



USAID GLOBAL HEALTH SUPPLY CHAIN PROGRAM

TECHNICAL ASSISTANCE, NATIONAL SUPPLY CHAIN ASSESSMENT TASK ORDER

Data Analysis Plan for Key Performance Indicators (Central and Non-Central)

NSCA 2.0



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INTRODUCTION

Data for multiple key performance indicators (KPIs) are collected at different levels of the supply chain. These are reflected in two data collection tools, one for warehouses (including a central warehouse), referral hospitals, and services delivery points (SDPs), such as lower level hospitals and health center (“non-Central KPIs”), and another tool for central level data collection (“Central KPIs”).

The data collection tool for the non-Central KPIs includes the following data:

- At health centers and hospitals (including referral hospitals and other hospitals): data on stock (both current at the time of the assessment and for the six month period prior to the assessment period) of selected tracer commodities, data on electronic Logistic Management information systems (electronic LMIS), data on the type and timing of deliveries received (upstream order data), data on temperature excursions for cold storage, and data on human resources are collected.
- At intermediate warehouses, the same data are collected as at SDPs and referral hospitals. In addition, data on upstream (e.g., deliveries from the central warehouse) and downstream deliveries (deliveries from the intermediate warehouse to health facilities) are collected as well as the costs of warehouse operations and distribution operations.
- Central warehouse: Stock data (on the selected tracer commodities), downstream (to, e.g., intermediate warehouses) order and delivery data, costs of warehouse operations and distribution operations, temperature excursion, and human resource data are collected.

The Central KPI data collection tool includes data on:

- Forecast accuracy data, supply plan accuracy data, sources of funds data, prices paid data, emergency orders and procurement methods data, vendor delivery data, National Essential Medicines List (or similar list) data, customs clearance data, stock turn data, human resources data, facility reporting data, and product testing data. These data could be collected from the central medical stores/ central warehouse, Ministries of Health, and other central level entities (depending on how a particular country organizes different functions).

Some KPIs are listed as ‘core’ (intended to be collected for all assessments) and others as ‘optional’ (to be included in the assessment if the assessment team and stakeholders decide to include them). This document includes analysis plans for both core and optional KPIs; if an assessment does not include some or all of the optional KPIs, the analysis plan for these KPIs can be disregarded.

Variable names

The variable names listed in this document reflect the names downloaded from the SurveyCTO data collection forms. By convention, the subscripts presented throughout this document refer to numbers. SurveyCTO downloads the variables with an underscore (“_”) between the numbers; these underscores are not reproduced in the nomenclature employed in this document, but should be considered when referencing the database. For example, `sfrorderdateco` in the database may look like “sfrorderdateC_O”

(with the *C* and the *O* being replaced by numbers, for example “sfrorderdateI_1” or “sfrorderdateI_2”). This document also included subscripts for facility; facility numbers are not reflected in variable names, but represent the rows in the databases.

Weighting

Many of the calculations presented below (for data collected in the non-Central KPI data collection tool) include weighting of the KPIs based on the survey design. These should be incorporated whenever possible or appropriate. Thus, the ‘central’ level KPIs will not need survey weights, but those collected at SDPs likely will. The “Sampling Template” included in the NSCA package of background documents automatically calculates sample weights, which can be used for these analyses (although note that some adjustments may need to be made if not all entities included in the sample were available for data collection).

For the data analyses, we recommend presenting the number of facilities in the results as *‘the number of facilities in the sample’*. Thus, if we report that 8 of 18 health facilities updated their electronic LMIS in the last 7 days, this indicates that 8 of the health facilities included in the sample updated their electronic LMIS out of the 18 included in the sample.

On the other hand, percentages are presented as weighted averages. Thus, while 8 of 18 facilities is 44%, the reported percentage may or may not be 44%, because it is weighted based on the probability of selection. The weighted percentages can be interpreted as *‘the expected percentage of <<entity type>> nationally to have the value reported value for the KPI, based on the sample drawn’*.

The remainder of this document describes the recommended methods for calculation of the KPIs, based on the recommended data collected.

I. FORECASTING INDICATORS

Forecasting indicators should include:

1. Forecast accuracy (core indicator),
2. Supply plan accuracy (optional indicator), and
3. Source of funds (core indicator).

Typically, these indicators will be collected from only one entity in the 'Central KPI' data collection tool, and thus averaging across entities likely will not be necessary.

I.1 FORECAST ACCURACY

FORECAST ACCURACY DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
productname _c	Name of commodity c
productdose _c	Dosage of commodity c
forecast49 _c	Quantity in forecast for 20XX or last quantification cycle for tracer commodity c. Variable recorded as a number.
forecast49a _c	Unit for Question forecast49 _c (for commodity c)
forecast49b _c	You selected "Other"; please specify: (unit for commodity c)
forecast50 _c	Quantity of consumption / issues for 20XX or last quantification cycle for tracer commodity c. Variable recorded as a number. "9998" indicates data are not known or not available.
forecast50a _c	Unit for Question forecast50 _c (for commodity c)
forecast50b _c	You selected "Other"; please specify: (unit for commodity c)
forecast51 _c	Quantity in forecast50 _c is Issues or Consumption, for tracer commodity c is available, with a value of 1 = Issues and 2 = Consumption.

Data for forecast accuracy is typically collected for the tracer commodities selected for the assessment - although exceptions may be possible, if data for the tracer commodities are not available - and the assessment team selected additional commodities. The variables productname_c and productdose_c provide descriptive information for each commodity c about the name and dosage (respectively) of each commodity, which should be used when presenting results.

FORECAST ACCURACY CALCULATION

This indicator measures how accurate forecasts of demand are compared with the actual consumption (or issues) of the product.

The basis for calculating this KPI is:

$$\left(1 - \left(\frac{|forecasted\ consumption - actual\ consumption|}{Actual\ consumption}\right)\right) \times 100$$

Before performing the calculation, the units of forecasted consumption and actual consumption should be the same. Thus, if forecast49_{a_c} (or forecast49_{b_c}) is not equal to forecast50_{a_c} (or forecast50_{b_c}), the values for either forecast49_c or forecast50_c need to be adjusted such that the units are the same. This indicator cannot be calculated if either forecast49_c or forecast50_c is equal to '9998' (indicating missing data).

In practice, this formula is applied to each commodity *c*, and disaggregated results are presented. Thus,

For each tracer commodity *c*:

$$\left(1 - \left(\frac{|forecast49_c - forecast50_c|}{forecast50_c}\right)\right) \times 100$$

With 100% reflecting completely accurate forecasts. Target deviations for demand forecasts are context dependent, and highly dependent on the quality, timeliness and accuracy of data used in the forecast. It is recommended that Ministries should aim for a deviation of less than 25% of the volume forecast, therefore >75% (and <125%) forecast accuracy.

I.2 SUPPLY PLAN ACCURACY

SUPPLY PLAN ACCURACY DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
productnameh _c	Name of commodity c
productdoseh _c	Dosage of commodity c
supplyplan49 _c	Quantity in supply plan for 20XX or last supply plan cycle for tracer commodity c. Variable recorded as a number.
supplyplan50 _c	Quantity ordered for 20XX or last supply plan cycle for tracer commodity c. Variable recorded as a number. "9998" indicates data are not known or not available.

Data for supply plan accuracy is typically collected for the tracer commodities selected for the assessment - although exceptions may be possible if data for the tracer commodities are not available - and the assessment team selected additional commodities. The variables productnameh_c and productdoseh_c provide descriptive information for each commodity c about the name and dosage (respectively) of each commodity, which should be used when presenting results.

SUPPLY PLAN ACCURACY CALCULATION

This indicator measures how closely the commodity quantity in orders placed on suppliers match the supply plan for the product category under review.

The basis for calculating this KPI is:

$$\left(1 - \left(\frac{|planned\ quantity\ of\ orders - actual\ quantity|}{Actual\ quantity}\right)\right) \times 100$$

This indicator cannot be calculated if either supplyplan49_c or supplyplan50_c is equal to '9998' (indicating missing data). In practice, this formula is applied to each tracer commodity, and disaggregated results are presented. Thus,

For each tracer commodity c:

$$\left(1 - \left(\frac{|supplyplan49_c - supplyplan50_c|}{supplyplan50_c}\right)\right) \times 100$$

With 100% reflecting completely accurate supply plans. Subject to available funding to meet the supply plan volumes, adhering to the supply plan volumes should be under management control. Deviation from the target should be less than 10%, therefore >90% (and <110%) supply plan accuracy.

I.3 SOURCES OF FUNDS

SOURCE OF FUNDS DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
Fundsavailable	Indicator variable for whether the total value of commodities were available for 20XX, with 1 = Yes and 0 = No.
Totalfunds	Total value of commodities for 20XX (inclusive of all sources both domestic and international), entered as a number.
Currencytotal	<p>Currency of totalfunds, entered as coded uniquely for each country, recommended coding is:</p> <ul style="list-style-type: none"> 1 Local currency in country of assessment 2 US Dollars 3 Euro 4 Indian Rupee 5 Other
Currencytotalother	Currency of totalfunds, if other is selected for currencytotal, entered as text.
Numberfunders	The number of sources of funding for health commodities; each source defined as f .
namefunder $_f$	Name of funder f (entered as text)
funderfunds $_f$	Total value of commodities for 20XX from funder f
currencyfunder $_f$	<p>Currency of funderfunds$_f$, entered as coded uniquely for each country, recommended coding is:</p> <ul style="list-style-type: none"> 1 Local currency in country of assessment 2 US Dollars 3 Euro 4 Indian Rupee 5 Other

SOURCE OF FUNDS DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
currencyfunderother _i	Currency of funderfunds _i , if other is selected for currencyfunder _i , entered as text.

SOURCE OF FUNDS CALCULATION

This indicator measures what organization/entity provides the funding for commodities and is a measure of system sustainability.

The basis for calculating this KPI is:

$$\left(\frac{\text{Value of each source of funds}}{\text{Total value of commodities}} \right)$$

In practice, this formula is applied for each Funder f :

$$\frac{\text{funderfunds}_f}{\text{totalfunds}}$$

However, care must be taken to ensure that both funderfunds _{f} and totalfunds are reported in the same currency. If they are not reported in the same currency, then the exchange rates should be applied to either or both of the variables to convert them into the same currency. Official exchange rates can be derived from central bank websites or using commercially available websites such as <https://data.worldbank.org/indicator/PA.NUS.FCRF> or <https://www.oanda.com/currency/converter/>.

If totalfunds is not available, this indicator cannot be calculated. Ideally, the sum percentages resulting from each Funder f would add to 100%, but some funders may be missing; if data are missing for more than one Funder, then 100% minus the sum of percentages resulting from each Funder f should represent the total percent of funding for all of the Funders with missing data.

This KPI in practice is thus, “the percentage of commodity costs paid by each source of funding”.

There is no absolute target for this measure as the result is dependent on historical donor support, and government budgeting. Over time the percentage of donor support should decline relative to government funding and other sources.

2. PROCUREMENT INDICATORS

KPIs for procurement are collected at the central level only. In total, up to seven indicators could be collected:

1. Vendor on-time and in full delivery rate (core indicator).
2. Percentage of international reference price paid (core indicator).
3. Percentage of orders placed as emergency orders (optional indicator).
4. Supplier fill rate (optional indicator).
5. Procurement methods employed (optional indicator).
6. Percentage of health products procured listed on the National Essential Medicines List or similar document for other health products (optional indicator).
7. Customs clearance time (optional indicator).

2.1 VENDOR ON-TIME DELIVERY AND IN FULL

VENDOR ON-TIME AND IN FULL DELIVERY RATE DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
vendornumber	Number of orders with available data (entered as a number <i>o</i>)
vendordataavailable _o	Order data available for order <i>o</i> , with 1 = Yes and 0 = No.
vendordeliverywindow _o	Delivery window, entered as number of days, for order <i>o</i>
vendordeliverynumber _o	Number of products in order <i>o</i> , entered as a number
vendorcommodityname _{oc}	Name of product for order <i>o</i> , product <i>c</i> , entered as text.
vendorcommodityamount _{oc}	Amount ordered for product <i>c</i> ordered in order <i>o</i> .
vendorcommoditycorrection _{oc}	Indicator variable for whether the vendor adjusted the quantity for order <i>o</i> , product <i>c</i> , with 1 = Yes and 0 = No.
vendorreasoncorrection _{oc}	Reason vendor adjusted the quantity ordered if vendorcommoditycorrection _{oc} = 1 for order <i>o</i> , product <i>c</i> , with 1 = Stock out 2 = Insufficient stock 3 = Incorrect calculations 4 = Product nearing expiry 5 = Surplus 6 = Other
vendorreasoncorrectionother _{oc}	Reason vendor adjusted the quantity ordered if vendorreasoncorrection _{oc} = 6 for order <i>o</i> , product <i>c</i> , entered as text.
vendoradjustedamount _{oc}	Quantity of product <i>c</i> ordered in order <i>o</i> after vendor adjustment (if vendorcommoditycorrection _{oc} is "Yes")
vendoramountreceived _{oc}	Quantity of product <i>c</i> accepted from the vendor in order <i>o</i> .
vendoramountunit _{oc}	Unit of product <i>c</i> in order <i>o</i> .
vendorpromiseddate _{oc}	Promised delivery date for product <i>c</i> in order <i>o</i> .
vendoractualdate _{oc}	Actual delivery date for product <i>c</i> in order <i>o</i> .

VENDOR ON-TIME AND IN FULL DELIVERY RATE DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
vendorverifieddata _{oc}	Data were verified with primary records for product <i>c</i> in order <i>o</i> ., with 0 = No, and 1 = Yes.

VENDOR ON-TIME AND IN FULL DELIVERY RATE CALCULATION

Vendor on-time delivery and in full measures the percentage of orders that vendors delivered within the agreed-upon delivery window, and in full.

The basis for calculating this KPI is:

$$\left(\frac{\text{Number of orders delivered according to the contract agreement with supplier(s)}}{\text{Total number of orders delivered in period}} \right) \times 100$$

To calculate this KPI, a decision has to be made about order adjustments. There may be reasonable or justifiable reasons for vendors to adjust the quantities ordered, but not all adjustments will be reasonable or justifiable. It is recommended that stock-out, insufficient stock, product nearing expiry and surplus NOT be considered reasonable or justifiable reasons for vendors to adjust the quantities ordered.

Thus, the variable 'quantityordered_{oc}' is = vendorcommodityamount_{oc} if vendorcommoditycorrection_{oc} = 0 OR (vendorcommoditycorrection_{oc} = 1 AND vendorreasoncorrection_{oc} NOT = 3), else 'quantityordered_{oc}' = vendoradjustedamount_{oc}.

The variable 'orderinfull_{oc}' = 1 if quantityordered_{oc} = vendoramountreceived_{oc}, else 'orderinfull_{oc}' = 0.

To deliver an order according to the contract agreement, suppliers must also deliver the order within the delivery window of the promised delivery date.

Thus, the variable 'orderintime_{oc}' = 1 if (vendoractualdate_{oc} > (vendorpromiseddate_{oc} - vendordeliverywindow_o)) AND (vendoractualdate_{oc} < (vendorpromiseddate_{oc} + vendordeliverywindow_o)), else = 0.

For each commodity *c*, calculate the percentage on-time and in full:

$$OTIF_c = \frac{\sum_{o=1}^n (\text{orderinfull}_{oc} * \text{orderintime}_{oc})}{\sum_{o=1}^n m = 1 \text{ if order contains commodity } c, \text{ else } 0}$$

Where *n* is the number of orders for which data were collected. The variable vendorcommodityname_{oc} can be retained as identifying information.

To calculate the final on-time and in full KPI:

$$\frac{\sum_{c=1}^{nc} OTIF_c}{nc}$$

Where nc is the number of individual commodities collected across all orders. Thus, the order in-time and in full should be calculated for each commodity, and then averaged across all commodities.

Typically, it is expected that the vendor on-time and in full KPI should be >85% for international suppliers, and >90% for local suppliers. These rates accord with commercial sector expectations in developing countries and are in line with Global Fund targets.

Note that analysts may choose to report the vendor in-full and the vendor on-time proportions as sub-indicators of the vendor on-time and in-full KPI.

2.2 PERCENTAGE OF INTERNATIONAL REFERENCE PRICE PAID

PERCENTAGE OF INTERNATIONAL REFERENCE PRICE PAID DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
numberprices	Number of commodities to be included in this section (entered as number c)
pricecommodityname _c	Product name of commodity c
pricecommoditydose _c	Product dosage of commodity c
pricepurchased _c	Variable indicating if any of commodity c was purchased in 20XX, with 1 = Yes and 0 = No.
pricepaidavailable _c	Variable indicating if any price paid data for commodity c is available for 20XX, with 1 = Yes and 0 = No.
numberordersprices _c	Number of orders o with price data available for commodity c for 20XX
amountorderedprices _{co}	Amount of commodity c ordered in order o, entered as a number.
unitorderprices _{co}	The amount in amountorderedprices _{co} reflects packs or units, with 1 = packs and 2 = units.
numberperpackprices _{co}	If unitorderprices _{co} = 1, the number of units in a pack for commodity c in order o.
amountpaidprices _{co}	Amount paid for commodity c in order o.
currencyprices _{co}	<p>Currency for amountpaidprices_{co} entered as coded uniquely for each country, recommended coding is:</p> <ul style="list-style-type: none"> 1 Local currency in country of assessment 2 US Dollars 3 Euro 4 Indian Rupee 5 Other
currencypricesother _{co}	Specified currency if currencyprices _{co} = 5, entered as text.

PERCENTAGE OF INTERNATIONAL REFERENCE PRICE PAID DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
ordervendorprices _{co}	Name of vendor for commodity <i>c</i> in order <i>o</i> , entered as text.
pricesprimarydata _{co}	Data for commodity <i>c</i> in order <i>o</i> was verified with primary data, with 1 = Yes and 0 = No.

PERCENTAGE OF INTERNATIONAL REFERENCE PRICE PAID CALCULATION

This indicator measures the percentage of the international reference prices paid for each product line procured.

The basis for calculating this KPI is:

$$\left(\frac{\text{Average price paid for a product}}{\text{International reference price of the same product}} \right) \times 100$$

This indicator is calculated separately for each commodity used in the assessment.

International references prices can be found also at various websites, including: <https://www.msh.org/resources/international-medical-products-price-guide> and <http://apps.who.int/hiv/amds/price/hdd/>. Median price listed for the commodity should be used. The data for international reference prices should match the year for the data collected; if this is not available, use the latest year of data available.

In order to make purchase prices comparable to international references prices, all purchases should be adjusted using an exchange rate to convert all of the figures into one common currency (typically local currency units) if they are not all in the same currency. This can be done either using the exchange rate obtained in for each individual order (if available) or the average official exchange rate for the year in question. Official exchange rates can be derived from central bank websites or using commercially available websites such as <https://data.worldbank.org/indicator/PA.NUS.FCRF> or <https://www.oanda.com/currency/converter/>. The resulting adjustments are recorded as pricepaidcommoncurrency_{co}.

Second, all products should be converted into a common quantity – either unit or pack – for each of the products to create the variable ‘amountreceived_{co}’, per amountorderedprices_{co} and unitorderprices_{co}.

The amount paid per unit for each commodity *c* is then calculated as:

$$\text{Unit price of commodity } c = \frac{\sum_{o=1}^n \text{pricepaidcommoncurrency}_{co}}{\sum_{o=1}^n \text{amountreceived}_{co}}$$

Where *n* is the number of orders for commodity *c* and *c* = the number of commodity *c*.

This formula gives the average amount paid per unit of commodity c in the currency specified for the year of interest.

Then, for each commodity c , unit price of the commodity should be converted to US dollars (if not already in US dollars), and the proportion of the international reference price paid is calculated as:

Proportion of international reference price paid for commodity c

$$= \frac{\text{Unit price of commodity } c}{\text{International reference price for commodity } c}$$

Results should be reported separately for each commodity.

WHO recommends that prices should be at or below international norms, however, this may not always be achievable due to volumes purchased and short-term supply market constraints. Suggested target is no more than 105% of international reference price.

2.3 NUMBER OF EMERGENCY ORDERS PLACED ON VENDORS, AS A PERCENTAGE OF TOTAL ORDERS PLACED

PERCENTAGE OF ORDERS PLACED AS EMERGENCY ORDERS DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
ordersnumbermonth _m	Indicator if data are available for month <i>m</i> , with 1 = Yes and 0 = No.
totalordersplaced _m	Total number of orders placed in month <i>m</i> , entered as a number.
totalemergencyordersplaced _m	Total number of emergency orders placed in month <i>m</i> , entered as a number.

PERCENTAGE OF ORDERS PLACED AS EMERGENCY ORDERS CALCULATION

This indicator measures the percentage of procurement orders placed on vendors during the reporting period that were emergency orders.

The basis for calculating this KPI is the formula:

$$\left(\frac{\text{Number of emergency orders placed in the reporting period}}{\text{Total number of orders placed in the same period}} \right) \times 100$$

In practice, the following formula is used to calculate this formula:

For each *m* where ordersnumbermonth_m = 1:

$$\frac{\sum_{m=1}^n \text{totalemergencyordersplaced}_m}{\sum_{m=1}^n \text{totalordersplaced}_m}$$

Where *m* represents the *n* months over which data were collected.

It is recommended that the target for this indicator be 5% or less of all orders being emergency orders.

2.4 SUPPLIER FILL RATE

SUPPLIER FILL RATE DATA

Supplier fill rate uses the data listed under **Vendor on-time and in full delivery rate data**.

SUPPLIER FILL RATE CALCULATION

This indicator compares the quantity ordered to the quantity received and is a complement to Measure 2.1 Vendor on time and in full delivery rate. Comparisons can be made for specific commodities or aggregated for all commodities. The formulas below show how to report disaggregated for specific commodities. To aggregate, it is recommended that the average (unweighted) results for each commodity be used.

The basis for this formula is:

$$\left(\frac{\text{Total quantity received}}{\text{Total quantity of product ordered}} \right) \times 100$$

In practice, this formula is applied to each tracer commodity, and disaggregated results are presented.

To calculate this KPI, a decision has to be made about order adjustments. There may be reasonable or justifiable reasons for vendors to adjust the quantities orders, but not all adjustments will be reasonable or justifiable. It is recommended that stock-out, insufficient stock, product nearing expiry and surplus NOT be considered reasonable or justifiable reasons for vendors to adjust the quantities ordered.

Thus, the variable 'quantityordered_{oc}' is = vendorcommodityamount_{oc} if vendorcommoditycorrection_{oc} = 0 OR (vendorcommoditycorrection_{oc} = 1 AND vendorreasoncorrection_{oc} NOT = 3), else 'quantityordered_{oc}' = vendoradjustedamount_{oc}.

Based on the variable vendoramountunit_{oc}, quantityordered_{oc} and vendoramountreceived_{oc} need to be in the same units for commodity c for all orders o. This adjustment needs to be checked or made before calculating the KPI.

The calculation of this KPI is, then:

$$\text{Supplier fill rate for commodity } c = \frac{\sum_{o=1}^n \text{vendoramountreceived}_{oc}}{\sum_{o=1}^n \text{quantityordered}_{oc}}$$

Where n is the number of orders for commodity c and c = the number of commodity c .

The average of the Supplier fill rate can be taken across all commodities with data.

The recommended target for this indicator is 95% in line with target for KPI 3.4.

2.5 BREAKDOWN OF ORDERS PLACED BY PROCUREMENT METHOD

PROCUREMENT METHODS EMPLOYED DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
ordersnumbermonth _m	Indicator if data are available for month <i>m</i> , with 1 = Yes and 0 = No.
totalordersplaced _m	Total number of orders placed in month <i>m</i> , entered as a number.
totalframeworkordersplaced _m	Total number of orders placed by framework contract in month <i>m</i>
totalrfpordersplaced _m	Total number of orders placed by Request for Proposal in month <i>m</i>
totalrfqordersplaced _m	Total number of orders placed by Request for Quote in month <i>m</i>
totaldirectordersplaced _m	Total number of orders placed by Direct order in month <i>m</i>

PROCUREMENT METHODS EMPLOYED CALCULATION

This indicator shows the percentage of the types of procurement undertaken during the reporting period to assess the performance of the procurement operation in using a variety of procurement methods as appropriate to the purchases made.

The basis for calculating this KPI is the formula:

$$\left(\frac{\text{Number of orders placed of each type}}{\text{Total number of orders placed in the same period}} \right) \times 100$$

In practice, the following formula is used to calculate this formula:

For each order type *i* and for each *m* where ordersnumbermonth_m = 1:

$$\frac{\sum_{m=1}^n [i] \text{ordersplaced}_m}{\sum_{m=1}^n \text{totalordersplaced}_m}$$

Where *m* represents the *n* months over which data were collected. The indicator *i* typically will be 4 different order types although this may be altered for individual countries assessed. Results are reported separately for each order type.

There is no global guidance on the mix of procurement types, but framework or call-off orders for routine product should grow to >60% in most cases to improve efficiency.

2.6 PERCENTAGE OF PHARMACEUTICAL PRODUCTS PROCURED LISTED ON THE NATIONAL ESSENTIAL MEDICINES LIST /HEALTH PRODUCTS OR SIMILAR DOCUMENT

ESSENTIAL MEDICINES DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
neml1	Indicator variable for whether the total number of different products procured in 20XX is known, with 1 = Yes and 0 = No.
neml2	The total number of different products procured in 20XX, entered as a number.
neml3	Indicator variable for whether the number of products entered in neml2 that are listed on the National Essential Medicines List or similar document is known, with 1 = Yes and 0 = No.
neml4	If neml3 = 1, the number of products neml2 that are listed on the National Essential Medicines List or similar document, entered as a number.

ESSENTIAL MEDICINES CALCULATION

This indicator measures the percentage of procurements that are made based on the National Essential Medicines List (NEML).

The basis for calculation of this KPI is:

$$\left(\frac{\text{Number of products procured on the NEML}}{\text{Total number of product procured}} \right) \times 100$$

In practice, this indicator can only be calculated if neml1 and neml3 are both = 1. If this condition is true, then the KPI is calculated as:

$$\frac{\text{neml4}}{\text{neml2}}$$

While 100% is recommended by WHO, the suggested target is 95% to allow flexibility.

2.7 CUSTOMS CLEARANCE TIME

CUSTOMS CLEARANCE DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
numbersampledcustoms	Total number of international consignments sampled for the assessment, entered as a number.
customsreceiveddate _o	Date order shipment (consignment) received by Customs for order <i>o</i> , entered as a date.
customsreleasedate _o	Date released to agent for delivery for order <i>o</i> , entered as a date.

CUSTOMS CLEARANCE CALCULATION

This indicator measures the time taken for international consignments to be processed by the Customs authorities, and released for delivery to the in-country delivery address.

The basis for calculating this KPI is:

(Date order consignment received by Customs - Date released to agent for delivery) = # of days

In practice, the formula is the same as the basis, but averaged over the data for the orders collected:

$$\text{Average customs clearance time} = \frac{\sum_{o=1}^n (\text{customsreleasedate}_o - \text{customsreceiveddate}_o)}{n}$$

Where *o* represents each order for which data were collected and *n* is the number of orders sampled (equal to numbersampledcustoms).

This measure is highly dependent on the customs regimen of the country, acceptable performance can vary from hours to weeks. Therefore, expected performance levels must be set locally.

3. WAREHOUSING AND INVENTORY INDICATORS

KPIs for warehousing and inventory were collected at all levels, although not every indicator was collected at each level. The levels for each of the indicators are noted below. The indicators include:

1. Stocked according to plan (at warehouses, referral hospitals, and SDPs; core indicator).
2. Stockout rate by tracer commodity by level in the system, including the average number of days out of stock in a month when there was a stockout (at warehouses, referral hospitals, and SDPs; core indicator).
3. Stock accuracy (done separately for paper-based records and electronic LMIS) (at warehouses, referral hospitals, and SDPs; core indicator).
4. Order fill rate (at warehouses only; core indicator).
5. Wastage from damage, theft and expiry (at warehouses, referral hospitals, and SDPs; core indicator).
6. Stock turn per annum (at central level only; optional indicator).
7. Number and duration of temperature excursions in cold storage facility (at warehouses, referral hospitals, and SDPs; optional indicator).
8. Stockout rates of one or more tracer products by facility (at warehouses, referral hospitals, and SDPs; optional indicator).
9. Cost of warehousing operations (at warehouses only; optional indicator).
10. Order turn round time (at warehouses only; optional indicator).
11. Percentage of incoming product batches tested (central level indicator; optional indicator).
12. Percentage of product batches tested meeting quality standards (central level indicator; optional indicator).

The following subscripts are used for this section:

C: Tracer commodities, typically taking values of 1 through 10, although individual assessments may have more or fewer tracer commodities.

M: month, taking the values of 1 through 6 (typically) for the period of interest of the assessment. For stock turns, *m* takes a value of 1 through 12 for the months of the year prior to the assessment.

F: denotes an individual health facility / warehouse.

O: Order number.

U: Unit for cold storage (more than one unit for cold storage could be entered).

STOCK DATA

VARIABLE NAME	VARIABLE DESCRIPTION
managed _{fc}	Indicator variable for whether tracer commodity <i>c</i> is managed by facility <i>f</i> , with 1 = Yes and 0 = No. If equal to no, no further questions were asked for tracer commodity <i>c</i> .
min_yesno _{fc}	Indicator variable for whether tracer commodity <i>c</i> is has a minimum level of stock known by facility <i>f</i> , with 1 = Yes and 0 = No. If equal to no, min_amount _{fc} not asked for tracer commodity <i>c</i> .
min_amount _{fc}	The established minimum stock level for whether tracer commodity <i>c</i> at facility <i>f</i> (in months).
max_yesno _{fc}	Indicator variable for whether tracer commodity <i>c</i> is has a maximum level of stock known by facility <i>f</i> , with 1 = Yes and 0 = No. If equal to no, max_amount _{fc} not asked for tracer commodity <i>c</i> .
max_amount _{fc}	The established maximum stock level for whether tracer commodity <i>c</i> at facility <i>f</i> (in months).
elmiss _{cfc}	Indicator variable for whether an electronic LMIS record available for tracer commodity <i>c</i> at facility <i>f</i> , with 1 = Yes and 0 = No.
elmissoh _{fc}	The amount of stock on hand recorded in the electronic LMIS system for tracer commodity <i>c</i> at facility <i>f</i> (if elmiss _{cfc} = 1).
elmissoha _{fc}	Indicator variable for whether the last modification of the electronic LMIS record for tracer commodity <i>c</i> was the date of assessment team visited facility <i>f</i> , with 1 = Yes and 0 = No (if elmiss _{cfc} = 1).
elmissohb _{fc}	If scsoha _{fc} = 0, the date of the last electronic LMIS modification for tracer commodity <i>c</i> at facility <i>f</i> (if elmiss _{cfc} = 1).
scphys _{fc}	Physical (hand) Count the stock in the storeroom for tracer commodity <i>c</i> at facility <i>f</i> .
unitl4a _{fc}	The unit that the amounts in scphys _{fc} are recorded in, coded as needed for each individual assessment. [Note: multiple codes are used for the same answer in order to ease data entry.]
unit_other _{fc}	If unitl4a _{fc} = 11 ("other"), text variable explaining units used for tracer commodity <i>c</i> at facility <i>f</i> .
sc _{fc}	Indicator variable for whether a paper stock card for tracer commodity <i>c</i> is available at facility <i>f</i> , with 1 = Yes and 0 = No.
meanmonth _{fc}	The average monthly consumption for tracer commodity <i>c</i> at facility <i>f</i> , based on up to the last 6 months of data, as available.

STOCK DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
scsoh _{fc}	The amount of stock on hand recorded on the stock card for tracer commodity <i>c</i> at facility <i>f</i> (if sc _{fc} =1).
Sclastdate	Date of the last updated on the paper stock card for tracer commodity <i>c</i> at facility <i>f</i> (if sc _{fc} =1).
Scuptodate	Indicator whether or not the paper stock card is up to date for tracer commodity <i>c</i> at facility <i>f</i> (if sc _{fc} =1), with 1 = Yes and 0 = No.
scupdated _{fmc}	Indicator variable for whether stock card or electronic LMIS data are available for tracer commodity <i>c</i> at facility <i>f</i> for month <i>m</i> , with 1 = Yes and 0 = No.
openingsoh _{fmc}	Initial stock for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> (i.e., the amount in stock at the beginning of month <i>m</i>).
consumption _{fmc}	The amount of issues from the stores for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> .
expiry _{fmc}	The total amount of expiry, damaged, and lost product from the stores for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> .
so _{fmc}	Indicator variable for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> with 1 indicating there was a stockout and 0 indicating no stockout.
expiry_detail _{fmc}	If expiry _{fmc} > 0, details of the amount and reason for amount of expiry, damaged, and lost product from the stores for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> .
daysso _{fmc}	If so _{fmc} > 0, the number of days of stockout for tracer commodity <i>c</i> at facility <i>f</i> in month <i>m</i> .

unit14a_{fc} and unit_other_{fc} are principally used to check the data and ensure that there are no outliers in the data (facilities with factor differences in the quantities of commodities reported compared to other facilities of the same type). However, units should be standardized for each commodity across facilities before any of the analyses below are conducted.

3.1 STOCKED ACCORDING TO PLAN

STOCKED ACCORDING TO PLAN DATA

This indicator utilizes the **stock data** presented at the beginning of the Warehousing and Inventory Indicators section.

STOCKED ACCORDING TO PLAN CALCULATION

This indicator measures the percentage of tracer commodities between the established minimum and maximum stock levels at each assessed facility.

Minimum and maximum stock levels are typically based on multiples of the average monthly consumption of a commodity (meanmonth_{fc}). The minimum and maximum stock levels need to be established either at each facility (using min_amount_{fc} and max_amount_{fc}), globally for the whole assessment based on the level of the facility / warehouse, or (less preferred) a mix of facility-specific minimums / maximums and global minimums / maximums (possibly for those sites that were unaware of their minimums / maximums).

Thus:

$\text{minimum}_{fmc} = \text{meanmonth}_{fc} \times (\text{min_amount}_{fc} \text{ or the minimum number of months of stock that should be on hand for a particular facility / warehouse}), \text{ and}$

$\text{maximum}_{fmc} = \text{meanmonth}_{fc} \times (\text{max_amount}_{fc} \text{ or the maximum number of months of stock that should be on hand for a particular facility / warehouse}).$

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of tracer commodity observations with months of stock between established minimum and maximum stock levels}}{\text{Total number of tracer commodity observations}} \right) \times 100$$

The calculation in practice averages across months and then facilities (for each tracer commodity and by type of facility):

The variable ' asplanned_{fmc} ' = 1 if $\text{openingsoh}_{fmc} > \text{minimum}_{fmc}$ AND $\text{openingsoh}_{fmc} < \text{maximum}_{fmc}$, else = 0. Thus, for each tracer commodity and type of facility, the KPI is calculated as:

$$\frac{\left(\sum_{f=1}^n \left(\frac{\sum_{m=1}^6 (\text{asplanned}_{fmc})}{\sum_{M=1}^6 \text{TRUE}(\text{scupdated}_{fmc} = 1)} \times w_f \right) \right)}{\sum_{f=1}^n w_f}$$

Where w represents the sample weight for each facility.

In practice, this formula calculates the percentage of months where the opening balance of a tracer commodity was between the minimum and maximum levels for each facility. It then takes the weighted average of those percentages across the facilities to calculate one overall average for each tracer commodity c.

WHO recommended target is that 100% of stocks should be within the max/min tolerance. This would be exceptional performance, in practice 90% or above would be a good target.

3.2 STOCKOUT RATES BY TRACER COMMODITY BY LEVEL IN THE SYSTEM

STOCKOUT RATES DATA

This indicator utilizes the **stock data** presented at the beginning of the Warehousing and Inventory Indicators section.

STOCKOUT RATES CALCULATION

This indicator measures the percentage of tracer commodity observations with a stockout during the reporting period and on the day of visit.

Two indicators are calculated for this KPI. The basic calculations for these indicators are:

$$\left(\frac{\text{Number of tracer commodity stock observations experiencing a stockout on the day of visit}}{\text{Total number of tracer commodity stock observations}} \right) \times 100$$

$$\left(\frac{\text{Number of days of tracer commodity stock observations experiencing a stockout during the reporting period}}{\text{Total number of days of tracer commodity stock observations during the reporting period}} \right) \times 100$$

If $\text{managed}_{fc} = 1$, the variable $\text{stockoutphys}_{fc} = 1$ if $\text{scphys}_{fc} = 0$, else $= 0$.

The calculation in practice averages across facilities (for each tracer commodity and by type of facility) for the Percentage of facilities with stockout on day of assessment:

$$\frac{\left(\sum_{f=1}^n ((\text{stockoutphys}_{fc}) \times w_f) \right)}{\sum_{f=1}^n w_f}$$

For all facilities f where $\text{managed}_{fc} = 1$. This is the weighted average, done separately for each type of facility.

An average percentage of facilities with stockout on the day of assessment is calculated as:

$$\frac{\sum_{c=1}^m \left(\frac{\left(\sum_{f=1}^n ((\text{stockoutphys}_{fc}) \times w_f) \right)}{\sum_{f=1}^n w_f} \right)}{m}$$

Where m represents the number of tracer commodities.

That is, the weighted average of the percentage of facilities with stockout on day of assessment is first calculated across facilities for each tracer commodity. Then, the average is calculated across tracer commodities.

Less than 5% of facilities should record a stock outs on the day of the assessor visit, as a goal.

The calculation in practice averages across facilities (for each tracer commodity and by type of facility) for the Stockout days for the period of interest for the assessment:

$$\left[\sum_{f=1}^n \left(\frac{(\sum_{m=1}^6 \text{daysso}_{fmc} \times \text{scupdated}_{fmc})}{\sum_{m=1}^6 \text{scupdated}_{fmc} \times \text{number of days in month } m} \right) \times w_f \right] / \sum_{f=1}^n w_f$$

Where w represents the sample weight for each facility and $\text{managed}_{ic} = 1$. It should be disaggregated by type of facility. This indicator first assesses the percentage of days a particular facility was out of stock of a commodity in the 6 month reporting period, and then takes the weighted average of this across the facilities. To report an overall average, average the results of the formula above across tracer commodities:

$$\sum_{c=1}^m \frac{\left[\sum_{f=1}^n \left(\frac{(\sum_{m=1}^6 \text{daysso}_{fmc} \times \text{scupdated}_{fmc})}{\sum_{m=1}^6 \text{scupdated}_{fmc} \times \text{number of days in month } m} \right) \times w_f \right]}{m} / \sum_{f=1}^n w_f$$

Where m represents the number of tracer commodities.

The ideal is no stock outs, but in line with the expectation that 90% of stocks should be within the max/min tolerances, the target for this measure is <5%, on the assumption that being outside the max/min tolerance does not mean a stock out in every case.

Secondary indicators (not KPIs): The analysis can report both the percentage of days facilities were out of stock of a commodity, the average stockout days for the assessment period, and the duration of a stockout, if there was a stockout.

The duration of a stockout, if there was a stockout is calculated as:

$$\sum_{f=1}^n \frac{(\sum_{m=1}^6 \text{daysso}_{fmc} \times \text{scupdated}_{fmc} \times \text{so}_{fmc}) \times w_f}{\sum_{f=1}^n w_f}$$

This formula calculates the weighted average number of days out of stock for each tracer commodity c . This formula should be done for each type of facility. It is also the numerator of the formula above. The results of this formula can be averaged across tracer commodities.

To calculate the duration of a stockout, if there was a stockout take the above formula and divide it by the number of months in which a stockout was reported:

$$\left[\sum_{f=1}^n \left(\frac{\left(\sum_{m=1}^6 \text{daysso}_{fmc} \times \text{scupdated}_{fmc} \times \text{so}_{fmc} \right)}{\sum_{m=1}^6 \text{scupdated}_{fmc} \times \text{so}_{fmc}} \right) \times w_f \right] / \sum_{f=1}^n w_f$$

This formula calculates the weighted average number of days out of stock for each tracer commodity *c*. This formula should be done for each type of facility. The results of this formula can be averaged across tracer commodities.

Stock outs should be corrected within 5 days, as a goal.

3.3 STOCK ACCURACY

STOCK ACCURACY DATA

This indicator utilizes the **stock data** presented at the beginning of the Warehousing and Inventory Indicators section.

STOCK ACCURACY CALCULATION

This indicator compares the stock quantity on a stock card and/or in an inventory management software with the quantity of a physical inventory conducted during a site visit.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total quantity of product on stock card or inventory management software}}{\text{Total quantity of the same product from physical inventory conducted during a site visit}} \right) \times 100$$

The calculation in practice needs to average this indicator across facilities. Since the indicator above is not bound (i.e., it can take a value greater than 1 and less than 1), a simple average will misconstrue the stock accuracy. That is, if one facility has a stock accuracy of 104, while another has a stock accuracy of 96, the unadjusted average is 100. This falsely conveys the message that stock accuracy is perfect, whereas both facilities had inaccuracies.

To aggregate this indicator across facilities, two metrics are used:

1. Percentage of facilities at 100% accuracy
2. Average deviation from 100% accuracy across facilities (no deviance = 0)

Further, these two indicators are repeated for paper-based records and electronic LMIS records.

Percentage of facilities at 100% accuracy:

The variable 'accuratepaper_{fc}' = 1 if scphys_{fc} = scsoh_{fc}, else = 0.

$$\frac{(\sum_{f=1}^n (\text{accuratepaper}_{fc} \times w_f))}{\sum_{f=1}^n w_f}$$

For paper stock cards, and,

With the variable 'accurateelmis_{fc}' = 1 if scphys_{fc} = elmisoh_{fc}, else = 0,

$$\frac{(\sum_{f=1}^n (\text{accurateelmis}_{fc} \times w_f))}{\sum_{f=1}^n w_f}$$

For electronic LMIS,

Where w represents the sample weight for each facility, given that $\text{managed}_{fc} = 1$, and $\text{sc}_{fc} / \text{elmiss}_{\text{sc}_{fc}} = 1$.

The percentage of facilities at 100% accuracy should be calculated for each tracer commodity, and be disaggregated by type of facility. Once the weighted average is taken for each tracer commodity, a simple average of the results for each tracer commodity can be reported:

$$\frac{\sum_{c=1}^m (\text{Percentage of facilities at 100\% accuracy}_c)}{m}$$

Where m is the number of tracer commodities.

The target should be 100% accuracy, as set by WHO.

Average deviation from 100% accuracy across facilities (no deviance = 0):

$$\frac{\left(\sum_{f=1}^n \left(\left| 1 - \left(\frac{\text{scsoh}_{fc}}{\text{scphys}_{fc}} \right) \right| \times w_f \right) \right)}{\sum_{f=1}^n w_f}$$

For paper stock cards, and

$$\frac{\left(\sum_{f=1}^n \left(\left| 1 - \left(\frac{\text{lmissoh}_{fc}}{\text{scphys}_{fc}} \right) \right| \times w_f \right) \right)}{\sum_{f=1}^n w_f}$$

For electronic LMIS,

Where w represents the sample weight for each facility, given that $\text{managed}_{fc} = 1$, and $\text{sc}_{fc} / \text{elmiss}_{\text{sc}_{fc}} = 1$.

This indicator takes the absolute value of the difference from one of the ratio of the amount of commodity as recorded and the amount of commodity as observed. If there were perfect accuracy, this metric would return a result of zero (e.g., $1 - (100/100) = 0$). Note, however, that this indicator can produce very large levels of deviance: if the stock card records 200 items of a commodity in stock, and there are actually only 4 items in stock, it will produce a measure of inaccuracy of 49 (or 4900%):

$$|1 - (200/4)| = 49$$

Thus, care needs to be taken when interpreting this indicator. Results close to zero indicate good *relative* accuracy, while results far from zero indicate poor *relative* accuracy, but do not necessarily imply large inaccuracies in absolute volume terms.

Thus, it is not recommended to take an average across tracer commodities, but to report the results for each tracer commodity separately. The range (e.g., the minimum and maximum results across the tracer commodities) should be reported.

Secondary indicators (not KPIs): The analysis can report both the percentage of stock cards up to date (on the day of the assessment visit) and the percentage of electronic LMIS records up to date (on the day of the assessment visit).

The percentage of stock cards up to date (on the day of the assessment visit) is calculated as:

$$\frac{(\sum_{f=1}^n (\text{suptodate}_{fc} \times w_f))}{\sum_{f=1}^n w_f}$$

Where w represents the sample weight for each facility, given that $\text{managed}_{fc} = 1$, and $\text{sc}_{fc} = 1$.

The percentage of electronic LMIS records up to date (on the day of the assessment visit) is calculated as:

$$\frac{(\sum_{f=1}^n (\text{elmissoha}_{fc} \times w_f))}{\sum_{f=1}^n w_f}$$

Where w represents the sample weight for each facility, given that $\text{managed}_{fc} = 1$, and $\text{elmissc}_{fc} = 1$.

Weighted averages for both indicators should first be calculated for each tracer commodity; a subsequent calculation should be done to take the average across tracer commodities.

3.4 ORDER FILL RATE

DOWNSTREAM ORDER DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
$dnsddateorder_{fo}$	Indicator variable for whether the order date was available for order o at facility f , with 1 = Yes and 0 = No.
$dnsorderdate_{fo}$	The date order o was received from the health facility for warehouse f , answered if $dnsddateorder_{fo} = 1$
$dnsddatepromdelivery_{fo}$	Indicator variable for whether the delivery date was available for order o at facility f , with 1 = Yes and 0 = No.
$dnsdeliverypromdate_{fo}$	The date order o was shipped to the health facility for warehouse f , answered if $dnsddatepromdelivery_{fo} = 1$
$dnsfacilitytype_{fo}$	Type of facility that made the order, with 1 = Health Center 2 = Hospital 3 = Referral Hospital 4 = Intermediate warehouse 99 = Other
$dnsfacilitytypeother_{fo}$	If $dnsfacilitytype_{fo} = 99$, text response for the type of facility making the order.
$downstreamproductnumber_{fo}$	Number of products in order o at facility f .
$nameproductdown_{foc}$	Name of product c in order o from the health facility to warehouse f , entered as text.
$amtordereddns_{foc}$	Amount of product c ordered in order o from the health facility to warehouse f .
$adjusteddnsyn_{foc}$	Indicator variable for whether warehouse f corrected or changed the quantity of product c ordered for order o , with 1 = Yes and 0 = No.
$reasonadjdns_{foc}$	If $adjusteddnsyn_{foc} = 1$, lists the reason the warehouse adjusted order o for product c , coded as: 1 Stock out 2 Insufficient stock

DOWNSTREAM ORDER DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
	3 Incorrect calculations 4 Product nearing expiry 5 Surplus 6 Other
$\text{reasonadjdnsspecify}_{fco}$	If $\text{reasonadjdnsspecify}_{fco} = 6$, text variable explaining the stated reason the warehouse adjusted order o for tracer commodity c .
amtadjddns_{foc}	If $\text{adjustedddnsyn}_{foc} = 1$, lists the adjusted amount of product c ordered in order number o . Data is recorded as an integer.
amtdeldns_{foc}	Amount of product c shipped in order o by the warehouse. Data is recorded as an integer.
unitrecddns_{foc}	The unit that the amounts in $\text{amtorderddns}_{foc}$, amtadjddns_{foc} , and amtdeldns_{foc} are recorded in, entered as text.

ORDER FILL RATE CALCULATION

This indicator compares the quantity in accepted orders to the quantity delivered, including frequency that distribution orders from health facilities are amended. Comparisons can be made for specific commodities or aggregated for all commodities.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total quantity issued or received}}{\text{Total quantity of product ordered}} \right) \times 100$$

In practice, this is calculated as:

Fill rate from warehouses to health facilities or intermediate warehouses:

$$\frac{\sum_{f=1}^n \left(\sum_{o=1}^m \left(\frac{\sum_{c=1}^z \left(\left| 1 - \frac{\text{amtdeldns}_{foc}}{\text{amount}_{foc}} \right| \right)}{z} \right)}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

Where Expected order amount_{foc} = amtadjdns_{foc} if reasonadjdns_{foc} = 3, else is equal to amtordereddns_{foc}, z equals the number of products c in order o, m equals the number of orders o at facility f, and n equals the number of facilities f. This formula uses the absolute value adjustment used for forecast accuracy and stock card accuracy to calculate the average fill rate across the products listed in a single order. Thus, 0% indicates that an order was filled in full. This formula first takes the average fill rate across products in a given order, then takes the average fill rate across orders to calculate the average fill rate for a facility. Then, a weighted average is taken across facilities.

In line with supply plan accuracy target 90% of all distribution orders should be filled in full.

Secondary indicators (not KPIs)

1. Percentage of orders delivered in full: This indicator measures the percentage of orders made in full for all products included in an order. In full is first calculated for each product in an order, where infull_{foc} = 1 if amtdeldns_{foc} = amount_{foc}, else it is equal to 0. The indicator variable infull_{fo} is then = 1 if for all c in order o at facility f, infull_{foc} = 1, else it is equal to 0. The percentage of orders delivered in full is then calculated as:

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{o=1}^m \text{infull}_{fo}}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

This formula calculates the percentage of orders delivered in full at each facility f, and then takes the weighted average of this result across facilities.

2. Order adjustment rate: This metric assesses the percentage of products for which orders were adjusted. For shipments to health facilities, the warehouse makes the adjustments, while for shipments to the intermediate warehouse, the central warehouse makes the adjustment.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total number of products that were adjusted}}{\text{Total number of products in the orders sampled}} \right) \times 100$$

In practice, this is calculated as:

$$\frac{\sum_{f=1}^n \left(\sum_{o=1}^m \left(\frac{\left(\frac{\sum_{c=1}^z (\text{adjustedd}nsyn_{foc})}{z} \right)}{m} \right) \right) \times w_f}{\sum_{f=1}^n w_f}$$

Where z equals the number of products c in order o , m equals the number of orders o at facility f , and n equals the number of facilities f . This first calculates the average number of products for which an adjustment was made in an order o at facility f , then averages that results across orders at facility f . Finally, the weighted average is taken of that result across all facilities. In line with supply plan accuracy target, less than 10% should require amendment.

3. Reason for order adjustment: This is a descriptive table showing the reasons for orders to be adjusted, among those orders that were adjusted, reporting the percentage results of $\text{reasonadj}sr_{foc}$ and $\text{reasonadj}dns_{foc}$.

3.5 WASTAGE FROM DAMAGE, THEFT AND EXPIRY

WASTAGE FROM DAMAGE, THEFT AND EXPIRY DATA

This indicator utilizes the **stock data** presented at the beginning of the Warehousing and Inventory Indicators section.

WASTAGE FROM DAMAGE, THEFT AND EXPIRY CALCULATION

This indicator compares the damaged, lost and expired stock to the total stock during the reporting period. It can be looked at by the quantity or value of the stock.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total quantity of product unusable due to loss, damage or expiry}}{\text{Total quantity of product available during the reporting period}} \right) \times 100$$

This indicator could also be calculated based on the value of the product; these data are not routinely collected in the NSCA 2.0, but should produce the same results as quantities when reported for each tracer commodity separately (value of commodities would be useful for aggregating this indicator across tracer commodities, and *would* produce different results than using quantities in that case).

For each facility f and tracer commodity c , the total quantity of product available during the reporting period is calculated as the sum of the opening balance (TQ_{fc}):

$$\left(\text{openingsoh}_{m=1} + \sum_{m=1}^5 (\text{openingsoh}_{m+1} + \text{consumption}_m - \text{openingsoh}_m) \right)$$

Note that consumption_m should include consumption due to loss, damage or expiry. While the formula above simplifies to:

$$\sum_{m=1}^5 \text{consumption}_m + \text{openingsoh}_{m=6}$$

This latter formula assumes that data are available for all months. The formula should thus be calculated for months when consumption data and the next month's data are available, and if some months of are missing data, then the former formula should be applied to months with full data.

For each facility f and tracer commodity c , the total quantity of product unusable due to loss, damage or expiry is calculated as (TL_{fc}):

$$\left(\sum_{m=1}^5 (\text{expiry}_m) \right)$$

Note that because the closing balance in Month 6 of data collection is not recorded, the total quantity of product available for Month 6 cannot be calculated. Thus, the reporting period for this KPI is 5 months (the last month of the reporting period cannot be calculated).

The final indicator is calculated for each tracer commodity c as:

$$\frac{\sum_{f=1}^n \left(\frac{TL_{fc}}{TQ_{tc}} \right) \times w_f}{\sum_{f=1}^n w_f}$$

This formula calculates the weighted average product damaged, lost and expired as a percentage of the total quantity of product available during the reporting period separately for each tracer commodity.

The overall average should then be taken across tracer commodities:

$$\frac{\sum_{c=1}^o \left(\frac{\sum_{f=1}^n \left(\frac{TL_{fc}}{TQ_{tc}} \right) \times w_f}{\sum_{f=1}^n w_f} \right)}{o}$$

Where o equals the number of tracer commodities c .

The overall target for losses <2% of turnover, with target of 0% for theft, and <1.5% for expiry, and 0.5% damage.

3.6 STOCK TURN PER ANNUM

STOCK TURN DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
Stockturn1 _f	List the total value of products issued in 20XX for warehouse f.
stockturn2 _f	Lists the currency used for Stockturn1 _f , coded (typically) as: 1 Local currency in country being assessed 2 US Dollars 3 Euro 4 Indian Rupee 5 Other
stockturn3 _f	If stockturn2 _f = 5, text variable listing the currency.
stockturn4 _f through stockturn15 _f	Lists the total value of stock held in the stores for each month of 20XX. "9998" entered if data are not available.

STOCK TURN CALCULATION

This indicator measures the number of times the warehouse issues and replaces its inventory during the period under review and is a measure of efficiency of the operation.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total value issued}}{\text{Average value of inventory held in the period}} \right) = X \text{ (number of turns)}$$

In practice, this is calculated as:

$$\frac{\text{Stockturn}_f}{\frac{\sum_{m=4}^n \text{stockturn}_{mf}}{n}}$$

Where n represents the number of months for which the total value of stock held in the stores at the end of the month is available. This indicator is calculated separately at all warehouses where data are collected.

Industry norms vary widely, but a pharmaceutical warehouse should expect a stock turnover of at least 4 times per year.

3.7 NUMBER AND DURATION OF TEMPERATURE EXCURSIONS IN COLD STORAGE FACILITY

TEMPERATURE EXCURSION DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
teupdated _{fmu}	Data are available at site <i>f</i> for month <i>m</i> and unit <i>u</i> , with 1 = Yes and 0 = No.
newexcursion _{fmu}	Number of new excursions for site <i>f</i> in month <i>m</i> for unit <i>u</i> .
lengthexcursion _{fmu}	Number of days on which there was the temperature excursion for site <i>f</i> in month <i>m</i> for unit <i>u</i> .

Units in the above represent separate areas for cold storage of products with a single site *f*.

TEMPERATURE EXCURSION CALCULATION

This indicator measures the number of days in which there was a temperature excursion or percentage of time (in days) that the cold storage facility may not have kept commodities at the required temperature.

The basic calculation for this indicator is:

$$\left(\frac{\text{Total number of days in the period where there was a temperature excursion}}{\text{Total number of days in the period}} \right) \times 100$$

In practice, this is calculated by:

Percentage of days with temperature outside of the acceptable range (across facilities) =

$$\frac{\sum_{f=1}^n \left[\frac{\sum_{u=1}^p (\sum_{m=1}^6 \text{lengthexcursion}_{fmu} \times \text{teupdated}_{fmu})}{\sum_{u=1}^p (\sum_{m=1}^6 \text{days in month}_{fmu} \times \text{teupdated}_{fmu})} \right] \times w_f}{\sum_{f=1}^n w_f}$$

Where *n* is the number of sites, *p* is the number of units in a site *f*. This formula calculates the weighted average percentage – it first calculates the total days of temperature excursions (for all units) and the total days in the assessment period (for all units) and divides the two numbers to determine the percentage of days outside of the acceptable range for site *f*. The weighted average of this result is taken across all sites.

The recommended target is no more than 1 day per month, or percentage equivalent (i.e., approximately 3.29%).

3.8 STOCKOUT RATES OF ONE OR MORE TRACER PRODUCTS BY FACILITY

STOCKOUT RATES OF ONE OR MORE TRACER PRODUCTS DATA

This indicator utilizes the **stock data** presented at the beginning of the Warehousing and Inventory Indicators section.

STOCKOUT RATES OF ONE OR MORE TRACER PRODUCTS CALCULATION

This indicator measures whether facilities experienced a stockout of one or more tracer commodities at any point during the reporting period being assessed. The result is expressed as a percentage of the total number of facilities.

The measure may also be used for a single facility, in which case the result will be expressed as the number of tracer commodities experiencing a stockout and the number of days. It may also be appropriate to report on the number of times a tracer commodity was stocked out, if there are multiple occurrences.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of facilities experiencing a stockout of one or more tracer commodities}}{\text{Total number of facilities dispensing tracer commodities}} \right) \times 100$$

In practice, this is calculated as:

$$\frac{\left(\sum_{f=1}^n \left(\text{If} \left(\sum_{c=1}^{10} \left(\sum_{m=1}^6 \text{so}_{fmc} \right) > 0 \right), = 1, \text{else} = 0 \times w_f \right) \right)}{\sum_{f=1}^n w_f}$$

This indicator assesses whether or not any tracer commodity was out of stock during the reporting period, and then takes the weighted average to produce the percentage of facilities that had at least one stockout of one tracer commodity during the assessment period.

In line with the expectation in KPIs 3.1, 90% of stocks should be within the max/min tolerances, ideally no more than 10% of facilities should record a stock out of a tracer commodity in any reporting period. However, dependent on the length of the reporting period, and the number of tracer commodities this could be a very difficult level to maintain. It is suggested that this measure be assessed over several reporting periods, with the objective that a declining incidence is seen, and from this record countries can establish a realistic performance level that meets their circumstances.

Less than 5% of facilities should record a stock out on the day of the assessor visit.

Stock outs should be corrected within 5 days.

3.9 COST OF WAREHOUSING OPERATIONS

COST OF WAREHOUSING OPERATIONS DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
costcurrency _f	<p>The currency used for warehouse <i>f</i>, typically entered as:</p> <p>1 Local currency unit</p> <p>2 US Dollars</p> <p>3 Euro</p> <p>4 Indian Rupee</p> <p>5 Other</p>
cost1 _f	Indicator variable for whether the costs of warehousing operations are available for warehouse <i>f</i> , with 1 = Yes and 0 = No.
Cost1a _f	Text entry for the currency if costcurrency _f = 5
Cost3 _f	Amount of operating costs for 20XX at warehouse <i>f</i> , entered as a number if cost1 _f = 1.
Cost5 _f	Indicator variable for whether the transport operating costs are available for 20XX for warehouse <i>f</i> , with 1 = Yes and 0 = No.
Cost7 _f	Amount of transport operating costs for 20XX at warehouse <i>f</i> , entered as a number if cost5 _f = 1.
Cost9 _f	Indicator variable for whether the balance of opening inventory (beginning of year 20XX) is available for warehouse <i>f</i> , with 1 = Yes and 0 = No.
Cost11 _f	Value of opening inventory balance (beginning of year 20XX) at warehouse <i>f</i> , entered as a number.
Cost13 _f	Indicator variable for whether the balance of closing inventory (end of year 20XX) is available for warehouse <i>f</i> , with 1 = Yes and 0 = No.
Cost15 _f	Value of closing inventory balance (end of year 20XX) at warehouse <i>f</i> , entered as a number.
Cost17 _f	Indicator variable for whether the value of incoming deliveries is available for warehouse <i>f</i> , with 1 = Yes and 0 = No.

COST OF WAREHOUSING OPERATIONS DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
Cost19 _f	Amount of the value of incoming deliveries at warehouse <i>f</i> , entered as a number.
Cost21 _f	Indicator variable for whether the value of commodities delivered is available for warehouse <i>f</i> , with 1 = Yes and 0 = No.
Cost23 _f	Amount of the value of commodities delivered at warehouse <i>f</i> , entered as a number.

COST OF WAREHOUSING OPERATIONS CALCULATION

This indicator compares the cost of the operation of the warehouse to the total value of the commodities managed by the warehouse during the period under review, and expresses the costs as percentage of turnover.

The basic calculation for this indicator is:

$$\left(\frac{\text{Costs incurred in operating the warehouse}}{\text{Total value of commodities managed by the warehouse}} \right) \times 100$$

In practice, this indicator can only be calculated if cost1_f, cost9_f, cost13_f, and cost17_f are all = 1. If all indicators are available, then the indicator in practice is calculated as:

$$\frac{\sum_{f=1}^p \left[\left(\frac{\text{cost3}_f}{(\text{cost11}_f + \text{cost19}_f - \text{cost15}_f)} \right) * w_f \right]}{\sum_{f=1}^p w_f}$$

Where *w_f* is the sample weight of each intermediate warehouse. The central level warehouse should be reported separately, and weighting would not be applied.

Budget costs vary extensively, and there is no international published norm, to recommend a target, but costs related to turnover should reduce over time.

3.10 ORDER TURNAROUND TIME

UPSTREAM ORDER DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
upstreamwindow _f	The agreed upon 'delivery window' for deliveries to this facility in order to NOT be considered late (entered in days).
ordertype _{fo}	The type of order sampled for order <i>o</i> at site <i>f</i> , with responses coded as: 1 Routine 2 Emergency
orderdateavailable _{fo}	Indicator variable for whether the date order <i>o</i> was placed is available, with 1=Yes and 0 = No.
orderdate_up _{fo}	Date order <i>o</i> was placed.
dateplannedavailable _{fo}	Indicator variable for whether the promised delivery date for order <i>o</i> was is available, with 1=Yes and 0 = No.
deldateplanned_up _{fo}	Date of promised / planned delivery for order <i>o</i> .
dateactualavailable _{fo}	Indicator variable for whether the actual delivery date for order <i>o</i> was is available, with 1=Yes and 0 = No.
deldateactual_up _{fo}	Date of actual delivery for order <i>o</i> .

UPSTREAM ORDER CALCULATION

This indicator measures the time taken by the warehouse to fulfill orders from hospitals and SDPs. Comparisons can be made for specific commodities, for specific regions or aggregated for all commodities and regions.

This indicator should be calculated using both **upstream order data** and the **downstream order data** presented at the beginning of section 3.4.

The basic calculation for this indicator is:

$$(\text{Date order received} - \text{Date delivered}) = \# \text{ of days}$$

In practice, this is calculated as:

Order turnaround time for upstream data is calculated for all orders with dates available as:

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{o=1}^m (\text{deldateactual_up}_{fo} - \text{orderdate_up}_{fo})}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

Where m represents the number of orders with both dates available and n represents the number of facilities. The formula produces the weighted average, and should be presented for each type of facility. The results can also be disaggregated by type of order (ordertype_{fo}).

Order turnaround time for downstream data (using data presented at the beginning of section 3.4):

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{o=1}^m (\text{dnsdeliverypromdate}_{fo} - \text{dnsorderdate}_{fo})}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

This indicator should be calculated separately for intermediate and central warehouses; results for intermediate warehouses should be weighted.

Results for upstream and downstream data should produce similar (but not exactly identical due to the vagaries of sampling) results and should be compared.

The recommended target is 5 business days, unless there is a set process for monthly orders and deliveries, in which the target is adherence to the agreed monthly timings.

3.11 PERCENTAGE OF INCOMING PRODUCT BATCHES TESTED

INCOMING BATCH TESTING DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
testdataavailable	Indicator variable for whether incoming batches are tested for quality, with 1 = Yes and 0 = No.
numbertestdataavailable	The number of batches sent for quality testing in year 20XX, entered as a number.
numbertestdatasampled	Number of products sampled for this assessment
testcommodityname _x	Product Name and Formulation for product x
testnumberreceived _x	Number of batches of product x received in 20XX
testnumbertested _x	Number of batches of product x sent for quality testing in 20XX
testnumberpassed _x	Number of batches of product x passed in 20XX

INCOMING BATCH TESTING CALCULATION

This indicator measures the percentage of product batches received from suppliers and tested by a quality assurance laboratory.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of product batches tested}}{\text{Total number of product batches received}} \right) \times 100$$

In practice, this is calculated as (provided that testdataavailable= 1):

$$\frac{\sum_{x=1}^n \text{testnumbertested}_x}{\sum_{x=1}^n \text{testnumberreceived}_x}$$

Where x represents each of n products. This indicator should be disaggregated by each product; if data are available, it could also be disaggregated for each individual supplier.

The level of testing needs to create a credible threat that non-compliance will be identified. This will normally be set by national policy to define number of batches to be tested, or in an appropriate SOP. The expected performance level should be 100% compliance with that policy or procedure.

3.12 PERCENTAGE OF PRODUCT BATCHES TESTED MEETING QUALITY STANDARDS

PRODUCT BATCHES TESTED MEETING QUALITY STANDARDS DATA

This indicator utilizes the **Incoming batch testing data** presented at the beginning of section 3.11.

PRODUCT BATCHES TESTED MEETING QUALITY STANDARDS CALCULATION

This indicator measures the percentage of product batches tested by a quality assurance laboratory that meet established standards.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of product batches passing quality testing}}{\text{Total number of product batches tested}} \right) \times 100$$

In practice, this is calculated as (provided that testdataavailable= 1):

$$\frac{\sum_{x=1}^n \text{testnumberpassed}_x}{\sum_{x=1}^n \text{testnumbertested}_x}$$

Where x represents each of n products. This indicators should be disaggregated by each product; if data are available, it could also be disaggregated for each individual supplier.

The objective is that all incoming products meet the required standard, but it is recognized that there may be some level of divergence even in well managed systems. It is suggested that if more than 5% of batches are failing there is problem to be investigated, or if a high level of failures is seen in particular product categories, or from particular suppliers, there is a root cause issue with selected suppliers.

4. DISTRIBUTION INDICATORS

KPIs for distribution include:

1. On-time delivery to facility (core indicator)
2. Percentage of orders placed by health facilities as emergency orders (core indicator)
3. Cost of distribution operation (optional indicator).

4.1 ON-TIME DELIVERY TO FACILITY

ON-TIME DELIVERY DATA

This indicator utilizes the **upstream order data** presented at the beginning of section 3.10.

ON-TIME DELIVERY CALCULATION

This indicator measures the percentage of orders that arrive on or before the scheduled delivery date.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of orders delivered within the time window specified in the distribution plan}}{\text{Total number of deliveries}} \right) \times 100$$

On time delivery within the specified window of promised delivery date (OTD2) = 1 if $|\text{deldateplanned_up}_{fo} - \text{deldateactual_up}_{fo}| \leq \text{upstreamwindow}_i$, else = 0.

Thus, in practice this indicator is calculated as=

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{o=1}^m \text{OTD2}_{fo}}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

This indicator calculates the percentage of m orders at a given site that were delivered on-time, and then takes the weighted average of these results across n sites. The results can also be disaggregated by type of order (ordertype_{fo}).

The majority of deliveries are made to a pre-agreed schedule; therefore, the target should be 95% of orders are received on or before the promised date (after allowing for any margin- see above).

4.2 PERCENTAGE OF ORDERS PLACED BY HEALTH FACILITIES AS EMERGENCY ORDERS

ORDERS PLACED BY HEALTH FACILITIES AS EMERGENCY ORDERS DATA

This indicator utilizes the **upstream order data** presented at the beginning of section 3.10.

ORDERS PLACED BY HEALTH FACILITIES AS EMERGENCY ORDERS CALCULATION

This indicator measures the percentage of orders placed by health facilities on a warehouse during the reporting period that were emergency orders.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of emergency orders placed in the reporting period}}{\text{Total number of orders placed in the reporting period}} \right) \times 100$$

Emergency orders (EO) are defined as = 1 if ordertype_{io} = 2, else = 0.

Thus, in practice this indicator is calculated as=

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{o=1}^m EO_{fo}}{m} \right) \times w_f}{\sum_{f=1}^n w_f}$$

This indicator calculates the percentage of m orders at a given site that were emergency orders, and then takes the weighted average of these results across n sites.

The recommended target is to have fewer than 10% of orders be placed as emergency orders.

4.3 COST OF DISTRIBUTION OPERATIONS

COST OF DISTRIBUTION OPERATIONS DATA

This indicator utilizes the **Cost of warehousing operations data** presented at the beginning of section 3.9.

COST OF DISTRIBUTION OPERATIONS CALCULATION

This indicator compares the cost of the operation of distribution from the warehouse to hospitals and SDPs with the total value of the commodities distributed, and expresses the costs as percentage of turnover.

The basic calculation for this indicator is:

$$\left(\frac{\text{Costs incurred in operating the distribution system}}{\text{Total value of commodities distributed from the warehouse}} \right) \times 100$$

In practice, this indicator can only be calculated if cost5_f and cost21_f are both = 1. If both indicators are available, then the indicator in practice is calculated as:

$$\frac{\sum_{f=1}^p \left[\left(\frac{\text{cost7}_f}{(\text{cost23}_f)} \right) * w_f \right]}{\sum_{f=1}^p w_f}$$

Where w_f is the sample weight of each intermediate warehouse. The central level warehouse should be reported separately, and weighting would not be applied.

Budget costs vary extensively, and there is no international published norm, to recommend a performance level, but costs as a proportion of turnover should reduce over time.

5. HUMAN RESOURCES INDICATORS

KPIs for human resources include:

1. Staff turnover rate (core indicator)
2. Percentage of supply chain positions vacant (optional indicator).

The following subscripts are used for this section:

F : denotes an individual health facility

s : Denotes the different supply chain staff positions

HUMAN RESOURCES DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
$scstaff_{fs}$	Number of supply chain posts FILLED in facility f for position s on the day of the assessment.
$scpositions_{fs}$	Number of supply chain posts VACANT (waiting or planned for hire) for position s at facility f on the day of the assessment.
$scfilled_{fs}$	Number of supply chain posts FILLED for position s at facility f at the beginning of 20XX.
$scdepartures_{fs}$	Number of supply chain posts VACATED for position s at facility f in the year 20XX.

5.1 STAFF TURNOVER RATE

STAFF TURNOVER RATE DATA

This indicator uses the **human resources data** presented at the beginning of section 5.

STAFF TURNOVER RATE CALCULATION

This indicator measures the percentage of supply-chain-specific staff leaving their posts during the reporting period.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of supply chain staff who vacated their position during the reporting period}}{\text{Total number of supply chain staff employed by the organization in the reporting period}} \right) \times 100$$

In practice, this indicator =

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{s=1}^m (scdepartures_{fs})}{\sum_{s=1}^m (scfilled_{fs})} \times w_f \right)}{\sum_{f=1}^n w_f}$$

This calculation total the number of departures / vacated positions across all m positions at a site and divides by the number of positions filled across all m positions at a site. The weighted average is taken across the results from all n sites. For data collected at the central level, weighting is not necessary.

Rates of staff turnover vary according to market and level of post, but HR institutes in the UK and USA suggest that a rate of 15% turnover per annum is “healthy”.

5.2 PERCENTAGE OF SUPPLY CHAIN POSITIONS VACANT

SUPPLY CHAIN POSITIONS VACANT DATA

This indicator uses the human resources data presented at the beginning of section 5.

SUPPLY CHAIN POSITIONS VACANT CALCULATION

This indicator measures the percentage of supply chain post vacancies that can be expected to impact performance.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of supply chain staff posts vacant on the day of assessment}}{\text{Total number of supply chain staff positions in the entity}} \right) \times 100$$

In practice, this indicator =

$$\frac{\sum_{f=1}^n \left(\frac{\sum_{s=1}^m scpositions_{fs}}{\sum_{s=1}^m (scpositions_{fs} + scstaff_{fs})} \times w_f \right)}{\sum_{f=1}^n w_f}$$

Where w_f is the facility sampling weight. This formula calculates the percentage of supply chain positions vacant at each site, and then takes the weighted average across sites.

To maintain operation efficiency >90% of supply chain posts should be filled at any one time.

6. DATA AND INFORMATION INDICATORS

KPIs for data and information include:

1. Facility reporting rates on-time (core indicator)
2. Facility reporting rates – complete reports (optional indicator).

The following subscripts are used for this section:

m : denotes the month for facilities to report; usually this is the six month period prior to the assessment.

t : denotes the type of facility / entity.

REPORTING DATA	
VARIABLE NAME	VARIABLE DESCRIPTION
$\text{numberoforders}_{mt}$	Number of facilities required to send LMIS reports in month m for entity type t .
orderfills_{mt}	Number of facilities submitting report on time in month m for entity type t .
$\text{reportcomplete}_{mt}$	Number of facilities submitting complete report in month m for entity type t .

Because the number of facilities potentially varies from month to month, these indicators are best measured as the unweighted average of the indicator per month.

6.1 FACILITY REPORTING RATES ON-TIME

FACILITY REPORTING RATES ON-TIME DATA

This indicator uses the **reporting data** presented at the beginning of section 6.

FACILITY REPORTING RATES ON-TIME CALCULATION

This indicator measures the percentage of facilities submitting their LMIS reports to the receiving facility (central or intermediary e.g. district) on time.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of facilities submitting report on time}}{\text{Total number of facilities required to report}} \right) \times 100$$

In practice, this indicator is calculated as:

$$\frac{\sum_{m=1}^n (\sum_{t=1}^s \text{orderfills}_{mt})}{\sum_{m=1}^n (\sum_{t=1}^s \text{numberoforders}_{mt})}$$

Where n is the number of months in the reporting period and s is the number of different types of facilities. This indicator can be disaggregated both by month, by type of facility, or both.

The target should be 100% as recommended by WHO, PfSCM, JSI and others.

6.2 FACILITY REPORTING RATES – COMPLETE REPORTS

FACILITY REPORTING RATES – COMPLETE REPORTS DATA

This indicator uses the reporting data presented at the beginning of section 6.

FACILITY REPORTING RATES – COMPLETE REPORTS CALCULATION

This indicator measures the percentage of facilities submitting complete LMIS reports to the receiving facility.

The basic calculation for this indicator is:

$$\left(\frac{\text{Number of facilities submitting complete reports}}{\text{Total number of facilities required to report}} \right) \times 100$$

In practice, this indicator =

$$\frac{\sum_{m=1}^n (\sum_{t=1}^s \text{reportcomplete}_{mt})}{\sum_{m=1}^n (\sum_{t=1}^s \text{numberoforders}_{mt})}$$

Where n is the number of months in the reporting period and s is the number of different types of facilities. This indicator can be disaggregated both by month, by type of facility, or both.

The target should be 100% as recommended by WHO, PfSCM, JSI and others.

7. REPORTING RESULTS

In total, up to 29 indicators (not including secondary indicators) can be reported in association with the NSCA 2.0 assessment; 14 of these indicators are considered ‘core’ KPIs, for which data should attempt to be collected for all NSCA 2.0 assessments. Further, some of these indicators are potentially collected at multiple levels of the health system and / or for multiple tracer commodities.

The foundation for presenting the results is first to calculate the indicators and build tables to report the results. To turn the raw quantitative results into specific recommendations, it is suggested that the entire assessment team review the results of this analysis and as a group identify recommendations. Not all data need be presented in the final report, as discussed below.

While the mean/average values for KPIs is naturally of interest to the assessment team and the target audiences for the assessment, assessing variance and ranges in the scores is also important to keep in mind when interpreting the results. This is especially, but not only, true for facilities / entities with smaller sample sizes (such as referral hospitals). For example, if only 5 referral hospitals are included in the assessment, it is possible that one may have placed 30 emergency orders in the last 6 months, while the other four placed 2 to 3 each. The KPI for the number of emergency orders placed as a percentage of all orders may, on average across the 5 referral hospitals, be quite high due to the high number placed by one hospital. However, interpreting the average as applying to all referral hospitals may lead to different conclusions and recommendations than understanding that the results are driven by one hospital.

Consideration should also be taken to report when the assessment team attempted to collect data but the data were not available for the assessment. Finding that data are not available for the calculation of KPIs can itself lead to recommendations (e.g., that data need to be collected, monitored, and used to inform decisions).

7.1 RESULTS FOR KPIS COLLECTED AT THE CENTRAL LEVEL ONLY

Fifteen indicators are intended to be collected at the central level only (i.e., at only one or a few different entities, although note that the two human resources indicators may be collected only at the central level in some assessments if complete and acceptable quality data are available at that level). With only one or a few entities, these KPIs do not lend themselves well to graphic display, although exceptions may exist (especially for KPIs collected for multiple commodities, in which case bar charts, spider graphs, etc. can be considered).

See the “KPI Central analysis template” and the accompanying instructions for more details on standard presentations for these KPIs.

Below, we present examples of how to present data for each of the 15 central level KPIs.

1. Forecast accuracy

#	Product	Product Dosage	Forecast Accuracy	Source of consumption data
1	Commodity X	<<dosage>>	XX%	Issues
2	.	<<dosage>>	XX%	Issues
3	.	<<dosage>>	X%	Consumption
4	.	<<dosage>>	XX%	Consumption
5	Etc.	<<dosage>>	XXX%	Issues
Range:			X% to XXX%	
Accurate forecast are = 0%				

2. Supply plan accuracy

#	Product	Product Dosage	Supply plan Accuracy	Was Supply Plan Accuracy Assessed?
1	Commodity X	<<dosage>>	XX%	Yes
2	.	<<dosage>>	XX%	Yes
3	.	<<dosage>>	X%	No
4	.	<<dosage>>	XX%	Yes
5	Etc.	<<dosage>>	XXX%	No
Range:			X% to XXX%	
Accurate supply plan are = 0%				

3. Source of funds

Name of funder:	Percentage of funds for commodities:
Government:	XX%
Other domestic 1:	XX%
(etc. for domestic sources)	XX%
Donor 1:	XX%
Donor 2:	XX%
.	XX%
.	XX%
.	XX%
Etc.	XX%

4. Percentage of international reference price paid

This indicator can potentially be reported as a single data point, reflecting the overall weighted average for the commodities included in the data collection. However, for discussion purposes, a fuller table should be developed:

#	Product	Product Dosage	Average price paid	International Reference Price	Percentage of international reference price paid
1	Commodity X	<<dosage>>	\$XX	\$XX	XX%
2	.	<<dosage>>	\$XX	\$XX	XX%
3	.	<<dosage>>	\$XX	\$XX	XX%
4	.	<<dosage>>	\$XX	\$XX	XX%
5	Etc.	<<dosage>>	\$XX	\$XX	XX%
				Average:	XX%

5. Percentage of procurement orders placed on vendors that were emergency orders

This is a single number, and should be reported as such, although perhaps consideration of data availability / unavailability can be addressed. In systems with decentralized procurement, health system level can also be an important factor to present for this indicator.

6. Procurement methods employed (percentage)

This should be presented for each of the types of procurement methods employed, in one table. The number of orders assessed can also be included.

Type of procurement	Percentage
Framework Contract:	%
Request For Proposal:	%
Request For Quote:	%
Direct Order:	%

7. Vendor on-time delivery and in full

This is a single indicator.

Further data could be added containing “the number of orders with necessary data” to highlight whether or not data from orders are available or not.

8. Supplier fill rate

This is a single indicator, but, similar to **vendor on-time delivery and in full**, further data could be added containing “the number of orders with necessary data” to highlight whether or not data from orders are available or not.

9. Percentage of pharmaceutical products procured listed on the National Essential Medicines List /health products or similar document

This is a single number, and should be reported as such, although perhaps consideration of data availability / unavailability can be addressed. In systems with decentralized procurement, health system level can also be an important factor to present for this indicator.

10. Customs clearance time

This is a single number, and should be reported as such, although perhaps consideration of variability and data availability / unavailability can be addressed.

I 1. Stock turn per annum

This indicator is calculated only for central warehouses. At central level, the results for the central warehouse or central warehouses should be reported individually.

I 2. Facility reporting rates on-time

This indicator can be reported as a single number, averaged across the different months of the assessment period. Disaggregating this indicator by month and then graphing the results compared to KPIs 4.2 Percentage of orders placed by health facilities as emergency orders, 3.1 Stocked according to plan, and 3.2 stockout rates by facility (which can also be disaggregated by month) *may* also be done to visually inspect if there appears to be a relationship between reporting rates on-time and KPIs from entities that are doing the reporting.

I 3. Facility reporting rates – complete reports

This indicator can be reported as a single number, averaged across the different months of the assessment period. Disaggregating this indicator by month and then graphing the results compared to KPIs 4.2 Percentage of orders placed by health facilities as emergency orders, 3.1 Stocked according to plan, and 3.2 stockout rates by facility (which can also be disaggregated by month) *may* also be done to visually inspect if there appears to be a relationship between reporting rates on-time and KPIs from entities that are doing the reporting.

I 4. Percentage of incoming product batches tested

This is a single number, and should be reported as such, although perhaps consideration of data availability / unavailability can be addressed. It can also be broken down by program or commodity if data allow.

I 5. Percentage of product batches tested meeting quality standards

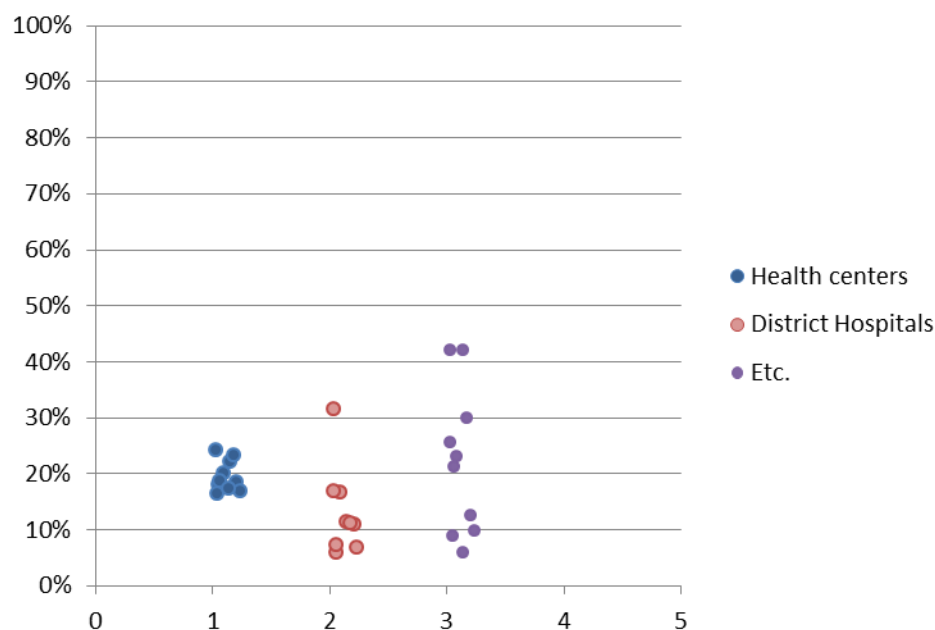
This can be a single number, and should be reported as such, although perhaps consideration of data availability / unavailability can be addressed. It can also be broken down by program or commodity if data allow.

7.2 RESULTS FOR KPIS COLLECTED AT MULTIPLE LEVELS OF THE HEALTH SYSTEM

See the “KPI Non-Central analysis template” and the accompanying instructions for more details on standard presentations for these KPIs.

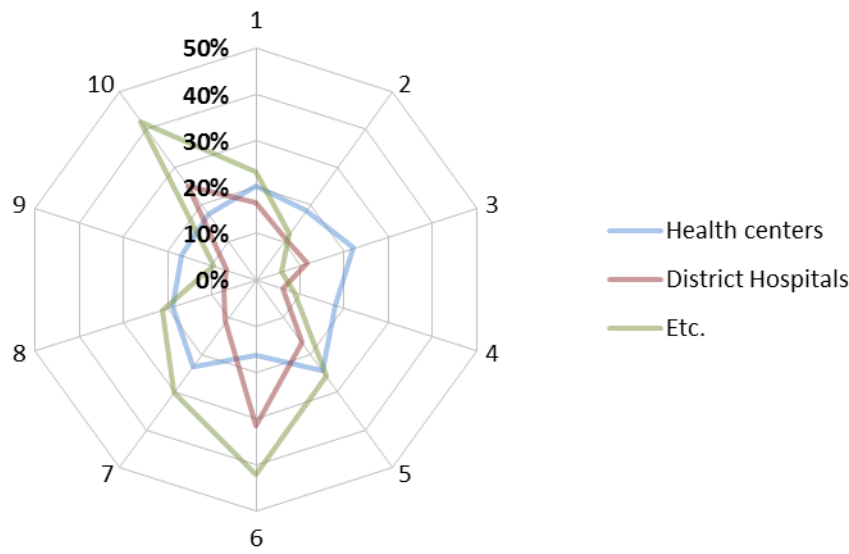
GRAPHING RESULTS

KPIs collected for the tracer commodities can, generally speaking, be graphed using ‘dot plots’, in which each dot represents one tracer commodity, with the average for each tracer commodity separated by level:



In the graph above, the y-axis may represent the KPI (e.g., percentage of facilities stocked according to plan, on average), while each dot represent a single tracer commodity and each column represents a facility / entity type. It is recommended that the individual dots in each column be randomly spread around a ‘center’ in order to minimize visual loss of data due to overlapping dots. The graphs help to identify overall trends across facility / entity type as well as variability within facility / entity type.

Spider web graphs can also be used to present these data if the analyst

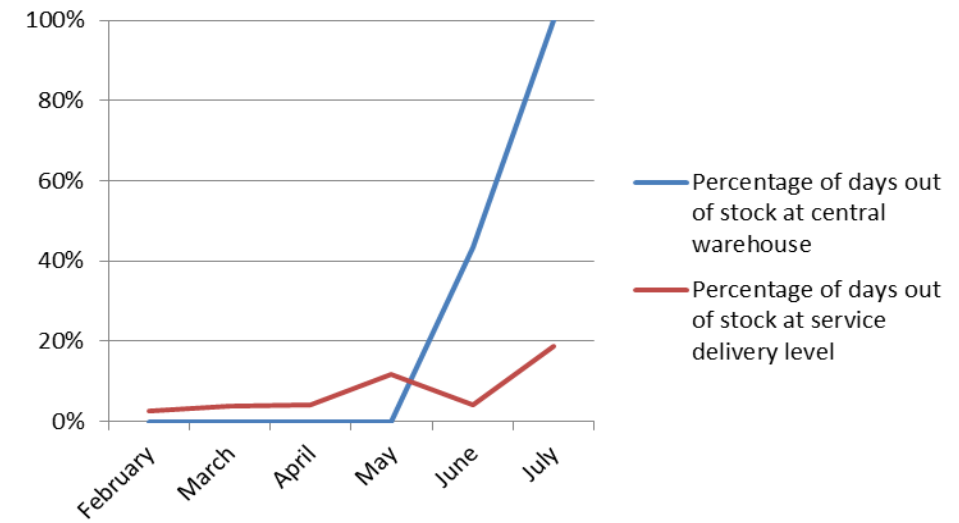


prefers:

In these graphs, each of the numbered 'axes' is for one tracer commodity, while the connected lines represent the averages for each type of facility / entity. These graphs are useful for inspecting variability within and across the different tracer commodities (as opposed to the facility types as above). They are, however, slightly misleading in that the lines connecting the different tracer commodities imply a relationship between the tracer commodities adjacent to each other that, in fact, may not exist. Note also that adding too many types of facilities / entities to the spider graph can be confusing to the reader.

These graphs should be considered especially for: Stocked according to plan, Stockout rates by tracer commodity, Percent of total stock lost, and damaged or expired during a reporting period. Depending on the variability and usefulness of the graphs produced, they may or may not be included in a final report.

A third possible graph is to assess stockout and/or ordering data over time (generally the assessment period):



These graphs can help to indicate the extent to which stockouts at different levels are associated with either issues with stockouts at the central level (and the amount of lag between stockouts at higher levels and lower levels) or, if stocks are available at higher levels, the cause of stockouts at lower levels is due to ordering or distribution issues. Note that these graphs may need to be repeated for multiple tracer commodities, although not all graphs for all tracer commodities may be included in the final report.

RESULTS TABLES

I. Stocked according to plan

STOCKED ACCORDING TO PLAN					
#	PRODUCT	PRODUCT DOSAGE	HEALTH CENTER	DISTRICT HOSPITAL	ETC.
1	Commodity X	<<dosage>>	XX%	XX%	XX%
2	.	<<dosage>>	XX%	XX%	XX%
3	.	<<dosage>>	X%	X%	X%
4	.	<<dosage>>	XX%	XX%	XX%
5	Etc.	<<dosage>>	XX%	XX%	XX%
Range:			X% to XX%	X% to XX%	X% to XX%

The table presents the average percentage of facilities ‘stocked according to plan’ by tracer commodity. Note that there are up to 6 months of observation per facility, so this is an average of averages as described in Section 3.

2. Stockout rates by tracer commodity, including the average number of days out of stock in a month when there was a stockout

Three separate tables are possible for this KPI:

I. PERCENTAGE OF FACILITIES WITH STOCKOUT ON DAY OF ASSESSMENT					
#	PRODUCT	PRODUCT DOSAGE	HEALTH CENTER	DISTRICT HOSPITAL	ETC.
1	Commodity X	<<dosage>>	XX%	XX%	XX%
2	.	<<dosage>>	XX%	XX%	XX%
3	.	<<dosage>>	X%	X%	X%
4	.	<<dosage>>	XX%	XX%	XX%
5	Etc.	<<dosage>>	XX%	XX%	XX%
Overall			XX%	XX%	XX%

This table presents stockouts on the day of the assessment; an overall average across tracer commodities is possible for this indicator.

Further comparisons between levels of the supply chain and stockouts are possible, for individual tracer commodities:

		Intermediate warehouse	
		In stock on day of assessment	Out of stock on day of assessment
		(65%)	(35%)
SDPs	In stock on day of assessment	90%	15%
	Out of stock on day of assessment	10%	85%

The above table indicates the following:

- (1) Among the intermediate warehouses in the sample, 65% had the tracer commodity in stock on the day of the assessment, while 35% were out of stock.
- (2) Of the SDPs that receive commodities from intermediate warehouses that had stock on the day of the assessment, 90% also had stock on the day of the assessment, while 10% did not.
- (3) Of the SDPs that receive commodities from intermediate warehouses that did not have stock on the day of the assessment, 85% also did not have stock on the day of the assessment, while 15% did.

Similar to graphs depicting stockouts over time at different levels of the supply chain, these tables can help to indicate the extent to which stockouts at different levels are associated with either issues with stockouts at the higher levels or, if stocks are available at higher levels, the cause of stockouts at lower levels is due to ordering or distribution issues (as well as the relative magnitude of either of these causes).

2. STOCKOUT DAYS FOR THE ASSESSMENT PERIOD

#	PRODUCT	PRODUCT DOSAGE	HEALTH CENTER	DISTRICT HOSPITAL	ETC.
1	Commodity X	<<dosage>>	# days (% of all days)	# days (% of all days)	# days (% of all days)
2	.	<<dosage>>	# days (% of all days)	# days (% of all days)	# days (% of all days)
3	.	<<dosage>>	# days (% of all days)	# days (% of all days)	# days (% of all days)
4	.	<<dosage>>	# days (% of all days)	# days (% of all days)	# days (% of all days)
5	Etc.	<<dosage>>	# days (% of all days)	# days (% of all days)	# days (% of all days)
Range:			X% to XX%	X% to XX%	X% to XX%

This table presents the average number of days each tracer commodity was out of stock during the assessment period, as well as the percentage of days a commodity was out of stock compared to the

total number of days in the assessment period, on average. This gives a sense not just whether facilities had stockouts, but the magnitude of potential stockouts (in terms of time).

The data that forms this table could be disaggregated by month, and the average # of days of stockout plotted in a graph separately for each level to visually assess the relationship between central, intermediate, and hospital / SDP stockouts.

3. AVERAGE DURATION OF A STOCK OUT, IF THERE WAS A STOCKOUT

#	PRODUCT	PRODUCT DOSAGE	HEALTH CENTER	DISTRICT HOSPITAL	ETC.
1	Commodity X	<<dosage>>	# days	# days	# days
2	.	<<dosage>>	# days	# days	# days
3	.	<<dosage>>	# days	# days	# days
4	.	<<dosage>>	# days	# days	# days
5	Etc.	<<dosage>>	# days	# days	# days
Range:			# to ## days	# to ## days	# to ## days

This table differs from the previous table in that it is conditional on there being a stock out. Thus, in the table above, if there were (on average) 2 stockouts (in different months) each lasting 5 days, the table would report 10 days of stockout, whereas this table would report 5 days. Note that because the data collection instrument only collects data on whether there was a stockout in a given month (and not the separate number of stockouts with a given month), if both stockouts in the example above were in the same month, the calculations here would produce 10 days as the result.

3. Stock out rate by facility

	Health center	District Hospital	Etc.
Percentage of facilities with any stockout of any of the XX tracer commodities during the assessment period	%	%	%

This indicator only produces one figure per type of facility / entity included in the assessment.

4. Stock accuracy (done separately for paper-based records and electronic LMIS)

Two tables can be presented for this KPI (for a total of 4 tables if repeated for electronic LMIS systems and paper based systems).

I. STOCK CARD ACCURACY: PERCENTAGE OF FACILITIES AT 100%

#	PRODUCT	PRODUCT DOSAGE	HEALTH CENTER	DISTRICT HOSPITAL	ETC.
1	Commodity X	<<dosage>>	XX%	XX%	XX%
2	.	<<dosage>>	XX%	XX%	XX%
3	.	<<dosage>>	X%	X%	X%
4	.	<<dosage>>	XX%	XX%	XX%
5	Etc.	<<dosage>>	XX%	XX%	XX%
Overall:			XX%	XX%	XX%

This table presents the percentages of facilities / entities (by type) that have completely accurate stock records for each of the tracer commodities. Computation of averages across the tracer commodities is possible.

2. AVERAGE DEVIATION FROM PERFECT ACCURACY ACROSS FACILITIES (NO DEVIANCE = 0)

#	PRODUCT	PRODUCT DOSAGE	Health center	District Hospital	Etc.
1	Commodity X	<<dosage>>	XX%	XX%	XX%
2	.	<<dosage>>	XX%	XX%	XX%
3	.	<<dosage>>	X%	X%	X%
4	.	<<dosage>>	XX%	XX%	XX%
5	Etc.	<<dosage>>	XX%	XX%	XX%
Range:			X% to XX%	X% to XX%	X% to XX%

This table presents the deviation from perfect accuracy, on average per facility / entity type for each of the 10 tracer commodities. As described in section 3.3, no deviance is calculated as 0% (if all entities in the previous table had 100% accuracy, then all entities in this table would have 0% deviance from perfect accuracy). Also as noted in section 3.3, the results of this calculation can often be very large (e.g., >1000%), so if presented in the assessment report, careful explanation of the calculations may be necessary.

5. Order fill rate

Results for this indicator can be reported for up to three indicators, by type of facility (if appropriate).

	Intermediate warehouse	National Warehouse 1	National warehouse 2
Percentage of orders adjusted	XX%	XX%	XX%
Average deviance from 100% fill rate (including orders delivered in full)	XX%	XX%	XX%
Percentage of orders delivered in-full	XX%	XX%	XX%

6. Cost of warehouse operations

This indicator is calculated only for warehouses. At central level, the results for the central warehouse or central warehouses should be reported individually. At the intermediate warehouse level, the average across facilities can be reported. Typically, these data can be presented alongside the cost of distribution operations.

	Central warehouse	Intermediate warehouses (n = X)
Cost of warehouse operations as a percentage of total value of commodities managed by the warehouse	X.X%	X.X%
Cost of distribution operation as a percentage of total value of commodities managed by the warehouse	X.X%	X.X%

7. Percent of total stock lost, damaged or expired during a reporting period

The results for this indicator can be presented in aggregate for lost, damaged, or expired, or, if the quantity is sufficient to be of interest, separately for lost, damaged, or expired products.

#	Product	Product Dosage	Health center	District Hospital	Etc.
1	Commodity X	<<dosage>>	XX%	XX%	XX%
2	.	<<dosage>>	XX%	XX%	XX%
3	.	<<dosage>>	X%	X%	X%
4	.	<<dosage>>	XX%	XX%	XX%
5	Etc.	<<dosage>>	XX%	XX%	XX%
Overall:			XX%	XX%	XX%

The table presents the percent of total stock lost, damaged or expiry during the assessment period, and an overall average by level is possible.

8. Number and duration of temperature excursions in cold storage facility

This table is disaggregated by level / type of entity and reports the percentage of days with temperature outside of the acceptable range, on average, for the assessment period. The percentage of facilities with temperature logs can be included to check the completeness of data. If desired, the number of days of temperature excursions (e.g., average per month, which can be calculated as the percentage of time with temperature excursions x the number of days in the reporting period / number of months in the reporting period) could also be included in this table.

	Health centers	District hospitals	Etc.
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Percentage of facilities that have temperature logs	X.X%	X.X%	X.X%
Percentage of time with temperature excursions	X.X%	X.X%	X.X%

9. Order turnaround time

Downstream order data is used to calculate order turnaround time only for warehouses. At central level, the results for the central warehouse or central warehouses should be reported individually. At the intermediate warehouse level, the average across facilities can be reported.

	Number of days between order receipt and order shipment
Central warehouse:	X.X
Intermediate warehouses (n = X):	X.X

Upstream order data is used to calculate order turnaround time for all entities receiving orders:

<i>1. Order Turnaround Time: Number of days between order receipt and order shipment</i>			
	SDPs	District hospital	Etc.
Turnaround time (all orders)	X.X	X.X	X.X
Turnaround time (routine orders)	X.X	X.X	X.X
Turnaround time (emergency orders)	X.X	X.X	X.X

10. On-time delivery to facility

This indicator can be provided for all orders together, and/or separated by the type of order. Results can also be disaggregated by 'on or before' promised delivery date and 'within the time period specified in standards for the country'

	SDPs	District hospital	Etc.
Percentage of orders with all relevant dates:	X.X%	X.X%	X.X%
On-time (all orders)	X.X%	X.X%	X.X%
On-time (routine orders)	X.X%	X.X%	X.X%
On-time (emergency orders)	X.X%	X.X%	X.X%

11. Percentage of orders placed by health facilities as emergency orders

Results for this indicator can be reported as for **on-time delivery to a facility**, except disaggregated by the type of order. If a country has more than two types of orders (e.g., planned and emergency) further breakdowns of the types of orders can be included in this table.

Type of order	SDPs	District hospital	Etc.
Emergency:	X.X%	X.X%	X.X%

12. Cost of distribution operation

See **Cost of warehouse operations** above.

13. Staff turnover rate

This KPI typically should be reported by the type of facility / entity.

	SDPs	District hospital	Etc.
Average number of supply chain positions	#	#	#
Staff turnover ratio*	X.X%	X.X%	X.X%
Percentage of positions vacant	X.X%	X.X%	X.X%

*Of those staff working in January 20XX, the percentage that were no longer working at the facility at the end of 20XX.

I 4. Percentage of supply chain positions vacant

While not a core KPI at these levels, these data can be collected as part of the assessment for warehouse, hospital, and SDP levels. Typically, they would be reported in the same table as the staff turnover ratio (see above).