrHwVi18.PRv2clZcZDD},{OASLj4Ju7ZK.PRv2clZcZDD},{qOyb1dTHTPL.ao0KjRCfKnu},{C38yt6zpg8y.ao0KjRCfKnu},{T9k9Xqjjs9w.ao0KjRCfKnu},{cV7FEO0IFQD.ao0KjRCfKnu},{boco8283qHz.ao0KjRCfKnu},{bFUsKz2pWei.ao0KjRCfKnu},{vGklrZtGAqr.ao0KjRCfKnu},{yD2omRpwdgO.aCixivwLTGT},{H8dprYadM7u.aCixivwLTGT},{sC1OsytlmGV.aCixivwLTGT},{J9HnmvKmvnA.aCixivwLTGT},{xbW7MJbPzsP.aCixivwLTGT},{eR9YUwacfW6.aCixivwLTGT},{tcVsfRfuYa3.aCixivwLTGT},{wqax0HZ8j8C.aCixivwLTGT},{aZ5bYoi8eGJ.aCixivwLTGT},{zfOIPV4Xsi4.aCixivwLTGT},{l4bK7nexBzO.aCixivwLTGT},{Zlvp0H691QI.aCixivwLTGT},{mm0V0sUTjNd.aCixivwLTGT},{cx2PPIYDfrQ.aCixivwLTGT},{yCKmQ6SkZwV.aCixivwLTGT},{q63BfVrtFT0.aCixivwLTGT},{ucUqa4cZfzZ.aCixivwLTGT},{ynLHeei6YBr.tluoi7RxF2K},{Nalaojz4VaS.tluoi7RxF2K},{tcgprTnX3rb.tluoi7RxF2K},{MGPZ6EazmrS.FQW61khUYOB},{eTHNxWDnP21.FQW61khUYOB},{Sv5xzOqMdCC.FQW61khUYOB},{DS6kPu3oxF0.FQW61khUYOB},{enYHOx39ITv.FQW61khUYOB},{mO3OnKIA5iY.FQW61khUYOB},{yVTkXhb6lwn.FQW61khUYOB},{HpDTXA2UF28.FQW61khUYOB},{Pb4HWMRnEe9.FQW61khUYOB},{Bodhc4qt0Id.FQW61khUYOB},{JwFdL71tWgm.FQW61khUYOB},{rMpliqBDJ7I.FQW61khUYOB},{UjmLrrNpsiW.FQW61khUYOB},{r9gVgpYpGwT.FQW61khUYOB},{uygrAMW8ZUC.FQW61khUYOB},{lppYZlk6P4g.FQW61khUYOB},{t2atbAD94F1.FQW61khUYOB},{O7YKEnk9FrR.FQW61khUYOB},{IRBupUIGBI3.FQW61khUYOB},{HElvcMeQmY.FQW61khUYOB},{Ouo7qwgEmkF.FQW61khUYOB},{dKXhrHwVi18.FQW61khUYOB},{OASLj4Ju7ZK.FQW61khUYOB},{qOyb1dTHTPL.tluoi7RxF2K},{C38yt6zpg8y.tluoi7RxF2K},{T9k9Xqjjs9w.tluoi7RxF2K},{cV7FEO0IFQD.tluoi7RxF2K},{boco8283qHz.tluoi7RxF2K},{bFUsKz2pWei.tluoi7RxF2K},{vGklrZtGAqr.tluoi7RxF2K},{yD2omRpwdgO.fvhhGVRUGZ3},{H8dprYadM7u.fvhhGVRUGZ3},{sC1OsytlmGV.fvhhGVRUGZ3},{J9HnmvKmvnA.fvhhGVRUGZ3},{xbW7MJbPzsP.fvhhGVRUGZ3},{eR9YUwacfW6.fvhhGVRUGZ3},{tcVsfRfuYa3.fvhhGVRUGZ3},{wqax0HZ8j8C.fvhhGVRUGZ3},{aZ5bYoi8eGJ.fvhhGVRUGZ3},{zfOIPV4Xsi4.fvhhGVRUGZ3},{l4bK7nexBzO.fvhhGVRUGZ3},{Zlvp0H691QI.fvhhGVRUGZ3},{mm0V0sUTjNd.fvhhGVRUGZ3},{cx2PPIYDfrQ.fvhhGVRUGZ3},{yCKmQ6SkZwV.fvhhGVRUGZ3},{q63BfVrtFT0.fvhhGVRUGZ3},{ucUqa4cZfzZ.fvhhGVRUGZ3},{ynLHeei6YBr.kjI3u0kkrwl},{Nalaojz4VaS.kjI3u0kkrwl},{tcgprTnX3rb.kjI3u0kkrwl},{MGPZ6EazmrS.J88I2uAcG6d},{eTHNxWDnP21.J88I2uAcG6d},{Sv5xzOqMdCC.J88I2uAcG6d},{DS6kPu3oxF0.J88I2uAcG6d},{enYHOx39ITv.J88I2uAcG6d},{mO3OnKIA5iY.J88I2uAcG6d},{yVTkXhb6lwn.J88I2uAcG6d},{HpDTXA2UF28.J88I2uAcG6d},{Pb4HWMRnEe9.J88I2uAcG6d},{Bodhc4qt0Id.J88I2uAcG6d},{rMpliqBDJ7I.J88I2uAcG6d},{UjmLrrNpsiW.J88I2uAcG6d},{r9gVgpYpGwT.J88I2uAcG6d},{uygrAMW8ZUC.J88I2uAcG6d},{lppYZlk6P4g.J88I2uAcG6d},{t2atbAD94F1.J88I2uAcG6d},{O7YKEnk9FrR.J88I2uAcG6d},{IRBupUIGBI3.J88I2uAcG6d},{HElvcMeQmY.J88I2uAcG6d},{Ouo7qwgEmkF.J88I2uAcG6d},{dKXhrHwVi18.J88I2uAcG6d},{OASLj4Ju7ZK.J88I2uAcG6d},{qOyb1dTHTPL.kjI3u0kkrwl},{C38yt6zpg8y.kjI3u0kkrwl},{T9k9Xqjjs9w.kjI3u0kkrwl}

s9w.kjl3u0kkrwl},{cV7FEO0IFQD.kjl3u0kkrwl},{boco8283qHz.kjl3u0kkrwl},{bFUkZ2pWEi.kjl3u0kkrwl},{vGKlrZTgAQR.kjl3u0kkrwl}}

#### 4.9.2 Number of stockout days

For monthly reports the number of "Stockout days (SO)" cannot exceed 31 (days).

For quarterly reports the number of "Stockout days (SO)" cannot exceed 92 (days).

#### 4.9.3 Negative stock balances

Any transaction values which affect the "Closing balance" must not lead to negative values which potentially the following data fields can:

- "Quantity received (B)"
- "Quantity consumed (C)"
- "Losses / Adjustments (D-/+" data-bbox="138 372 863 404" data-label="Text">

As "Quantity received" can (by definition) only be a positive value, no entered value can result in a negative "Closing balance" and therefore no validation rule is needed.

##### "Quantity consumed (C)"

Quantity consumed (C)  $\leq$  "Opening balance (A)" + "Quantity received (B)" + "Losses / Adjustments (D-/+" data-bbox="152 496 862 512" data-label="Text">

It is physically impossible to remove more than the entire physical stock on hand from a stock.

##### - "Losses / Adjustments (D-/+" data-bbox="138 564 863 597" data-label="Text"> "Losses / Adjustments (D-/+" data-bbox="138 603 863 652" data-label="Text"> Positive "adjustments" have no limit while the maximum negative "adjustment" that can be made is for the quantity which should be in stock and therefore the maximum "adjustment" that can be made is to result in a "Closing balance" of zero.

Since the validation rule does not evaluate values of a specific data field (but only the result of the entire calculation) and the requirements for "Quantity consumed (C)" and "Losses / Adjustments (C-/+" data-bbox="138 752 862 801" data-label="Text">

Note that if at the end of the month positive "Losses / Adjustments" is reported and the "Quantity consumed" is entered first, the validation rule for the "Quantity consumed" may be prompted but will be removed as soon as a (positive) "Losses / Adjustments" is recorded.

#### 4.10 Scheduler

Three "Scheduled jobs" are configured according to the three Predictor "cascades" presented earlier:

Name (\*): "Stock calculation - PR - Cascade A: Opening balance, AMC"

---

Job type (\*): "Predictor"

CRON Expression (\*): "0 5 0 ? \* \*" (At 12:05 AM)

Relative start: "-32"

Relative end: "31"

Predictor groups: "Stock calculation - PR - Cascade A: Opening balance, AMC"

Stock calculation - PR - Cascade B: Closing balance, Stock max limit

CRON Expression (\*): "0 15 0 ? \* \*" (At 12:15 AM)

Stock calculation - PR - Cascade C: Quantity required

CRON Expression (\*): "0 30 0 ? \* \*" (At 12:15 AM)

The scheduled times need to be adjusted to ensure that Scheduler A is completed before Schedule B is started.

The configuration is based on the assumption that running all Predictors once a day is sufficient but the frequency could be increased to several times per day as needed.

#### 4.11 Advice for future projects

Xx

- simplify the Data entry form
- remove all columns related to stock replenishment ("AMX", "Stock max limit" and "Quantity required").

5 ADVICE ON DHIS2 INTEGRATION WITH NATIONAL ERP

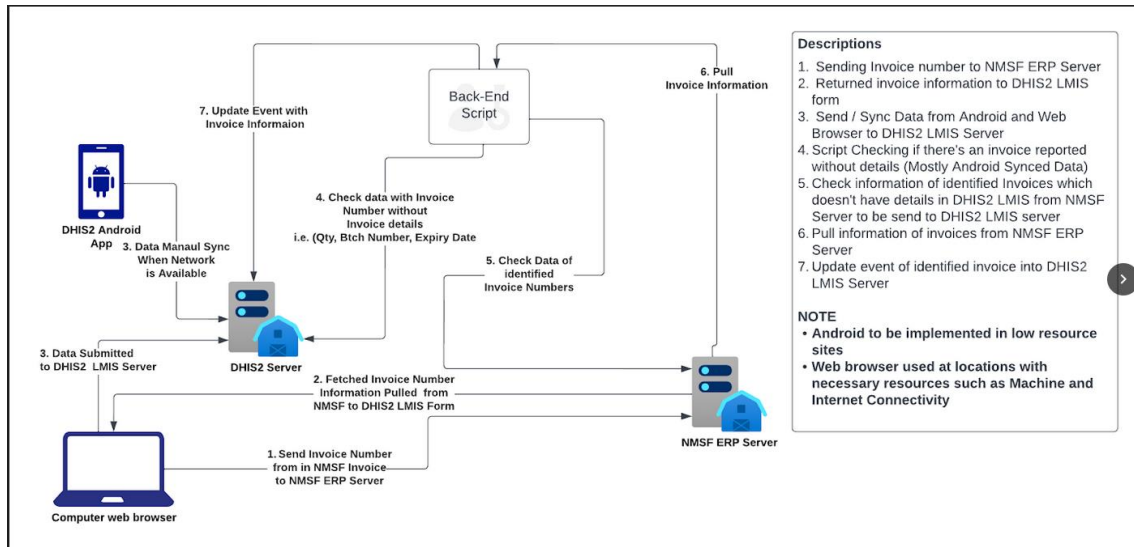
Xx

[This draft chapter will be edited for round two]

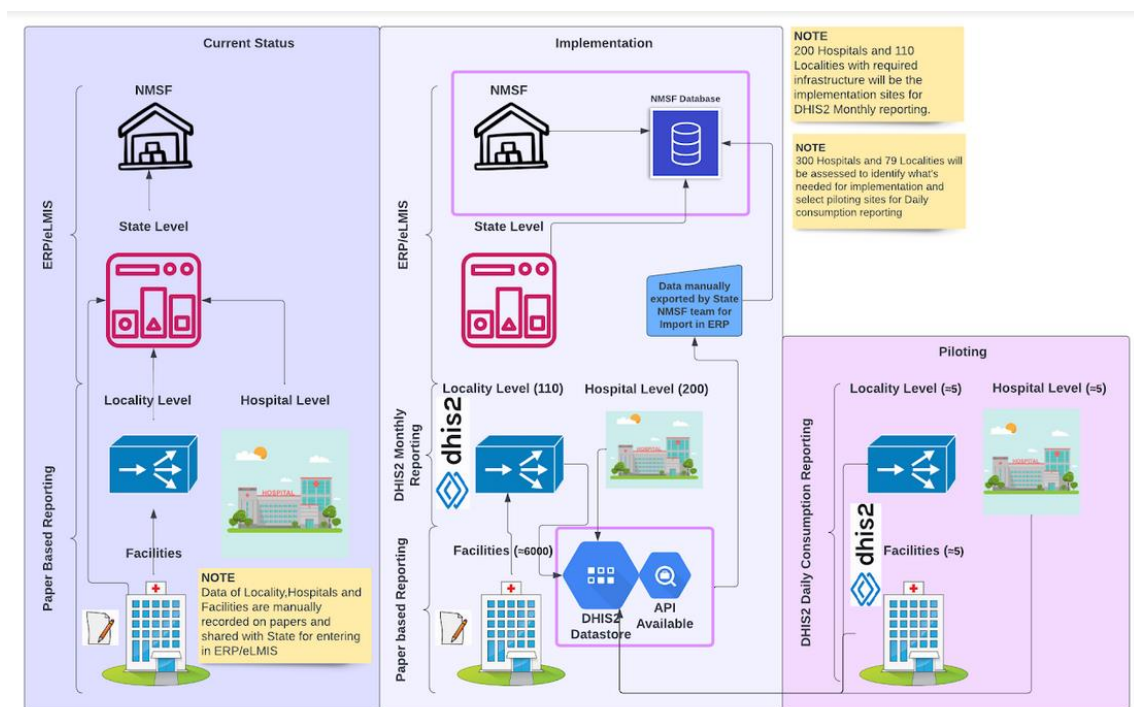
5.1 Xx

Xx

Interoperability.png



Xx



**5.2 Xx**

Xx

**5.3 Xx**

Xx

## 6 ADVICE ON STOCK REPLENISHMENT AT THE FACILITY LEVEL

Irrespective of the details of the inventory control system, the general (strongest possible) advice is that:

- all inventory control calculations should be effected in the national ERP system (and not in DHIS2) using a VMI (Vendor Managed Inventory) approach

- irrespective of the chosen parameters for the inventory control system, all calculations in DHIS2 are by default incorrect as the stock on order is an indispensable parameter for any calculation (DHIS2 can only happen to be correct for items without any backorders at all or if the supplying medical distribution centre does not keep any record of backorders, does not deliver them and requests healthcare facilities to reorder stock in case orders have not been filled)

Neither health workers nor pharmacists are not trained in inventory control and health workers should spend as much time as possible looking after patients rather than stock management issues. Allowing users to change recommended order quantities inevitably leads to ration gaming and demand distortion. Even the simplest inventory control systems, if applied consistently and systematically, are known to perform far better than any unskilled or skilled humans.

The use of the equal time supply system (multiplying average stock issues by a predefined factor) may appear to be intuitive but is qualified by one of the leading authorities on inventory control in the following way:

***Equal Time Supplies as "Simple-Minded Approach"***

*"This approach is seriously in error because it fails to take account of the difference in the uncertainty of forecasts from item to item"*

*(Silver, E.A., D.F. Pyke, and R. Peterson 1998, 244).*

### 6.1 Order-up-to-level

Until the stock replenishment in Sudan is, eventually, changed to a Vendor Managed Inventory (VMI) approach, correctness of the current calculations using paper forms and the configured automated calculations in DHIS2 must be ensured to be correct.

The forms use three different sets of parameters:

Monthly calculations

"Stock max limit (AMC x 5)"

"Stock max limit (C x 2)"

Quarterly calculations

"Stock max limit (AMC x 5)"

Incorrect headers, such as "Monthly avg consumption (AMC = C/3)" as well as confusing "C" (monthly stock issues) with "AMC" (average stock issues of the past three years) point to lack of understanding of and rigour in inventory control. The worst flaw is applying the same



calculations used for monthly stock replenishment to the quarterly stock replenishment which will lead to excessive overstocks.

Below the essential inventory control parameters which are needed for the current system are listed. The following three parameters can be determined and chosen by a policy:

**Review period:** the duration between placing replenishment orders (1 or 3 months)

**Lead time:** the time from ordering until 98% of line items are delivered in full

**Safety stock level:** coverage time (counted in months) which should be available at the healthcare facility at all times, including at the time just before receiving deliveries

The lead time is the critical parameter to study and confirm in detail. In principle, managers can set a customer service level which the supply chain services must comply with but all actors must of course ensure that those lead times are actually feasible. Or, alternatively, the actual lead time can be measured and the result of the measurement can be used for the calculations. It is reasonable to assume that lead times for all healthcare products are at least very similar.

The following parameters are determined by the above parameters as well as actual customer demand, are the result of calculations and cannot be determined by policy:

**Stock on hand:** the physical quantity of stock on the shelf as determined by a physical stock count at the end of the month

**Average monthly demand (stock issues):** the average quantity of stock issued from the central pharmacy during the past three months

**Order-up-to-level:** quantity up to which the inventory position is to be raised with an order

**Inventory position:** stock on hand + stock on order + backorders

**Order quantity:** the quantity which needs to be ordered

The objective of the analysis is to ensure that the three parameters which can be chosen by policy, namely the review period, lead item and the safety stock level are set deliberately and the impact on the performance of the inventory control system and the variation of stock levels is known.

When applying the equal time supply system, the order-up-to-level ("Stock max") is always calculated in the following way:

average monthly stock issues x (Review period + Lead time + Safety stocks [all in months])

As a general comment, assuming that the lead time is similar for all product groups, the safety stock (0.5 months, 1.5 months and 3.5 months) is inconsistent. Moreover, the safety stocks should be higher for quarterly orders than for monthly orders while the safety stocks are configured in the opposite way.

### 6.1.1 Monthly orders with "C x 2"

For monthly orders the Review period is by definition one month.

Review period: 1 month

Lead time: 0.5 months

Safety stocks: 0.5 months

If the Review period of one month is subtracted from 2, only 1 month is left for the lead time and the safety stock. Lead times of one to two weeks seem quite unrealistic and even if maintained leave only a two week safety stock at the end of the month. That means that in order not to run out of stock, all stock replenishment orders have to be filled on-time in-full for all orders and any monthly demand must never exceed 50% of the average demand of the past three months which is also unrealistic.

In conclusion, an order-up-to-level of only 2 months of average monthly demand seems too low and prone to a large number of prolonged shortages and stockouts.

### 6.1.2 Monthly orders with "C x 5"

For monthly orders the Review period is by definition again one month.

Review period: 1 month

Lead time: 0.5 months

Safety stocks: 3.5 months

Assuming the lead time is the same as for the previous system, an order-up-to-level of 5 months would leave a safety stock of 3.5 months. Assuming a more realistic lead time of 1 month, safety stocks would be set at 3 months which seems very appropriate.

However, the difference between a safety stock of only 0.5 months for some items and 3 or 3.5 months of stock for other items seems highly inconsistent.

### 6.1.3 Quarterly orders with "C x 5"

For quarterly orders the Review period is by definition one quarter or three months.

Review period: 3 months

Lead time: 0.5 months

Safety stock: 1.5 months

"Quantity consumed C": this quantity represents the stock issues for the current quarter.

"Monthly avg consumption (AMC = C/3)": this quantity is calculated by dividing the stock issues (only) of the current quarter by three.

## 6.2 Advice for future projects

Xx

- carefully review existing inventory control policies and systems
- measure customer order lead times
- develop consistent and rational approach for determining safety stocks
- Implement Vendor managed inventory (where the national LMIS systems calculates all stock replenishment orders and manages order fulfillment)

## 7 ADVICE ON PERFORMANCE MANAGEMENT

[Introduction and overview]

### 7.1 Proposed LMIS metrics

The following LMIS metrics were proposed by the Sudan project team:

<https://docs.google.com/spreadsheets/d/1k03F0gJ2au8PVdKhNTToPFSCI7fW6zZa7/edit#gid=635944530>

List of inventory management KPIs (provided by Sudan).					
#	KPI	Definition	Numerator	Denominator	Frequency
1	No Stock-out rate	The percentage of sites that reporting no stock-out	# of sites reported no stock-out	Total # of sites	Monthly
2	Average Months of Stock	How long available stock will last	Stock on hand	Average monthly consumption	Monthly
3	Rate of expiration/damage	Percentage of expired/damaged	Quantity of expired/damaged	Total quantity received	Quarterly

During the meeting on 21.08.2023 it was agreed to drop the third KPI (Rate of expiration/damage) as this data point is currently not being collected on the paper forms.

During the meeting on 04.09.2023 Ismail requested adding the number of stockout days to the list.

### 7.2 Recommended performance metrics at the facility level

Precision on the proposed metrics.

As a general comment, these three metrics capture the main parameters which should be monitored but in addition stock on hand and monthly demand must be monitored (even though these are not KPIs).

- Stockout count (number of stockouts by month/quarter by product group)
- Stock coverage time
- Stock availability
- Stock coverage time distribution

#### 7.2.1 Stock coverage time

##### Definition

Stock on hand divided by the monthly distribution quantity of the most recent month(s) expressed as a fraction.

##### Calculation

- Determine the stock on hand of each item
- Determine the monthly distribution quantity of the same item
- Divide the stock on hand by the monthly distribution quantity for the same item
- Express calculation result as a fraction

##### Meaning

The stock coverage time corresponds to the number of months the medical store can continue delivering items provided that (!) demand does not change (does not differ from the demand used for the calculation) and (!) that for the entire stock coverage time period no resupplies are received.

To some degree the stock coverage, which can only be measured once a month after the physical stock count, as a monthly "snapshot" is arbitrary as the physical stock count might be taken just before the stock replenishment (where stock levels and therefore stock coverage times are low) or just after the stock replenishment (where stock levels and therefore stock coverage times are high).

If monthly demand is zero, this metric cannot be calculated and has no meaning although one could argue that it is infinite as long as no stockout has occurred.

A stock coverage time of zero corresponds to a stockout (as the stock on hand must be zero)

If stock coverage times are "low", shortages and stockouts are likely.

If stock coverage times are "high", shortages and stockouts are unlikely but the likelihood of expiry of stock before it can be used is high.

Quantifying stock coverage times as "low" or "high" is highly arbitrary.

Actual stock coverage times should always be related to target stock levels.

### 7.2.2 Stockout

#### Definition

Stock on hand of zero (no stock) at the time of the physical stock count which ideally should take place on the last day of the month.

Note that stockouts are just a special case of the stock coverage time being zero and therefore in principle redundant. But because the implications for corrective action, separate measurement is warranted.

#### Calculation

Calculated for each item separately.

Stock on hand = 0.

#### Meaning

A stockout always requires urgent action to resupply the facility.

The definition of a stockout is somewhat arbitrary as a stock of one tablet is nearly as useless as a stockout but it is still useful to measure these "worst" cases while low stock levels and "near stockouts" are accurately captured by the stock coverage time.

### 7.2.3 Stock availability

#### Definition

Percentage of items on the stock item list which are not out of stock (which have at least one unit on hand).

### **Calculation**

Calculated for all stock items of the stock item list.

- Determine the number stock items on the stock item list
- Determine for each item whether it is out of stock
- Count all items which are in stock
- Divide the number of items which are in stock by the number of items on the stock item list
- Calculate as percentage

### **Meaning**

This metric allows to quickly assess the service level provided to customers for a large number of stock items with a single metric in a very meaningful way.

Stock availability = 0%: all items are out of stock

Stock availability = 100%: all items are in stock (no items are out of stock)

### **7.2.4 Stock losses**

*As stock losses are not being recorded on the paper form, this metric cannot be measured as no data is available.*

### **Definition**

Percentage of (quantity of) items which have become unusable during the recording period because of expiry, damage, manufacturer recall or any other reason.

### **Calculation**

- Determine the quantity of stock damaged, expired etc. by counting
- Determine the stock on hand at the beginning of the month ("opening balance" which identical with the "closing balance" of the previous month)
- Determine the quantity received at any time during the period
- Add the stock on hand ("opening balance") and the quantity received
- Divide the quantity of stock damaged, expired etc. by the stock on hand at the beginning of the month plus the stock received
- Calculate as percentage

### **Meaning**

The interpretation of this metric depends on the reason for the stock loss:

- Expired stock: high percentages indicate overstocking (and therefore poor inventory control) or that stocks are received with relatively short remaining shelf lives or both

- Damaged stock: in principle damage to stock at the facility level is completely preventable with the exception of poorly managed cold chain equipment which also depends on the technical service health facilities receive.

#### 7.2.4 Stock discrepancy

##### Definition

Difference between the mathematical sum of the stock transactions and the actual result of the physical stock count at the end of the month:

Stock on hand end of the month (result of physical stock counting)

- (Opening stock (stock on hand on the last day of the previous and first day of current month)

+ Stock received

- Stock issued

+ Stock correction (expired, damaged or correction))

This value should always be zero. If the value is greater than zero, then there is more stock on hand than there should be and if the value is less than zero then stock is "missing".

The stock discrepancy is an excellent metric for the overall accuracy of stock management. If the stock discrepancy is always zero this means that all transactions and stock corrections were accurately recorded.

##### Calculation

- Determine the stock on hand at the end of the month

- Determine the stock on hand at the beginning of the month ("opening balance" which identical with the "closing balance" of the previous month)

- Determine the quantity received at any time during the period

- Determine that quantity issued

- Determine the recorded stock corrections

- From the stock on hand at the beginning of the month subtract the Opening stock + stock received - stock issued + stock correction from the stock on hand

##### Meaning

By definition, the values for stock discrepancy should also be zero and non-zero values indicate transactions which are not accounted for or incorrect recording and some kind of mistake:

- Negative value: stock is "missing", the stock on hand at the end of the month is less than it should be because of theft, mislaying or incorrect recording.

- Positive value: stock is "found", the stock on hand at the end of the month is greater than it should be because more stock was received than documented or less stock was issued than recorded or both.

### 7.2.6 Possible additional metrics

The following metrics are meaningful and can be configured in DHIS2 but would require configuring a large number of additional Predictors:

- Stock discrepancy (difference between "theoretical" stock and physical stock count)
- Stockout duration (number of months with stockout during the past 12 months)
- Stockout duration distribution
- stockout duration distribution (number of items with stockout duration of x)
- stockout probability (projection based on the mean and standard deviation of demand as well as stock on hand)
- stock coverage range distribution (number of items with stock coverage range of x)

### 7.3 Recommended visualizations at health facility level

The recommendations for visualizations of LMIS metrics are based on the LMIS metrics proposed above as well as the limitations of DHIS2. In general, additional visualizations will require additional Predictors or Indicators usually at the Data element.

The demo configuration was configured only the OIs group but in general, each of the below visualizations could be created separately for each of the healthcare product groups:

- ART
- MALARIA
- OIs, STIs and HIV kits or separately for OIs, STIs and HIV kits
- TB drugs
- TB MDR drugs

The following chapters describe the visualizations (only) for the OI group as an example but they in principle also apply to all other product groups.

#### 7.3.1 Overview of visualizations at health facility level

The following visualizations were configured for demonstration purposes, listed in alphabetical order:

- OI - Number of items in stock / month / bar chart
- OI - Number of items in stock / month / table
- OI - Stock availability in % / month / bar chart
- OI - Stock availability in % / month / table
- OI - Stock coverage / month / table
- OI - Stock data / month / table
- OI - Stockout days count / month / table

These visualizations present the above LMIS data and metrics in the following way:

#### A Stock data

- OI - Stock data / month / table

**B Stock coverage time** (stockout being equal to stock coverage time of 0):

- OI - Stock coverage / month / table

**C Stock availability (and stockout) at the item level**

- OI - Stockout days count / month / table

**D Stock availability (and stockout) at the product group level**

- OI - Number of items in stock / month / bar chart
- OI - Number of items in stock / month / table
- OI - Stock availability in % / month / bar chart
- OI - Stock availability in % / month / table

**7.3.2 Stock data of visualizations at health facility level**

**7.3.2.1 Stock data summary**

- Name: OI - Stock data / month / table
- Type: Pivot table
- Columns: select all 8 options from "Health Facilities - Stock report & demand" dimension
- Rows: "Data" (assigned all OI - drug products)
- Filter: "Organisation Unit": select as required
- Aggregation type: "By data element"
- Legend: (none)
- Interpretation: this Pivot table is an exact rendering of the Data entry form but allows displaying data for several periods and several Organisation units.

OI - Stock data / month / table									
24 ulgrahy Hospital									
		Stock - Stockout days (SO) †	Stock - Opening balance (A) †	Stock - Quantity received (B) †	Stock - Quantity consumed (C) †	Losses / Adis (D+I) †	Stock - Closing balance (E = (A+B-C +/D)) †	Stock max limit (C X 2) †	Stock - Quantity required (G = F - E) †
OI-Acyclovir 200 mg, Tablet	January 2023	1	0	100	97	-3	0	64.7	0
	February 2023	1	74	89	45	8	126	94.7	0
	March 2023	0	74	90	56	-9	99	132	0
	April 2023	0	74	89	87	-8	68	125.3	0
	May 2023	0	74	78	98	9	63	160.7	0
	June 2023	0	63	89	98	0	54	188.7	123.7
	July 2023	1	65	30	90	-8	-3	190.7	184.7
	August 2023	1	6	30	90	-30	-84	185.3	75.3
OI-Acyclovir 5% oint, Tube of 15 gm	January 2023	2	0	200	34	2	168	22.7	0
	February 2023	2	168	67	87	0	148	80.7	0
	March 2023	0	168	89	90	-10	157	140.7	0
	April 2023	0	168	78	89	5	162	177.3	0
	May 2023	0	168	34	76	0	126	170	0
	June 2023	0	126	89	90	0	125	170	3
	July 2023	0	167	89	67	0	189	155.3	133.3
	August 2023	1	22	70	89	-50	-47	164	233
OI-Azithromycin 500mg, Tablet	January 2023	1	0	900	86	-2	812	57.3	0
	February 2023	0	812	78	99	-8	783	123.3	0
	March 2023	0	812	78	34	90	946	146	0
	April 2023	1	812	67	87	8	800	146.7	0
	May 2023	0	812	56	87	7	788	138.7	0
	June 2023	8	788	34	65	-4	751	159.3	0
	July 2023	0	775	67	87	0	755	159.3	0
	August 2023	0	880	78	87	0	871	159.3	0

**7.3.3 Stock coverage time visualizations at health facility level**

**7.3.3.1 Stock coverage time**

- Name: OI - Stock coverage / month / table



- Type: Pivot table
- Columns: "Period" (select months as required, for example months of the current year)
- Rows: select all [OI - item description] - Stock coverage (Indicator)
- Filter: "Organisation Unit": select as required
- Aggregation type: "By data element"
- Legend: Stock coverage time / Max = C x 2
- Interpretation: a value of zero indicates a stockout, low values indicate short coverage times (stock will run out quickly) and high values indicate overstocking (stock will eventually expire before it can be used). Any negative values indicate incorrect stock data and "NaN" indicates that the data required for calculating the Indicator is incomplete.

OI - Stock coverage / month / table								
24 alqshy Hospital								
	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023	July 2023	August 2023
OI-Acyclovir 200 mg, Tablet - Stock coverage	0	2.8	1.8	0.8	0.6	0.6	-0	-0.9
OI-Azithromycin 500mg, Tablet - Stock coverage	9.4	7.9	27.8	9.2	9.1	11.6	8.7	10
OI-Cotrimoxazole injection, Ample - Stock coverage	13.8	9	NaN	7.2	5.8	8.3	8.2	6.9
OI-Cotrimoxazole, Tablet - Stock coverage	26.2	0.5	2.1	0.5	0.3	0.4	1.8	1.1
OI-Ferrus sulphate tablet, Tablet - Stock coverage	17	10.7	NaN	8	8.8	9.8	11	11.2
OI-Fluconazole 100mg/50ml infusion, Bottle - Stock coverage	10.6	14.1	4.7	5.2	5.7	4.6	6.4	6.6
OI-Folic acid, Tablet - Stock coverage	9.7	7.8	10.5	7	12	8.1	7.6	7.7
OI-Ibuprofen 400mg, Tablet - Stock coverage	5.4	3.7	NaN	3.2	3.2	4.7	3.7	3.6
OI-Loperamide, Tablet - Stock coverage	6.1	3.1	2.5	3	2.1	1.8	1.8	2.5
OI-Mefenamic acid, Tablet - Stock coverage	4.5	3.4	3.1	4.9	3.4	2.7	2.9	3.7
OI-Metoclopramide, Tablet - Stock coverage	0	5.6	3.3	0.6	1.6	1.1	-0	1.3
OI-Multivitamin ped Syrup, Bottle - Stock coverage	15.4	16.7	11.8	7.7	7	8.3	7.6	8.1
OI-Multivitamin, Tab/Cap - Stock coverage	26	9.2	5.5	5.3	6.5	8.2	7	7.3
OI-Nystatin susp, Bottle - Stock coverage	11.1	7.9	7.5	3.8	4.7	5.3	5.1	4.9
OI-Pyridoxine, Tablet - Stock coverage	23.3	10.1	10.5	5	5.5	6.7	8.3	8.1
OI-Syringe, piece - Stock coverage	16.3	2	3.2	1.6	2.4	NaN	1.5	1

### 7.3.4 Stock availability visualizations at the item and health facility level

#### 7.3.4.1 Number of stockout days / month / table

- Name: OI - Stockout days count / month / table
- Type: Pivot table
- Columns: "Period" (select months as required, for example months of the current year) and select (only) "Stock - Stockout days (SO)" from "Health Facilities - Stock report & demand" dimension
- Rows: "Data" (assigned all OI - drug products)
- Filter: "Organisation Unit": select as required
- Aggregation type: "By data element"
- Legend: Stockout days count
- Interpretation: a value of zero means that the health care product was always available and never out of stock (at least at the time of the daily recording). Values between 1 and 31 indicate the number of days during which the health care product was reported as out of stock. The legend (from yellow to purple) indicates the number of stockout days in weekly increments.

OI - Stockout days count / month / table								
24 alqrshy Hospital								
	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023	July 2023	August 2023
	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓	Stock - Stockout days (SO) ↓
OI-Acyclovir 200 mg, Tablet	1	1	0	0	0	0	1	1
OI-Acyclovir 5% oint, Tube of 15 gm	2	2	0	0	0	0	0	1
OI-Azithromycin 500mg, Tablet	1	0	0	1	0	8	0	0
OI-Ceftriaxone 1g, Vial	3	0	0	25	8	7	0	0
OI-Cotrimoxazole Injection, Ampul	1	0	0	0	0	5	10	0
OI-Cotrimoxazole susp, Bottle	0	0	2	0	1	1	0	0
OI-Cotrimoxazole, Tablet	1	1	1	2	2	9	2	1
OI-Ferrous sulphate susp, Bottle	0	0	0	0	6	0	15	0
OI-Ferrous sulphate tablet, Tablet	1	0	0	1	7	0	8	0
OI-Fluconazole 100mg/50ml infusion, Bottle	0	0	30	1	9	1	1	0
OI-Fluconazole 50mg, Tablet	2	0	2	30	0	0	0	0
OI-Folic acid, Tablet	1	0	0	0	6	1	0	0
OI-Ibuprofen 400mg, Tablet	2	0	0	0	5	1	10	8
OI-Loperamide, Tablet	0	1	1	0	0	0	0	0
OI-Mefenamic acid, Tablet	0	1	0	0	0	0	0	0
OI-Metoclopramide, Tablet	1	1	1	0	0	0	0	0
OI-Multivitamin ped Syrup, Bottle	1	0	8	2	5	0	1	0
OI-Multivitamin, Tab/Cap	1	0	7	2	8	9	0	1
OI-Nystatin susp, Bottle	2	5	0	0	0	0	0	1
OI-Pyridoxine, Tablet	2	0	0	1	6	0	0	1
OI-Syringe, piece	2	5	0	0	0	0	0	0
OI-Water for inj, Ampul	1	5	10	0	0	0	5	8

### 7.3.5 Stock availability visualizations at the product group and health facility level

#### 7.3.5.1 Number of products in stock / month / table

- Name: OI - Number of products in stock / month / table
- Type: Pivot table
- Columns: "Period" (select months as required, for example months of the current year)
- Rows: "Data": select "OI stockout count" indicator
- Filter: "Organisation Unit": select as required
- Aggregation type: "By data element"
- Legend: (none)

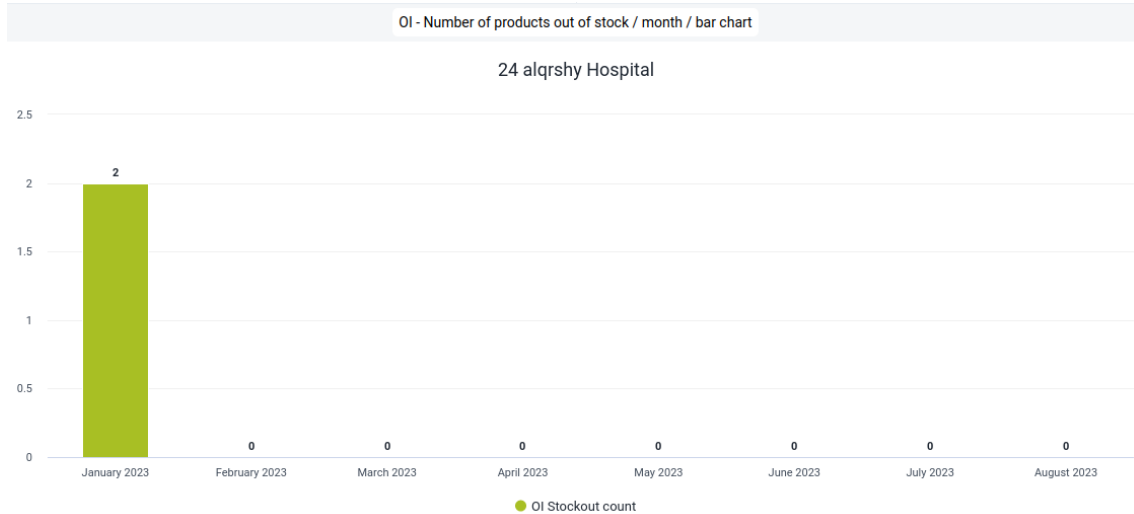
- Interpretation: a value of zero means that all the health care products were in stock at the time of the stock data reporting. Any value other than zero indicates the number of health care products which were out of stock where the maximum number depends on the number of health care products in the respective product group (which varies between product groups).

OI - Number of products in stock / month / table - Edited								
24 alqrshy Hospital								
	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023	July 2023	August 2023
OI Stockout count	2	0	0	0	0	0	0	0

#### 7.3.5.2 Number of products out of stock / month / bar chart

- Name: OI - Number of products out of stock / month / bar chart
- Type: Column (chart)
- Series: "Data": select "OI stockout count" indicator
- Category: "Period" (select months as required, for example months of the current year)
- Filter: "Organisation Unit": select as required

- Aggregation type: "By data element"
- Legend: (none)###
- Interpretation: the x-axis represents the time in months (and years) and the vertical axis displays the number of products



### 7.3.5.3 Stock availability in % / month / table

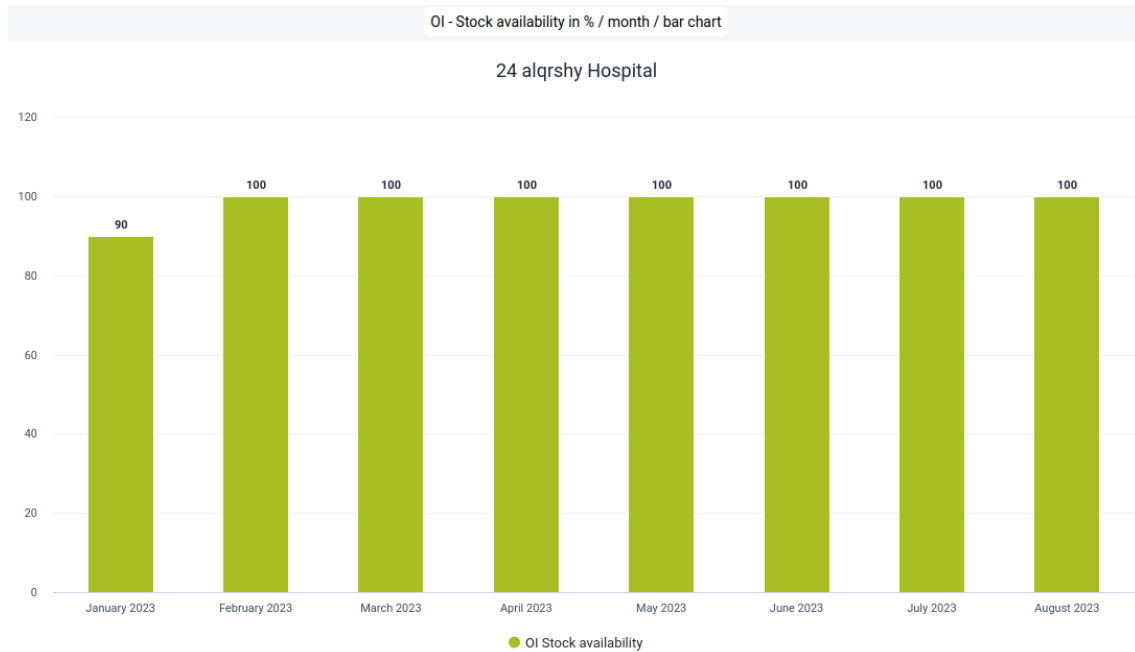
- Name: OI - Stock availability in % / month / table
- Type: Pivot table
- Columns: "Data" select "OI Stock availability" (indicator) and "Period" (select months as required, for example months of the current year)
- Rows: "Organisation Unit": select as required
- Filter: (none)
- Aggregation type: "By data element"
- Legend: (none)
- Interpretation: a value of zero means that all the health care products were out of stock at the time of the stock data reporting. Any value other than zero indicates the percentage of products in the product group which were in stock with 100 indicating that all products were in stock. For technical reasons values can only be displayed as integers but without the "%" sign.

	OI Stock availability							
	January 2023	February 2023	March 2023	April 2023	May 2023	June 2023	July 2023	August 2023
24 alqrshy Hospital	90	100	100	100	100	100	100	100

### 7.3.5.4 Stock availability in % / month / bar chart

- Name: OI - Stock availability in % / month / bar chart
- Type: Column (chart)

- Series: "Data": select "OI stockout count" indicator
- Category: "Period" (select months as required, for example months of the current year)
- Filter: "Organisation Unit": select as required
- Aggregation type: "By data element"
- Legend: (none)
- Interpretation: the x-axis represents the time in months (and years) and the vertical axis displays the percentage of number of products which were in stock every month.



#### 7.4 Recommended performance metrics at the Locality level

The following LMIS metrics can be meaningfully aggregated across health care facilities at the Locality level:

- Xx
- Xx

#### 7.5 Recommended performance metrics at the State level

The following LMIS metrics can be meaningfully aggregated across health care facilities at the State level:

- Xx
- Xx

#### 7.6 Recommended performance metrics at the National level

The following LMIS metrics can be meaningfully aggregated across health care facilities at the National level:

- Xx

- Xx

### **7.7 Recommended performance management framework**

[to be completed].

### **7.8 Advice for future projects**

Xx

- Develop and implement a systematic performance management framework
- Focus on corrective action (rather than analysis).

[to be completed].

**8 Summary of advice for future projects**

XX

**8.1 General recommendations**

XX

**8.2 Recommendations on data collection at the facility level**

XX

**8.3 Recommendations on DHIS2 configuration**

XX

**8.4 Recommendations on integration with national eLMIS**

XX

**8.5 Recommendations on inventory control**

XX

**8.6 Recommendations on analytics and visualizations**

XX