USAID GLOBAL HEALTH SUPPLY CHAIN PROGRAM

Procurement and Supply Management

The Active Site Rule for Contraceptive Stockout Rates

Assessing the Use of a Business Rule Approach for Health Facility Stock Status

November 2021

The USAID Global Health Supply Chain Program-Procurement and Supply Management (GHSC-PSM) project is funded under USAID Contract No. AID-OAA-I-15-0004. GHSC-PSM connects technical solutions and proven commercial processes to promote efficient and cost-effective health supply chains worldwide. Our goal is to ensure uninterrupted supplies of health commodities to save lives and create a healthier future for all. The project purchases and delivers health commodities, offers comprehensive technical assistance to strengthen national supply chain systems, and provides global supply chain leadership.

GHSC-PSM is implemented by Chemonics International, in collaboration with Arbola Inc., Axios International Inc., IDA Foundation, IBM, IntraHealth International, Kuehne + Nagel Inc., McKinsey & Company, Panagora Group, Population Services International, SGS Nederland B.V., and University Research Co., LLC. To learn more, visit ghsupplychain.org

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Acronyms

ASR	Active Site Rule
BI	business intelligence
eLMIS	electronic logistics management information system
FP	family planning
FP/RH	family planning/reproductive health
GHSC-PSM	Global Health Supply Chain Program - Procurement and Supply Management project
HMIS	health management logistics system
HQ	Headquarters
IUD	intra-uterine device
LMIS	logistics management information system
M&E	monitoring and evaluation
PPR	USAID's Performance Plan and Report
PIRS	performance information reference sheet
PRH	USAID Office of Population and Reproductive Health
RHSC	Reproductive Health Supplies Coalition
SDP	service delivery point
USAID	United States Agency for International Development

Executive Summary

The Active Site Rule for Contraceptive Stockout Rates, Assessing the Use of a Business Rule Approach for Health Facility Stock Status presents analysis on the impact of the newly developed Active Site Rule (ASR) on the average contraceptive stockout rate indicator. The ASR serves as a safety net to catch the status of sites (active or inactive), which increases trust in stockout data and leads to proactive action for determining stock status.

This analysis aims to assess how the ASR affects four key elements of data quality: 1) operational accuracy; 2) consistency; 3) timeliness; and 4) repeatability of stockout rate reporting for family planning/reproductive health (FP/RH) tracer products. These four elements are intended to provide insights into the ability of key decision makers to use the indicator to support data-based decisions and actions.

Although GHSC-PSM anticipates rolling out the ASR to all USAID FP/RH countries, in 2019 the project and country partners automated it into the electronic logistics management information systems (eLMIS) in Nepal, Malawi, and Pakistan. Only Nepal and Malawi are used as case studies here for the ASR.

This analysis examines the possible advantages of an automated approach compared to a manual approach on facility stock status. An "active" site is one that has had an FP product in stock at any point in the previous 12 consecutive months and/or issued the product to clients at any time in that period. Facilities deemed "inactive" are removed from the stockout rate calculation for a particular method if the method has not been in stock or issued at any point in the previous 12 months.

It is important to tailor the ASR to the products and context of individual countries. For example, the ASR may need to be applied on a product-by-product basis where low demand or provider-reliant products will more likely become inactive. In this case, a 6-month rule will detect these sites more quickly than a 12-month rule. Using 12- and 6-month criteria will more accurately identify active sites.

Key findings/lessons learned

1. **Operational accuracy**
   Implementation of the ASR will improve the operational accuracy of the stockout rate, as defined by the ability to identify a true active site and consistently eliminate false negatives. However, some situations can still lead to false negatives, such as the effects of high staff turnover on the active site status for methods such as intrauterine devices (IUDs) and implants that require skilled providers to administer them.

2. **Consistency and repeatability**
   Any process for identifying inactive and active sites should be auditable, as this is required to determine if the process is consistent and repeatable and will build trust. When working within an LMIS, there will be multiple existing process rules in place, some of which may interact with or even contradict the ASR. This can lead to inconsistent results.

3. **Timeliness**
   Late reporting sites did not have a notable effect on stockout rates in either country. Therefore, stockout rates calculated at different time lags following a reporting deadline are likely to remain consistent and reliable, at least for the high reporting rates that were observed. Frequency of reporting was found to have an impact on the ability to identify and quickly act upon stockouts. Trends that occurred in months between quarterly reporting periods in Malawi, for example, often changed more quickly or in different directions than quarterly trends.

4. **Automation**
   Automation offers numerous advantages over manual calculations. In addition to creating a consistent and repeatable process, it removes the delay in analysis, meaning once the data is received it is processed and available for review and use. For example, with ASR, "flagging" sites can be followed up immediately after the data is received. Additionally, it allows the stockout analysis to continue without the need to wait for the review of flagged site status. This enables the data and action to be more effectively based on the available data. An automated process also enables users to more easily track inactive sites and target them for follow-up actions.

Recommendations for action:

- Clearly document the criteria for when a site is flagged as inactive, either by the ASR or by another process (e.g., from the master data).
- Maintain an audit trail for sites when their status is changed from active to inactive or vice-versa, including what triggered the change in status. This is critical for transparency and improving the management of site status.
- Include in the requirements for implementation of an eLMIS the services provided at the site and an "active" process for maintaining the master data. This should include the status of services provided at a site and be auditable for changes in status.
  In consultation with relevant stakeholders, define the universe of sites to be included and integrate the ASR into existing business processes and in tandem with other sources of information on facility status (e.g., master data). This helps to ensure transparency and consistency on the criteria used to define which sites are considered active.

In summary, the ASR's usefulness as a safety net cannot be understated for consistently reporting stockout rate changes over time, reducing false negatives, and removing the delay in analysis of data. The ASR provides a transparent, or auditable, way for countries to ensure their stockout rates are reflective of active sites stocked out, excluding inactive sites, and improves consistency, timeliness, and trust in data.

Background

Measuring health facility stockout rates is a way to assess the performance of in-country health commodity supply chains. It is becoming more important to ensure consistency and clarity in the definitions, calculations, and application of these rates. As more countries are transitioning to automated logistics management information systems (LMIS), more reliable data is available to make routine decisions. It is also an opportunity to automate and streamline calculation of key performance indicators, including stockout rate calculations. A constant challenge in calculating stockout rates across sites is interpretation of whether a facility is actively offering a product and tracking those facilities over time. To address these challenges, the Global Health Supply Chain Program – Procurement and Supply Management (GHSC-PSM) project has been working to improve stockout rate data quality and to facilitate stockout rate calculations. This work has included:

- Developing a business rule, the "Active Site Rule", to standardize the stockout rate definition applicable to USAID FP/RH-supported countries and most LMIS's in general.
- Setting up an automated script in Malawi, Nepal, and Pakistan that applies the business rule to stock data via the LMIS.
- Developing training and support materials to help countries apply the new business rule.

The Active Site Rule is a business rule developed by GHSC-PSM and USAID based on the universal Reproductive Health Supplies Coalition's (RHSC) standard stockout indicator: *Average stockout rate of contraceptives at service delivery points by family planning method*. To align with RHSC guidance, ensure a more consistent measurement of the stockout rate, and to assist in decision-making, USAID revised its annual Performance Plan and Report (PPR)[1] family planning/reproductive health Standard Indicator. It is one of six required indicators for USAID Missions receiving FP assistance, reported annually It is defined as the percentage of facilities stocked out, by family planning product or method offered, on the day of the assessment (reporting day or day of visit). For more details on the PPR indicator, please see the performance indicator reference sheet in Annex A.

USAID and GHSC-PSM believe that there is value in using this approach for all stakeholders, as the rule seeks to provide a standard definition and guidance for analyzing LMIS data and reporting on the indicator to determine which health facilities are "active" for a particular family planning method. Applying the rule takes into consideration the differences in country LMIS's in an attempt to standardize the capture and measurement of the indicator across all system capabilities. Beyond standardization, the rule seeks to provide a more useful measure of stockouts that allows decision-makers to prioritize health facilities that are deemed to be actively offering specific commodities, in order to direct scarce

[1] USAID Global Health Standard Performance Plan and Report Indicator HL.7.1-3

resources toward supporting those sites. Furthermore, automation of the business rule seeks to improve data reliability and consistency and reduce the amount of labor required for data analysis.

Purpose of paper

This paper presents the analysis results on the impact of the newly developed Active Site Rule on the average stockout rate indicator. Although the rule is anticipated to be rolled out to all USAID FP/RH countries, in 2019 it was automated into the eLMIS in Nepal, Malawi, and Pakistan. This assessment of the business rule's impact on the stockout rate will focus on Nepal and Malawi as case studies.

This analysis sought to assess how the business rule affects four key elements of data quality: 1) operational accuracy (functionality), 2) consistency, 3) timeliness, and 4) repeatability of stockout rate reporting for family planning tracer products. The decision to focus on these four areas aims to provide insights into the ability of key decision-makers to use the indicator to support decisions and actions based on the data.

In assessing the effects of the business rule, this analysis also seeks to examine the possible advantages of an automated approach to calculating the business rule in comparison to a manual approach.

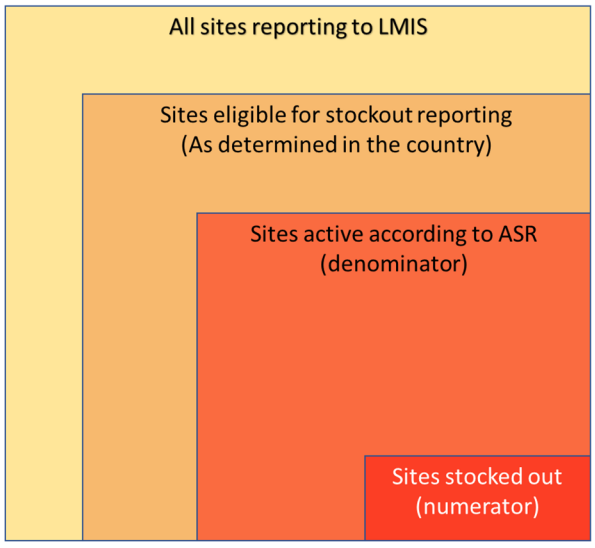
Active Site Rule

Definition

An active site is considered to be currently offering/dispensing a family planning method. In the absence of any other systematic information indicating whether a family planning method is currently being offered or not, facilities are considered active if they have had the product in stock at any point in the previous twelve consecutive months and/or issued the product to clients at any point in that period (Figure 1). Facilities deemed "inactive" are removed from the stockout rate calculation for a particular method. This business rule is aimed at addressing the current issue where a family planning method as considered in stock even if the facility is not offering the method.

The starting point for defining the universe of active sites under the rule is the largest square - all family planning sites which report to the LMIS. The next are reporting sites which fit one or a combination of Active Site Rule (ASR) criteria in a country. The third square illustrates the active sites included in the stockout rate denominator and the innermost square depicts the active, stocked out sites in the numerator.

Figure 1. Classification of sites for stockout reporting



Is a Health Facility Active?[2]

As national health facilities lists are not always consistently updated to indicate which sites are actively offering particular products or methods, or which sites have the trained personnel to be able to offer a product/method, this rule is a way of using the available data in a country's logistics management information system (LMIS) or health management information system (HMIS) to provide a more accurate understanding of the percentage of facilities stocked out of a particular family planning (FP) method, based on which sites are actively able to offer it.

[2] From - Stockout Rate Reporting for FP/Reproductive Health Commodities SOP

If one or a combination of the following is true, the service delivery point (SDP, referred to also as a site in this paper) is providing voluntary FP services and **is actively offering** the product/method:

1. The SDP has had the product/method **in stock** at any time in the past 12 consecutive months (prior to the month when the indicator is reported)

2. The SDP has **issued** the product/method to clients at any time in the past 12 months

3. The SDP has **ordered** the product/method at any time in the past 12 months

Therefore, any SDP providing voluntary FP services that has had zero stock on hand, and/or no consumption or ordering of the product/method in the previous 12 consecutive months, is considered not actively providing family planning commodities. Such sites should not be included in the calculation of this indicator and removed from both the numerator and denominator. Removal of these inactive SDPs should be done product by product, as an SDP that is inactive for one product may still be active for another product within the same method.

This rule can be applied by all countries whose LMIS or HMIS reports both stock status and consumption data by individual health facilities on a monthly or bi-monthly (every two months) basis. For example, where data is reported bi-monthly, the period for determining an active site is one which has had stock or has issued and/or ordered the product/method for all of the previous six consecutive bi-monthly reporting periods.

Methodology

An analysis of the business rule and its implementation was conducted to determine any differences in stockout rates with and without the application of the rule. Raw LMIS data was analyzed, and the approaches used in each country were reviewed in two GHSC-PSM country offices, Malawi and Nepal, to calculate stockout rates with and without implementation of the business rule. The analysis set out to determine if application of the rule could more effectively measure and manage stockouts in a country.

Analysis Areas

The analysis of the business rule intends to demonstrate its impact on stockout rate data reporting quality and the process for stockout rate calculations. Assessing the consistency and transparency of the process and whether the process can be repeated as needed will demonstrate the operational accuracy of the rule. Analysis of the rule was based around the following four (often intertwining) elements:

Accuracy

Application of the rule is intended to improve the accuracy of the stockout rate by standardizing the definition and identification of an active site, eliminating sites no longer offering, receiving, ordering, or dispensing the product. Inactive sites are excluded from the universe of sites to be evaluated for stockouts. This improves stockout rate functional accuracy by enabling decision-makers to consistently target operational sites through an established set of criteria, and to enable follow-up of any sites deemed inactive that would otherwise be expected to offer the FP method. Accuracy was assessed by reviewing the difference in the number of excluded sites before and after applying the business rule.

The intention of the rule is to reduce the number of false negatives and false positives. A true active site is shown as true positive, and a true inactive site is shown as true negative (Figure 2). A false negative is when the rule includes an inactive site as active, increasing the denominator. A false positive excludes an active site, decreasing the denominator. The accuracy of the denominator will affect the stockout rate. When the business rule is not applied, it will lead to more false positives being included in the denominator. The key aspect of studying accuracy is to ensure that the rule reduces the number of false positives while not increasing the number of false negatives.

Figure 2. Classification of false positives and false negatives through use of the 12-month Active Site Rule

		Active site rule applied	
		Site Active	Site Inactive
Actual State	Site Active	True Positive	False Positive
	Site Inactive	False Negative	True Negative

Consistency

Consistency in applying the defined exclusion criteria – determining which are active sites - impacts the accuracy of the average stockout rate. The business rule improves the precision of the stockout rate indicator by specifying a common interpretation of which sites to exclude. Consistency was assessed by reviewing the number of active sites excluded historically with and without the application of the rule. The rule acts as a filter to determine if and when a facility was excluded both before or after application of the rule and will reveal variations in the number of active sites over a defined period of time.

Repeatability

A repeatable process will produce more consistent results by correctly including active sites. Automation of the rule into an LMIS can ensure that the rule is applied in a consistent and repeatable manner. The analysis aimed to determine what process changes occurred to calculate the stockout rate with and without the rule and the approach used to apply the rule's criteria.

Timeliness

The rule was analyzed to assess the impact on stockout rates when reporting timeliness is taken into account. The stockout rate was assessed first with only facilities reporting on-time, and subsequently when late reports were factored in. Timeliness in reporting reveals the potential impact of late reporting on the stockout rate. Reporting timeliness was determined using the dates when reports were uploaded into a country's LMIS.

If stockout rate denominators (the number of sites reporting) do not change substantively from period to period, it is an indication that the process of applying the rule is consistent and repeatable. In this case, the variations seen in stockout rates can be attributed to changes in the actual stock situation rather than to the nuances of how the definition is applied.

The frequency of reporting was also examined to assess whether monthly reporting shows any trends that would be missed by only reporting quarterly.

Analysis approach

A Python script was written to prepare the data and calculate stockouts based on the Active Site Rule. Outputs for different periods were printed to Excel files, before being consolidated and analyzed. Comparative analysis between stockout rates reported by GHSC-PSM in quarterly performance reports compared to the application of the rule through the Python script was calculated by extracting from each country's LMIS in September 2020.

Country Data

A different approach was used in each of the two GHSC-PSM countries to clean data and calculate stockout rate indicators before and after implementation of the business rule. The process to apply the rule is discussed for each country, including the challenges encountered to apply the rule and the impact on data usage.

Data sources

Logistics data for Nepal were gathered through LMIS data, reported quarterly by the GHSC-PSM project from October 2018 to April 2020 for all family planning tracer products.

Monthly LMIS data from January 2019 to August 2020 was available for analysis for Malawi.

Implementation of the Active Site Rule

Each of the countries began at different starting points in their technological capabilities, and in the business rules already being implemented either during or after extraction from their eLMIS. The *Stockout Indicator Automation Design Guidance* document shared with these countries in July 2019, recommended that the specific business rules defined should be evaluated with the HQ M&E team to provide guidance before being deployed in quarterly reporting. Although not currently the case for the Active Site Rule, it is recommended that all business rules, whether implemented directly in the automated LMIS or in a BI reporting platform, should have audit traceability so that the rows eliminated from the denominator can be traced to the specific business rule executed.

The actual implementation of the business rule has been different per country as well. Nepal initially implemented the ASR only for annual reporting, and only in the most recent quarter did it introduce it for quarterly stockout reporting. Malawi has been employing a three-month rule-- whereby sites that had no stock or units dispensed of a product for three months are deemed inactive and excluded from the numerator and denominator. Neither country has put in place the tools to enable audit traceability. The expectation that the reporting results should be auditable is critical for repeatability and consistency of the business rule.

Data preparation

Defining the universe of sites

In Nepal, four specific types of facilities are considered SDPs as defined by the government: health posts, primary health care centers, district hospitals, and district clinics. These categories align with what is outlined in the performance indicator reference sheets of Nepal's GHSC-PSM country M&E plan. The eLMIS has an automated process to determine sites that report: a site is automatically flagged as active when a transaction takes place. If there are no transactions for 12 months (no opening or closing balance, receipts, issues, or requested quantities) the reporting flag is turned off and the facility is considered inactive. However, in a separate process affecting the list of sites, the local level governments (LLGs) determine when new sites come online, or existing sites become non-operational (e.g., sites that are closed). This can create a disconnect with the master data; therefore, the LMIS help desk adds or takes out the sites as requested by the district or the LLGs.

There are also cases where the sites appear as active despite not having any transactions; hence manual review and data cleaning are used to ensure that the data used in the stockout calculation is accurate. This could be due to bugs in the system or human error, for example if data personnel mistakenly check the reporting flag for a site despite a lack of transactions. This issue is mainly found in reporting on IUDs

and implants. It is recommended when such instances are identified that follow up is done with these facilities.

Aligning data sets

A date-mapping was conducted to align the Nepali and Gregorian calendars in order to run a 12-month Active Site Rule on a quarterly basis from October 2019 onwards. This enabled comparison between the Python script calculation and Nepal's previously reported data.

Product alignment

In the analysis stage, any products that refer to a larger category or are generic duplicates of an existing list were excluded to avoid double-counting. Examples of this include implantable contraceptives and injectable contraceptives in the reported data.

Defining the measurement point (transactional to cumulative)

For Nepal, data came from both reports that were entered electronically at SDPs, and data originating from paper-based SDP reports. Paper-based sites, which report data on a quarterly basis, account for more than 90 percent of the sites. For these sites, only those marked as "reported" were included in the analysis. For electronic sites, which report real-time on a transactional basis, the last transaction of the quarter was used.

Standard data cleaning

Data cleaning procedures included aligning column names where data were pulled from multiple sources and merged, and the creation of additional columns needed for analysis, such as "submission delay", which measures the number of months between the time when a stock recording period ends and when data is entered into the LMIS.

Analysis

As neither Nepal nor Malawi had been applying the 12-month Active Site Rule in quarterly performance reporting, this enabled a comparison between reported stockout rates without the rule and a retroactive calculation of stockout rates for the same time periods, using a Python script that applied the rule. The analysis compared product stockout rates, numerators (number of sites stockout out), denominators (number of sites reporting), and the differences in numerators by FP product. As the GHSC-defined quarterly stockout rate, a point-in-time measurement, derives results from the ending stock balance from the middle month of each quarter, the Python script calculation did the same to ensure an alignment of data sources. Any differences observed in the results from project reporting and the retroactive analysis, therefore, could be mostly attributed to the effects of the business rule.

Nepal

Data were gathered from the period of October 2018 through April 2020. In order to take into account the previous 12 months of stock reporting per the Active Site Rule, the first quarter where results could be compared was Quarter 4 of FY2019 (reported in October 2019), followed by Quarters 1 and 2 of FY2020. Just as Nepal limits its stockout rate reporting to four categories of health facilities (health posts, primary health care centers, district hospitals, and district clinics), the retroactive analysis also filtered out all other types of facilities. An additional step-by-step PPR/annual stockout rate analysis was shared using data from July 2019 to July 2020 for the full Nepali year of 2076-77. This was mainly used to confirm and validate the algorithmic output.

Data were separated into different data entry horizons based on a timestamp provided for each entry using the Transaction Created Date field. The effects of sites reporting at different time lags were assessed by comparing the changes in stockout rates at different data extraction times.

Malawi

All types of sites in the LMIS are included in GHSC-PSM quarterly reporting in Malawi. Any sites for which a specific product was not reported (left blank) in a given month were removed from analysis for that product in that quarter and considered unreported, consistent with the point-in-time definition of the quarterly stockout rate that relies on only sites that reported in the middle month of the quarter.

Malawi's eLMIS enables monthly reporting. This analysis therefore compared stockout rate trends on both a monthly and quarterly basis by product to assess the impacts of this increased frequency of reporting on the ability to monitor stockout trends.

Automation vs. manual analysis

The process of collecting and comparing the datasets and the challenges that emerged in attempting to understand how LMIS data were analyzed for quarterly reporting led to additional insights into an automated approach to stockout rate calculation.

Annex A includes the full analytical code applied in the analysis. Once the stockout indicators were produced, additional comparative analyses were done in Excel for inferences.

Limitations

This study has highlighted some capacity constraints in application of the business rule. In one of the countries, it was not possible to fully assess what rules were applied to stockout calculations, and therefore to fully appreciate the differences observed between the reported figures and the study analysis. Specifically, it was not possible to determine which sites had been excluded from the reported stockout rates due to the configuration of the LMIS reports and the lack of audit logs.

In 2019, Nepal, Malawi, and Pakistan had endeavored to incorporate the Active Site Rule into their systems through an automated process. Since then, when the data from Nepal and Malawi were revisited for this analysis, it was found that the methodology used to report stockout rates was not

explicit, and LMIS outputs were not sufficiently detailed to assess whether differences in the number of included facilities arose from the timing of report submissions or the business rule methodology. Additionally, the programming details of the automations were not accessible, therefore it was not possible to review how the stockout results were derived or to audit how the business rule was applied.

On average, 10-15 percent of facility sites were missing the Transaction Created Date field in the Nepal dataset, slightly reducing the ability to assess the impact on timeliness. However, this did not affect the overall stockout rate or analysis of the other elements of the business rule.

Reporting rates were marginally impacted by COVID-19 in FY2020 Quarter 3. Lower reporting rates impacted the visibility to analyze data during this quarter. Reporting resumed to normal rates the following quarter.

Results

Nepal

Figure 3 is a comparison of stock data with and without the Active Site Rule applied for IUDs, implants, injectables, combined oral contraceptives, and male condoms. IUDs and implants show the largest difference in stockout rates without the rule and with the rule (12.7% and 9.9%, respectively for IUDs; 9.0% and 8.9%, respectively for implants). These two methods have the largest number of excluded sites: 139 and 89 for IUDs and implants, respectively, demonstrating the impact of the rule to produce a more operationally accurate stockout rate when inactive sites are excluded. These long-term methods are more prone to becoming inactive because of the dependence on skilled health providers at the facility. In Nepal, the rule consistently filtered out these facilities. By contrast, the lower numbers of sites included in stockout calculations without the rule applied indicates that the team in Nepal used external information on inactive sites to remove sites that would otherwise have been categorized as active by the Active Site Rule. These sites that would be considered active under the rule, but which were classified as inactive and therefore excluded from the stockout rate, are considered false negatives. Using manual inputs to make determinations based on external information might be more accurate, but it is not as repeatable as relying on a consistent, clearly defined rule.

Figure 3. Comparison of stockout rates and exclusions by FP method in Nepal

FP method	GHSC-PSM Quarterly Reporting (No Active Site Rule applied)			12-month Active Site Rule (April 2020[3])			
	No. of SDPs Reporting	Reported Stockouts	Stockout Rate	No. of SDPs Reporting	Reported Stockouts	Stockout Rate	No. of SDPs Excluded
Copper-bearing IUDs *(CuT 380 A Set)*	996	126	12.7%	1,000	99	9.9%	139
Implants *(Levonorgestrel 75mg/rod, 2 rod Implant)*	1,631	147	9.0%	1,691	150	8.9%	89
Injectables *(Depot Medroxyprogesterone Acetate 150mg Vial, Intramuscular)*	3,287	194	5.9%	3,421	207	6.1%	2
Combined Oral Contraceptives *(Levonorgestrel/ Ethinyl Estradiol 150/30 mcg + Fe 75 mg, 28 Tablets/Cycle)*	3,259	312	9.6%	3,387	338	10.0%	3
Male Condoms	3,246	232	7.1%	3,381	244	7.2%	5

[3] The number of facilities reporting in GHSC-PSM quarterly performance reports was based on a fixed cutoff date, while this analysis was able to use all sites reporting both before and after the cutoff date. Slight differences in the overall stockout rate are due to changes in the numerator and denominator due to time of reporting. The greatest increase in denominator (for injectables) was only 4 percent and only led to a 0.2% change in the stockout rate.

Figure 4 below shows the number of facilities reporting and number of stockouts by method over three quarters. In each quarter, the top two bars represent stockouts and sites reporting using the 12-month Active Site Rule. The bottom two bars represent GHSC-PSM reported results (without the ASR applied). The most observable differences are for IUDs and implants. In Quarter 4 of FY2019, the number of stockouts of IUDs with the rule is 119 and without the rule is 343. The number of sites reporting is 1,096 with the rule and 1,318 without the rule. This demonstrates the impact of removing false negatives through the Active Site Rule. The difference is about 200 sites for both the numerator and denominator, indicating that likely false negatives were removed.

Fluctuations in the denominator with the ASR can be attributed either to the exclusion criteria or to the reporting rate. Without the ASR, it is more difficult to determine what causes these fluctuations when a manual process is used to determine if a site is active or not.

Figure 4. Comparison of the number of quarterly stockouts and reporting sites with and without the Active Site Rule, by FP method in Nepal

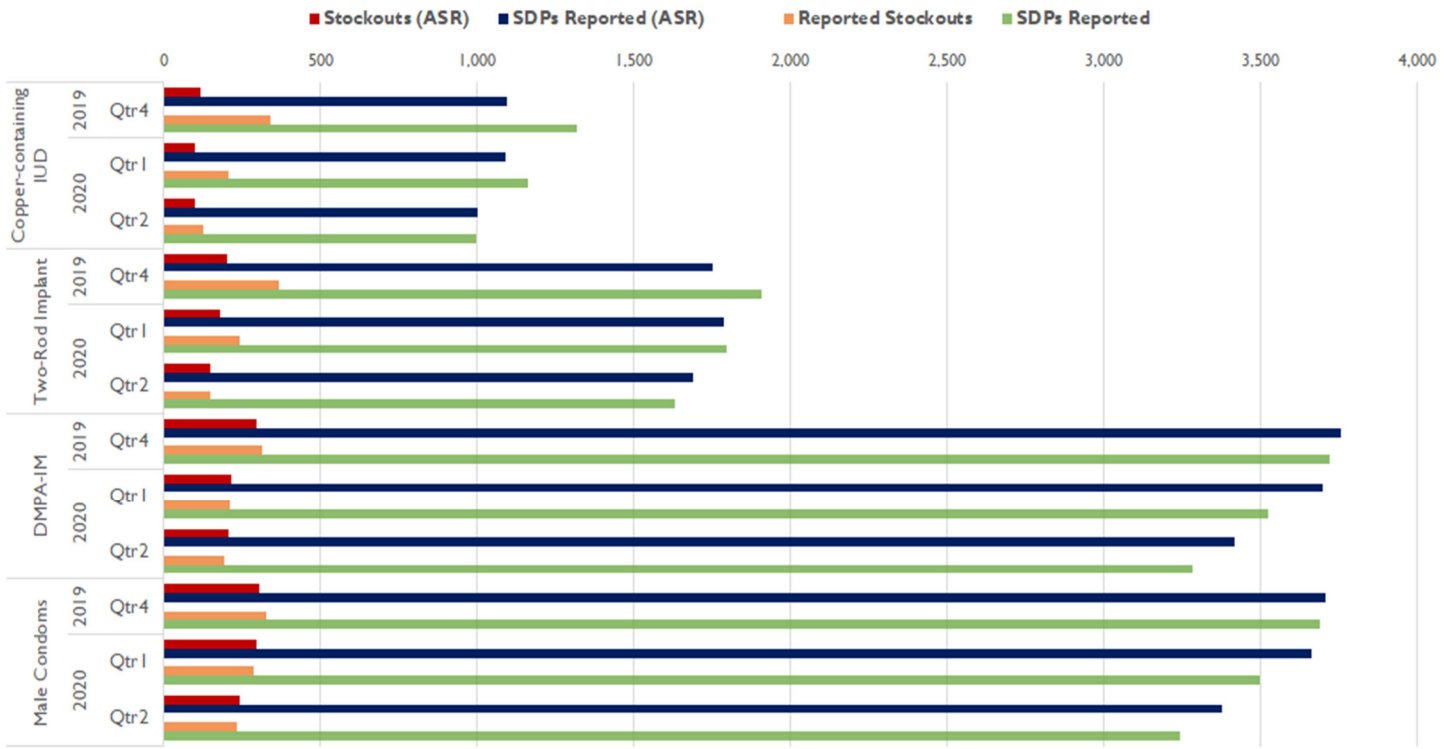
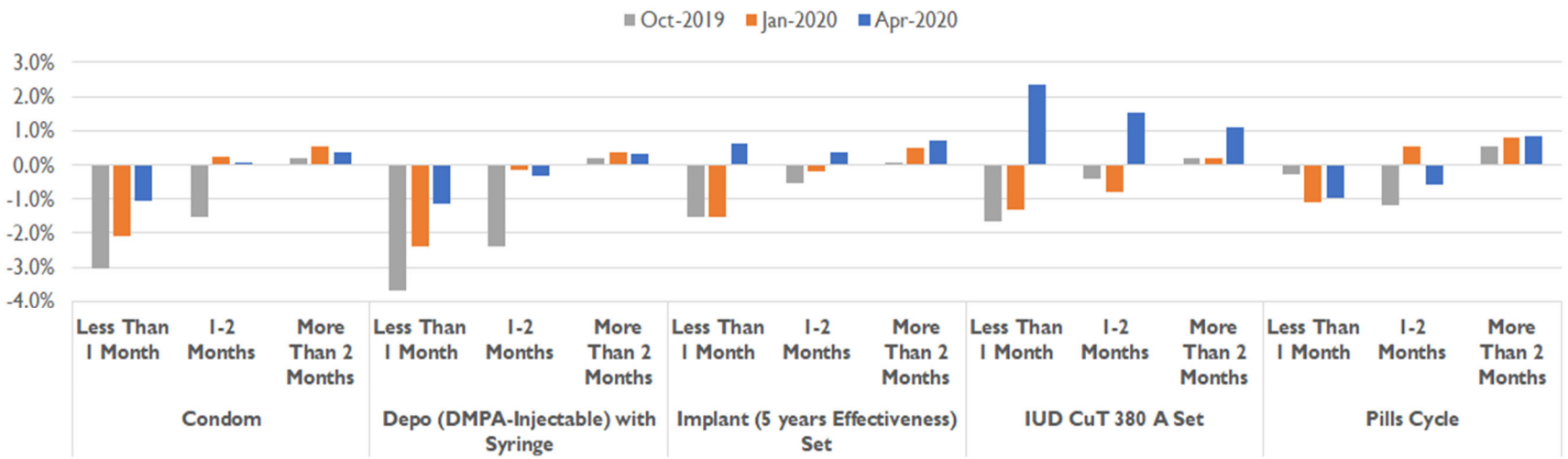


Figure 5 below looks at the difference in stockout rates when data is pulled at three different intervals after the reporting due date: less than 1 month after period-end, 1-2 months after, and more than 2 months after. Analysis of timeliness over three different quarters showed the stockout rate did not change by more than 1.5 percent, regardless of when data was pulled after the reporting period ended. This is including the second quarter of FY2020 (reported in April 2020) when COVID-19 caused a greater degree of delayed reporting. The majority of sites reported on time, but nonetheless, late reporting sites were shown to have little impact on the stockout rate.

Figure 5. Cumulative difference in total stockout rates by submission time and FP method



Malawi

Figure 6 below shows the impact of the Active Site Rule on stockout rate denominators using the period ending in June 2020. Comparison of the GHSC-PSM reported results (grey bars), understood to be based on a 3-month exclusion rule, with a 12- and 6-month exclusion rule illustrates that IUDs and implants, which require a skilled service provider, as well as injectables, have larger differences in the denominator than do male condoms. Due to the shortened active period, a 6-month rule identifies (and removes) likely false negatives sooner than when using a 12-month rule. As the window narrows further to 3 months, it will start to remove sites that may truly be stocked out, causing more fluctuations in the denominator. The effects of this can best be seen among IUDs and injectables. Products that do not require a service provider to administer,

such as male condoms, are less likely to have false negatives (inactive sites reported as active). This is shown in the smaller difference in denominators across all three approaches to determining active sites.

Figure 6. Malawi June 2020 stockout rate denominator (sites reporting) comparison by FP method

Figure 7 below combines actual stockouts with sites reporting to produce stockout rates.

As also seen in Nepal, in this example from Malawi, the numerators and denominators are dropping by approximately the same factor in all three stockout rate approaches. In general, there is an apparent trend that the numerators and denominators shift in the same downward direction across stockout rate approaches, however, due to differences in processes used to exclude sites for project reporting, it is difficult to confirm these trends without further investigation.

One possible explanation for a stockout that would otherwise be seen as an active site (a false positive) by the ministry of health is if a site has not had a particular commodity for 12 or more months, even though it may have trained service providers. The Active Site Rule would deem this an inactive site. Thus, the Active Site Rule could be removing both false negatives and false positives, but at different rates.

Sites that have not had a commodity for 12 or more months and are therefore deemed inactive should still be captured, though separately from the stockout reporting. This will allow the sites to be targeted for follow-up, in order to be restocked and made active again if they are in fact required to offer family planning services.

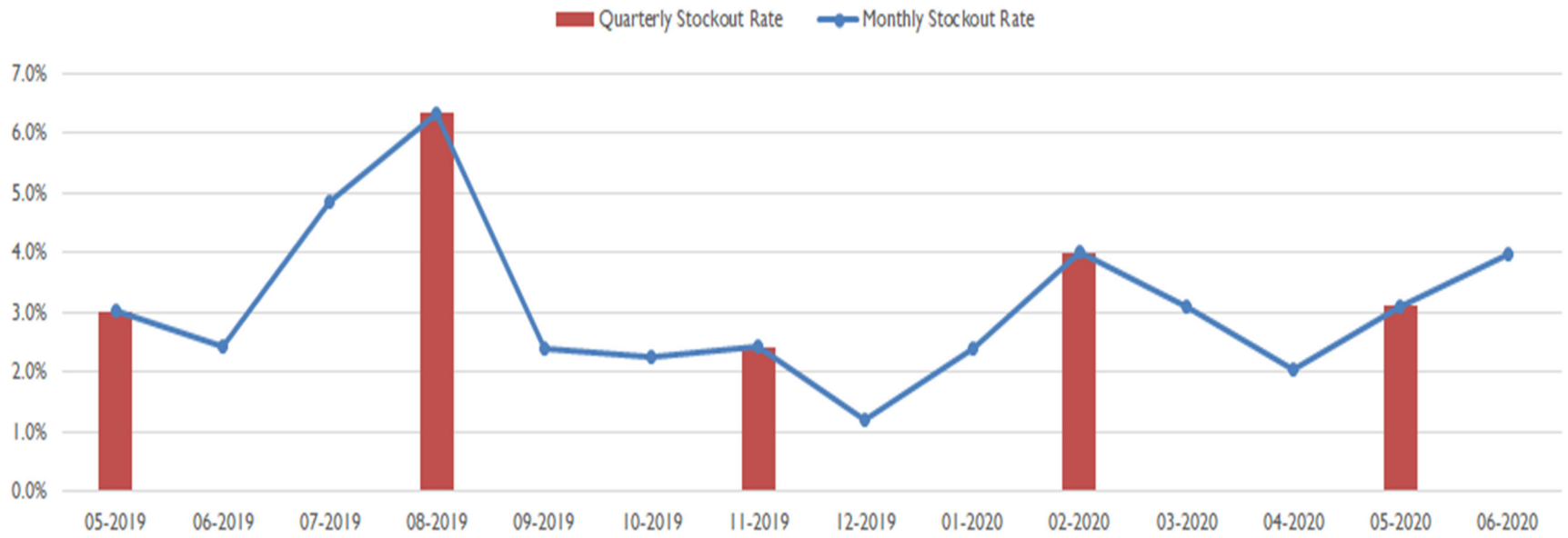
Figure 7. Malawi June 2020 comparison of stocked out and in-stock sites by stockout rule and FP method

Darker shading = stocked out sites, Lighter shading = in-stock sites

Timeliness

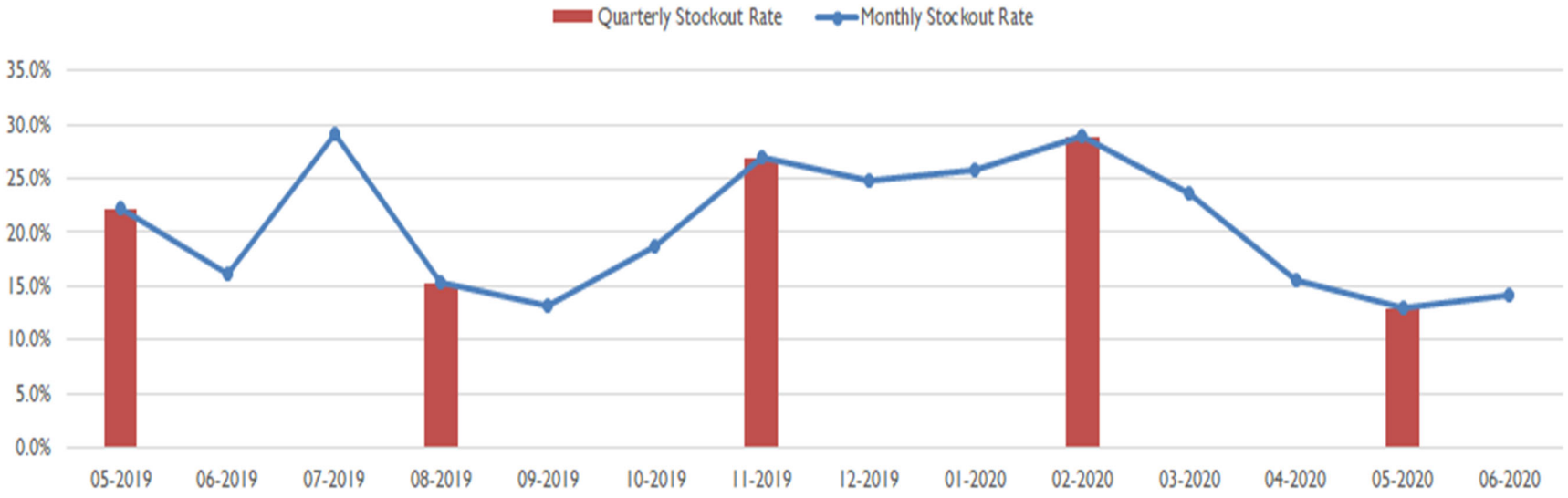
The graph below (Figure 8) shows the monthly and quarterly calculated stockout rates for male condoms between May 2019 and June 2020. Quarterly stockout rates showed sharp fluctuations each quarter. However, trends are more effectively detected when monthly data is available (blue line). Use of quarterly data misses the rise in stockouts in July 2019 followed by decreases in September 2019 and December 2019. Monthly data provides more immediate feedback to enable quicker decision-making to address increases in stockout rates in the subsequent month, instead of two or three months later if only quarterly data are available.

Figure 8. Malawi monthly vs. quarterly calculated stockout rate for male condoms



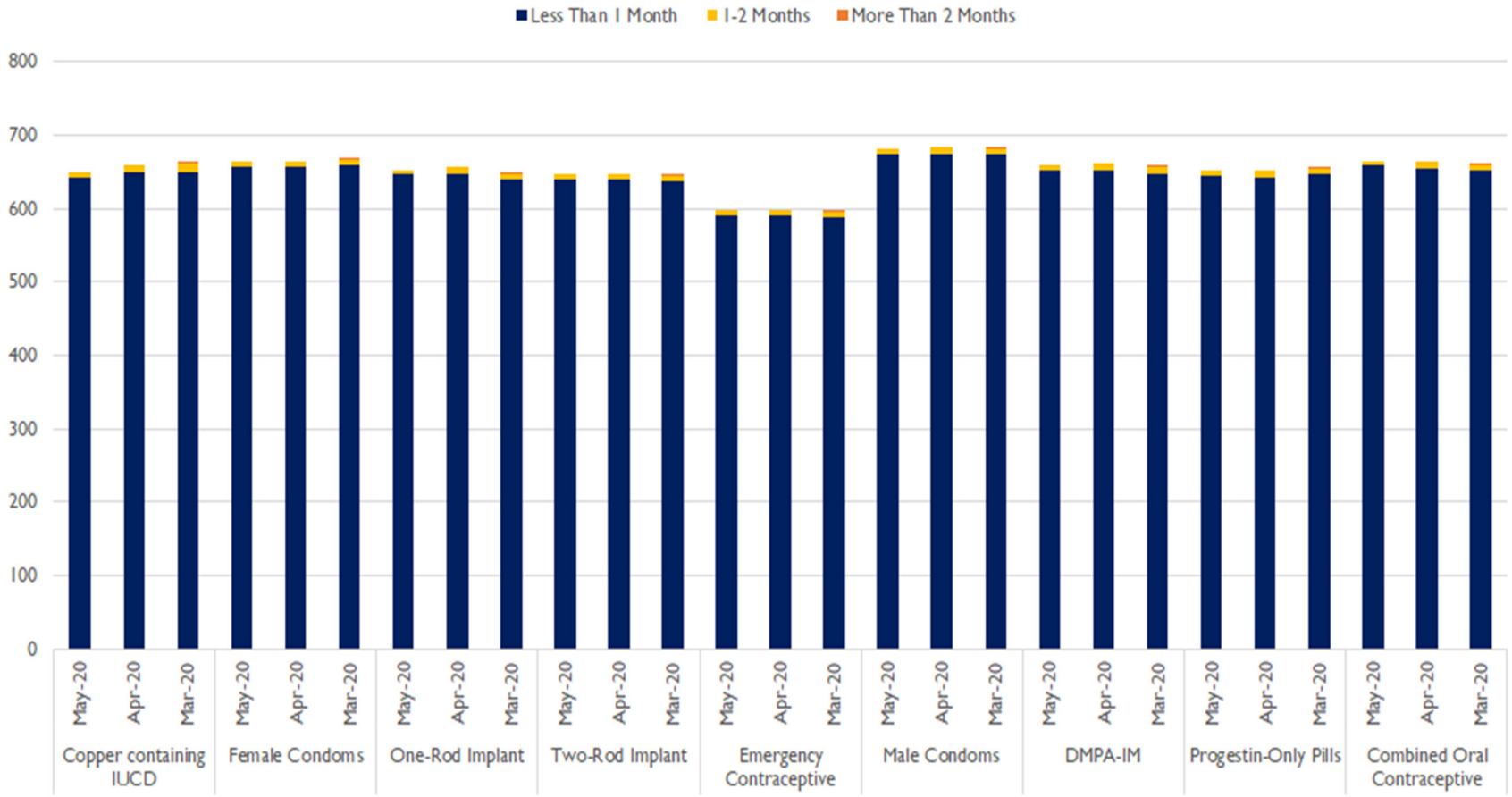
As shown in Figure 9 below, quarterly reporting of Depot Medroxyprogesterone Acetate 150 mg Intramuscular (injectable) stockout rates over the same period shows decreases in May 2019 and increasing rates in November 2019 and February 2020 followed by another decrease in May 2020. This trend is similar to monthly reporting; however, quarterly data misses the sharp increase that occurred between June and July 2019 but does not appear in the August 2019 quarterly report. Monthly data also shows a steady increase between September and November 2019.

Figure 9. Malawi monthly vs. quarterly calculated stockout rates for injectables (Depot Medroxyprogesterone Acetate 150mg/ml, Intramuscular)



Late reporting sites did not have a large impact on the stockout rate in Malawi. Figure 10 below shows that 98-99 percent of sites regularly report within one month after period-end. Stockout rates calculated later, therefore, would not have a large impact on the result, as long as the reporting rate remains high.

Figure 10. Number of sites reporting by LMIS data entry period and FP method, Malawi



Lessons Learned and Recommendations

Operational Accuracy

Lessons learned

A key finding for both Malawi and Nepal is that the implementation of the Active Site Rule will improve the operational accuracy of the stockout rate, as defined by the ability to identify a true active site and consistently eliminate false negatives. However, there will be conditions that cannot be defined to identify the status of every site. Following the current criteria, it will take 12 consecutive months for a site to be counted as active. For short-term methods such as condoms, oral contraceptives, and injectables, which have more stable consumption rates (sites issuing products), there will be fewer inactive sites. However, for products that are dependent on health facilities with qualified service providers, such as implants and IUDs, these sites are highly susceptible to becoming inactive due to staff turnover, creating more false negatives.

Recommendations

The ability to make the rule more sensitive for particular products can capture these conditions to correctly identify active sites. Setting a 6-month exclusion criterion may need to be considered for specific products to eliminate inactive sites in a shorter time frame versus using a 12-month rule. These are inactive sites that have not been able to offer the product in the last 3 or 6 months due to the lack of a qualified provider. A 3-month rule, on the other hand, may remove too many true stockouts, as was seen in Malawi. Tailoring the exclusion criteria by product is necessary to find inactive sites earlier, therefore minimizing the number of false negatives (facilities incorrectly included as active sites).

Consistency and Repeatability

Lessons learned

During this analysis, it was identified that there may be additional information outside of eLMIS data that provides a more accurate determination of a site being active or inactive. Where this information can be documented and the criteria for determining a site's active status defined, the recommendation in these cases is to use the external data source and to document the source and the active site status rationale. The key is to create transparency in setting rules for establishing the status of a facility and the parameters that would change its status. This is particularly important when a facility's status could be determined by more than one source (e.g., master data and ASR). Without a transparent and consistently defined rule, the observed fluctuations in stockout rates are harder to attribute to changes in actual stock status as opposed to changes in the methodology of the stockout rate. There will therefore be uncertainty around the outcome of the stockout rate depending on whether inactive sites have been inadvertently included (false negatives) or if active sites were excluded (false positives). Furthermore, if the reasoning for manually removing a site is not captured, it is not possible to audit or

assess the reasons for its removal and therefore to target follow-up actions toward inactive or active sites.

Additionally, the universe of sites that are used to measure stockouts may vary by country, and it is important for all stakeholders in a country to share a common understanding of what sites will be considered for the stockout rate prior to any exclusion criteria. There may also be other process rules in place, particularly in an automated system, that may interact with or even contradict the Active Site Rule. During the Nepal analysis, for example, it was discovered that when raw data were used to calculate the stockout rate, they were different than the reported data because an additional filter had been applied to the facility type before calculating the reported stockout rate. That application of the filter had been agreed upon and set by the Ministry of Health to consider four types of health facilities for stockout reporting. In Malawi, certain religious health facilities provide family planning services but do not provide contraceptives. Although provision of services is one of the criteria of an active site, these facilities would be considered non-reporting, and would be classified as inactive under the Active Site Rule, even though the Ministry of Health would consider them to be active family planning sites.

Recommendations

When adding a business rule, it must be integrated transparently with existing rules and processes in consultation with relevant stakeholders. It is important that the implementation of a new business rule is both transparent and integrated with existing processes.

Key recommendations from the analysis of the impact of the Active Site Rule:

- The Active Site Rule (ASR) serves as a "safety net" to catch the status of sites (active or inactive) not as the default measure of site status. The ASR assumes a site is active and is only triggered when the data indicates that the site meets set criteria to flag the site as inactive. If a site is flagged by the ASR, then the site should be proactively contacted to confirm its status.

- The criteria for when a site is flagged as inactive, either by the ASR or by another process (e.g., from the master data), need to be clearly documented.

- Maintain an audit trail for sites when their status is changed from active to inactive or vice-versa, including what triggered the change in status. This is critical for transparency and improving the management of site status.

- Include in the requirements for an implementation of an eLMIS system the services provided at the site and an "active" process for maintaining the master data, including the status of services provided at a site.

Use of the automated Active Site Rule acts as a safety net to identify sites whose operational practice (no stock, consumption, or ordering in the last 12 months) indicates that its status may have changed to inactive, i.e., the site is no longer providing a particular family planning product(s). This leads to a

proactive action for determining stock status and providing a more accurate measure of the stockout rate of sites that are actively providing family planning products.

Timeliness and Automation Considerations

Lessons learned

In this analysis, late reporting sites did not have a notable effect on stockout rates in either Nepal or Malawi. Therefore, stockout rates calculated at different time lags following a reporting deadline are likely to remain consistent and reliable, at least for the high reporting rates that were observed.

Frequency of reporting was found to have an impact on the ability to identify and quickly act upon stockouts, as trends that occurred in months in-between quarterly reporting periods in Malawi often changed more quickly or in different directions than quarterly trends.

In terms of the time and level of effort it takes to implement the Active Site Rule, lack of automation will require more time to filter out inactive sites and calculate stockout rates. After data cleaning, the average time to calculate the quarterly stockout rates with the ASR took less than 4 minutes in Nepal for all products, and just over 2 minutes in Malawi for monthly rates for all products. By contrast, manual calculations in Nepal take about half a day each reporting period.

An unclear application of the rule, whether manually or through automation, can lead to inconsistency, less precision, and expending more time conducting manual checks and re-validating data and results.

Recommendations

When possible, automating the application of the Active Site Rule can offer numerous advantages over manual calculations. Firstly, it creates consistency in defining the universe of sites and then in identifying active sites, therefore creating a repeatable process. Secondly, manual implementation requires a greater level of effort to clean the data, making the process less repeatable and transparent. Carrying out reporting-related tasks also draws staff time away from focusing on using the data for decision-making. Additionally, an automated process enables inactive sites to be more easily tracked and assessed separately from the stockout rate, thereby enabling targeted follow-up actions.

It is recommended to build in an audit system into the LMIS to validate the automation of the business rule. Auditing is necessary to ensure the automation is working correctly. An audit will show the process and code to exclude sites, which can be reviewed through an audit trail if it is designed into the LMIS. Building in an audit trail facilitates review of the structure, requirements, and language of the rule to make corrections quickly. With an audit trail, stock managers can verify previous active and excluded sites to determine whether the rule has been applied appropriately and consistently, minimizing differing interpretations and helping to build trust in the data.

Any future changes to the rule can also be made quickly with automation to either current or retroactive data and impacts from the update can be reviewed and adjusted swiftly. Digital systems are just digital

representations of the real environment. Thus, as the environment evolves, so does the digital representation. Thus, the coding and data structure will need updates and, in some cases, might in fact drive change.

Automation needs to be designed to be flexible as it will need to be sensitive and adjusted to accommodate the introduction of new products or formulations, taking into consideration that facilities will receive new stock at varying speeds while old products are phased out. Awareness of new product introductions will be needed to accurately include active sites to avoid inaccurate stockout rates.

To improve the automation process for the Active Site Rule, countries are recommended to follow the design recommendations in the Stockout Indicator Automation Design Guidance document finalized in July 2019, particularly to evaluate how the business rule is being implemented, and how the recommendations for auditability of the qualified data will be achieved. For example, automating the data cleaning process can automatically flag issues, allowing users to prioritize time and actions to confirm and resolve the flagged issues and improve data consistency.

Regarding reporting frequency, this study shows that more frequent reporting, such as monthly, can be advantageous to stock managers in flagging problems earlier.

Conclusions

The Active Site Rule (ASR) is very useful in consistently reporting stockout rate changes over time, reducing false negatives, and providing more reliable comparisons across different time periods and regions within a country. When setting the ASR as a "safety net" there are considerations into the length of time before a site is flagged as "inactive". The ASR can be applied in correlation with other sources of information on facility status (e.g., master data). When the ASR is used with other sources, it is key to have both transparency and auditability to understand when a facility's status has changed and to trigger appropriate actions, e.g., confirmation of the facility's status. The ASR provides a transparent way for countries to ensure their stockout rates are reflective of active sites stocked out, excluding inactive sites.

Applying the rule can be facilitated through the following:

1. Clearly defining the universe of sites through agreement with key actors. Transparency and clarity on the criteria used to define which sites are considered active will improve the operational accuracy and consistency of the rule.
2. Clearly defining the period of time which the rule will cover. This may need to be applied on a product-by-product basis where low demand or provider-reliant products will more likely become inactive, and a 6-month rule will detect these sites more quickly than a 12-month rule. Using 12- and 6-month criteria will more accurately identify active sites.
3. Flagging sites whose status needs to be confirmed: If a site is flagged by the ASR, then actions are needed to confirm it is not active, otherwise action is required.
4. Having an automated, auditable process enables repeatability and trust in the Active Site Rule, offers the ability to understand why sites were removed and to follow up, allows for changes to the rule over time, and lends value to be able to accurately and consistently represent the status of active sites as the denominator for determining the stockout rate.
5. More frequently measuring stockouts to spot trends and act upon them sooner.

Annex A. Active Site Rule Code

Please note that the script below excludes country-specific cleaning. To run the script, please make sure that the LMIS data includes stock and issues data on the facility and product level. Data should also include start and end date columns for what period the stock row covers. There should be enough data to cover the window specified. For example, to calculate stockout indicator for November 2020 on 12-month active site rule, data should at least date back to November 2019.

```
import numpy as np

import pandas as pd

from datetime import datetime

from pandas import ExcelWriter

import os

from os import listdir

from os.path import isfile, join

import re

from time import strptime

import datetime

from os import listdir

from collections import defaultdict

from os.path import isfile, join

import itertools

from collections import Counter

import time

import sys

import calendar

from datetime import date

from dateutil.relativedelta import relativedelta
```

```
def get_start_date(date, window):
    """Returns the start date of the selected stockout indicator period

    Args:
        date (String): Date in the format of yyyy-mm-dd
        window (Integer): Stockout indicator active site rule period

    Returns:
        window_start, window_end: Datetime parameters for the start and end date of the specified date
    """
    date = pd.to_datetime(date)
    window_end = quarter_map[(quarter_map['End_Date']<=date)]['End_Date'].max()
    temp_start = window_end + relativedelta(months=-window)
    print(temp_start)
    window_start = quarter_map[(quarter_map['Start_Date']>=temp_start)]['Start_Date'].min()
    print(window_start)
    if((window_start >= window_end)|pd.isna(window_start)):
        window_start  = quarter_map[(quarter_map['Start_Date']<=temp_start)]['Start_Date'].max()

    print(window_start, window_end)
    return window_start, window_end


def in_window(df, window_start, window_end):
    """Checks for entries that fall within the active site rule window

    Args:
        df (Dataframe): Table containing stock data
        window_start (Date): Start of the active site calculation
        window_end (Date): End of the active site calculation

    Returns:
        Dataframe: Data with In_Window column indicating whether the row falls within the window
    """
    df['In_Window'] = False
    df.loc[(df['Start_Date']>=window_start)&(df['End_Date']<=window_end),'In_Window'] = True
    return df

def aggregate1(x):
    """Aggregation function to calculate sum of stock on hand, issues, records, number of stockouts, and
whether to include the entry

    Args:
        x (Dataframe): Table containing stock data

    Returns:
        Series: Sum of stock, issues, record count, number of stockouts
    """
```

```
    d ={}
    d['Sum_SOH'] = x['Balance_Qty'].sum()
    d['Sum_Issues'] = x['Issued_Qty'].sum()
    d['Count_Records'] = x['Count_Record'].sum()
    d['Count_Stockouts'] = x['Count_Stockout'].sum()
    d['Include'] = False if (x[x['In_Window']]['Balance_Qty'].sum() + x[x['In_Window']]['Issued_Qty'].sum()
== 0) else True
    return pd.Series(d, index=['Sum_SOH','Sum_Issues','Count_Records','Count_Stockouts', 'Include'])


def aggregate2(x):
    """Second aggregation function to calculate stockout and records

    Args:
        x (Series): Input series from aggregate1 function

    Returns:
        Serie: Output series of total stockouts and records
    """
    d = {}
    d['Stockouts_Total'] = x['Count_Stockouts'].sum()
    d['Records_Total'] = x['Count_Records'].sum()
    return pd.Series(d, index =['Stockouts_Total','Records_Total'])

def aggregate3(x):
    """Aggregation function without the inclusion indicator

    Args:
        x (Dataframe): Input dataframe

    Returns:
        Series: Output series with stock, issues, and records
    """
    d ={}
    d['Sum_SOH'] = x['Balance_Qty'].sum()
    d['Sum_Issues'] = x['Issued_Qty'].sum()
    d['Count_Records'] = x['Count_Record'].sum()
    d['Count_Stockouts'] = x['Count_Stockout'].sum()
    return pd.Series(d, index=['Sum_SOH','Sum_Issues','Count_Records','Count_Stockouts'])

def get_indicators(window, date, df, indicator_period , country):
    """Calculates the stockout indicator and prints incremental output of each step to an Excel file

    Args:
        window (Integer): Numer of periods to consider for the active site rule. 12-month ASR has a window
of 12
        date (String): Ending date for calculation. For example, June 2020 stockout indicator has date '06-
30-2020'
```

```
        df (Dataframe): Input data table containing stock information
        indicator_period (Integer): Number of months considered for stockout. Monthly = 1, quarterly = 3
        country (String): Name of country. Can be used to customize function

    Returns:
        prod_indicators, qtr_prod_indicators: Tables containing stockouts over the entire period over the
window and the current period
    """
    df = df.copy()
    if (country == "Nepal"):
        start, end = get_start_date(date, window)
    else:
        end = pd.to_datetime(date)
        start = end + relativedelta(months=-window)
        print(start, end)

    file_name = "Stockout_Indicator_All_Output_"+str(country) + str(date) + ".xlsx"
    writer = pd.ExcelWriter(file_name)
    df = in_window(df, start, end)
    df_use = df[df['In_Window']==True]
    if(country == "Malawi"):
        df_use.dropna(subset = ['Issued_Qty','Balance_Qty'], inplace = True)
    df_use.to_excel(writer, sheet_name = 'In_Window',index = False)

    ### GROUP UP TO PRODUCT & FACILTIY LEVEL ###
    all_df =
df_use.groupby(['Product_Code','Product_Description','WarehouseCode','WarehouseName','District']).a
pply(lambda x: aggregate1(x)).reset_index()

    print(all_df.head(3))
    all_df.to_excel(writer, sheet_name = 'Grouped',index = False)
    exclusions = all_df[all_df['Include'] == False]
    exclusions.to_excel(writer, sheet_name = 'Exclusions',index = False)
    print(exclusions.head(1))
    inclusions = all_df[all_df['Include'] == True]
    inclusions.to_excel(writer, sheet_name = 'Inclusions',index = False)

    ### GROUP UP TO PRODUCT LEVEL - DENOM ###

    ### GROUP UP TO PRODUCT LEVEL - NUM ###

    product_indicators = inclusions.groupby(['Product_Code','Product_Description']).apply(lambda x:
aggregate2(x)).reset_index()
    product_indicators['Annual Stockout Rate'] =
product_indicators['Stockouts_Total']/product_indicators['Records_Total']
    product_indicators['Facilities with Stockouts'] =
product_indicators['Product_Description'].apply(lambda x: inclusions[(inclusions['Count_Stockouts'] > 0)
& (inclusions['Product_Description'] == x)]['WarehouseCode'].nunique())
```

```
    product_indicators['Facilities Total'] = product_indicators['Product_Description'].apply(lambda x:
all_df[all_df['Product_Description'] == x]['WarehouseCode'].nunique())

    #product_indicators['Annual Stockout Rate'] = product_indicators['Stockouts
Total']/product_indicators['Records Total']
    product_indicators['Annual Stockout Rate Facilities'] = product_indicators['Facilities with
Stockouts']/product_indicators['Facilities Total']
    product_indicators['Records Excluded'] = product_indicators['Product_Description'].apply(lambda x:
exclusions[exclusions['Product_Description'] == x]['Count_Records'].sum())
    product_indicators['Facilities Excluded'] = product_indicators['Product_Description'].apply(lambda x:
exclusions[exclusions['Product_Description'] == x]['WarehouseCode'].nunique())

    if(country == "Nepal"):
        qtr_start, qtr_end = get_start_date(date, indicator_period)
    else:
        qtr_end = end
        qtr_start = qtr_end + relativedelta(months=-indicator_period)
        print(qtr_start, qtr_end)

    curr_qtr = df[(df['Start_Date']>=qtr_start)&(df['End_Date']<=qtr_end)]
    curr_qtr =
curr_qtr.merge(all_df[['Product_Code','Product_Description','WarehouseCode','WarehouseName','Distri
ct','Include']], on =
['Product_Code','Product_Description','WarehouseCode','WarehouseName','District'],how = 'left')
    curr_qtr_ind =
curr_qtr.groupby(['Product_Code','Product_Description','WarehouseCode','WarehouseName','District','I
nclude']).apply(lambda x: aggregate3(x)).reset_index()

    print(curr_qtr_ind.head(3))
    curr_qtr_incl = curr_qtr_ind[curr_qtr_ind['Include']==True]
    curr_qtr_incl.to_excel(writer, sheet_name = 'Current Period Inclusions',index = False)
    curr_qtr_excl = curr_qtr_ind[curr_qtr_ind['Include']==False]
    curr_qtr_excl.to_excel(writer, sheet_name = 'Current Period Exclusions',index = False)
    qtr_prod_indicators = curr_qtr_incl.groupby(['Product_Code','Product_Description']).apply(lambda x:
aggregate2(x)).reset_index()
    qtr_prod_indicators['Quarter Stockout Rate'] =
qtr_prod_indicators['Stockouts_Total']/qtr_prod_indicators['Records_Total']
    qtr_prod_indicators['Facilities with Stockouts'] =
qtr_prod_indicators['Product_Description'].apply(lambda x:
```

```
curr_qtr_incl[(curr_qtr_incl['Count_Stockouts'] > 0) & (curr_qtr_incl['Product_Description'] ==
x)]['WarehouseCode'].nunique())
    qtr_prod_indicators['Facilities Total'] = qtr_prod_indicators['Product_Description'].apply(lambda x:
curr_qtr_ind[curr_qtr_ind['Product_Description'] == x]['WarehouseCode'].nunique())

    qtr_prod_indicators['Quarter Stockout Rate Facilities'] = qtr_prod_indicators['Facilities with
Stockouts']/qtr_prod_indicators['Facilities Total']
    qtr_prod_indicators['Records Excluded'] = qtr_prod_indicators['Product_Description'].apply(lambda x:
curr_qtr_excl[curr_qtr_excl['Product_Description'] == x]['Count_Records'].sum())
    qtr_prod_indicators['Facilities Excluded'] = qtr_prod_indicators['Product_Description'].apply(lambda
x: curr_qtr_excl[curr_qtr_excl['Product_Description'] == x]['WarehouseCode'].nunique())
    qtr_prod_indicators.to_excel(writer, sheet_name = 'Current Period Stockout Ind',index = False)
    writer.save()
    writer.close()
    return product_indicators, qtr_prod_indicators
```

Annex B. PPR PIRS: Average stockout rate of contraceptives at service delivery points by family planning method indicator

Definition	This indicator reports an annual rate or "average stockout rate" for each contraceptive commodity (to be referenced as "family planning method") at Family Planning service delivery points (SDPs) across all reporting periods in the USG fiscal year. It provides the average stockout for the most commonly used and other methods offered in a country. Operating Units (OUs) should report the following results for this indicator: a) Parent Indicator (HL.7.1-3a-b): This result should represent the average stockout rate for the most commonly used family planning method in the country during the fiscal year. The parent indicator uses the most commonly used method because this is where stockouts would have the most impact on users. This result should also appear in the Method Disaggregate Table. (Note: OUs can refer to The Demographic and Health Surveys (DHS) Program to determine or confirm the most commonly used method.) b) Disaggregates (HL.7.1-3c-i): These results should represent the average stockout rate for each family planning method offered, including the most commonly used. Although the parent indicator represents the average stockout rate for the most commonly used family planning method in the country across the fiscal year, average stockout rates should be calculated and reported for each method that is offered in the country. The parent indicator uses the most commonly used method because this is where stockouts would have the most impact on users. (Note: This result should also appear in the Method Disaggregate Table.) Note: The parent indicator should provide the stockout rate for the most commonly used method in the country. For example, let's assume in DevLandia, injectable hormonal contraceptives are the most commonly used contraceptive method. Disaggregate results are as follows: * Male condom's stockout rate is 20%, * Female condom's stockout rate is 30%, * Injectable contraception stockout rate is 22%, * Implantable hormonal contraceptives stockout rate is 40%, * IUD's stockout rate is 50%, and * Orals stockout rate is 25%.

	Since injectable contraceptives are the most commonly used method, the parent indicator result would be 22%. Calculate the average stockout rate for each family planning method as follows: *Numerator:* Sum of SDPs stocked out of a specific product or method according to the ending balance of the most recent logistics report (or on the day of site visit) across all available reporting periods in the fiscal year. *Denominator:* Sum of SDPs that reported or were visited that offer the product or method across all available reporting periods in the fiscal year. **Points of Clarification:** 1. **Stockout Definition:** Being stocked out indicates having zero usable (non-expired or non-damaged) stock of the offered family planning method at the location being assessed, both in storerooms and dispensaries (as applicable). 2. **Definition of Method Offered:** Offering the method refers to providing or managing it. An SDP is considered to offer a method if it has stocked it or has issued/dispensed or ordered the method at some point during the 12-month reporting period. This indicator's definition does not consider the availability of trained providers for relevant methods. Only SDPs that offer a particular method per this definition should be included in the stockout rate calculation for that method. 3. **Reporting by Method:** When collecting data by method, it will be important to determine whether SDPs that offer more than one product brand (e.g. Depo-Provera) or product type (e.g. three-month progestin-only injectable) within a method category were stocked out of all at the same time, if feasible. **Methods include**: Male Condoms, Female Condoms, Calendar-based Methods, Implantable Hormonal Contraceptives, Injectable Hormonal Contraceptives, Intrauterine Devices, and Oral Hormonal Contraceptives (includes both combined oral contraceptives and progestin-only pills; does not include emergency contraceptives). 4. **Multiple reporting periods generally occur when a country's logistics management information system (LMIS) is used to compute the indicator.** Usually in such cases, the average stockout rate by family planning method would be computed by summing the number of SDPs stocked out across monthly or quarterly LMIS data and dividing by the sum of the number of SDPs reporting. However, if consistent stockout data are not available, OUs should use data from all available reporting periods in the fiscal year to average the percentage of SDPs stocked out; this should be noted in the Indicator Narrative.

	5. **Family planning SDPs should include all public sector SDPs offering family planning commodities;** however, if there are concerns with feasibility, OUs should contact their supply chain implementing partner in-country or Bureau for Global Health POCs to discuss alternatives. Family Planning SDPs should also include all NGO, social marketing, and private sector SDPs that are USG-supported.
Primary SPS Linkage	Investing in People: Health: Family Planning and Reproductive Health: HL. 7.1. Secondary: HL.7.6: Procurement and Supply Chain (FP/RH)
Linkage to Long-Term Outcome or Impact	The availability of contraceptives is a critical determinant of the success and long-term impact of any family planning program. This indicator measures the ability of a supply chain to ensure that products are consistently available to clients at the SDP level.
Indicator Type	Outcome
Reporting Type	Percent
Use of Indicator	This indicator is used by in-country program managers and stakeholders as the ultimate measure of how well the supply chain is working. The indicator is used to help focus program investments for supply chain strengthening. Where USG FP assistance is not directed at contraceptive donations or supply chain strengthening, this indicator can serve to flag where lack of supplies to clients may constrain the success of other program investments and where assistance for supply availability may be warranted. This indicator is used by USAID/W staff to support in-country managers in allocating resources and program support. This measure can also inform stakeholders (e.g., Congress) on how well programs that are supported by USAID are progressing towards reliable availability of family planning methods for clients.
Reporting Frequency	Annual

Data Source	1. The preferred source of data is the host country LMIS (specifically, the ending balance of the logistics report), where the LMIS provides regular and reliable stock information at the SDP level. 2. Where the national LMIS cannot provide reliable information, and a parallel LMIS run by a USAID project exists, this LMIS can provide the data. 3. Where reliable LMIS data are not available, data from regular surveys (such as facility surveys, drug use surveys, End Use Verification surveys) may be used. Whenever possible, surveys that serve as data sources should provide statistically representative samples. a. Where survey data are used for monitoring, USAID/Washington and the Mission should annually reassess the need for surveys as the LMIS is strengthened. 4. Where no source of reliable data is available, USAID/W and the USAID Mission will come to agreement on steps to be taken to improve country-level logistics data and LMIS performance, and on other means to temporarily collect this data. 5. Missions are highly encouraged to reach out to the Bureau for Global Health and/or their supply chain implementing partner in country (if applicable) for guidance on how to compute this indicator for their specific circumstances or to discuss data collection issues.
Bureau Owner(s)	**Agency:** USAID **Bureau and Office:** Bureau for Global Health, Office of Population and Reproductive Health **POC:** Wezi Munthali, GH/PRH/CSL, amunthali@usaid.gov Secondary POC: Kevin Pilz, GH/PRH/CSL, kpilz@usaid.gov
Disaggregate(s)	Numerator, Denominator The indicator should be reported for each of the following method categories, as applicable: Male Condoms, Female Condoms, Calendar-based Methods, Implantable Hormonal Contraceptives, Injectable Hormonal Contraceptives, Intrauterine Devices, and Oral Hormonal Contraceptives. Note: Disaggregates do not aggregate to the parent indicator.

Annex C.

GHSC-PSM Stockout Reporting Automation Guidance

USAID
FROM THE AMERICAN PEOPLE

GHSC-PSM Stockout Reporting Automation Guidance

How Countries with Electronic LMIS Systems can Design for Automated Stockout Reporting

July 2019

CONTENTS

ABBREVIATIONS AND ACRONYMS

API –	Application Program Interface
CWH –	Central Warehouse
DHS –	Department of Health Services
eLMIS -	electronic Logistics Management Information Systems
ETL –	Extract, Transact, Load
GHSC-PSM	Global Health Supply Chain – Procurement and Supply Management
M&E –	Monitoring and Evaluation
PIRS –	Performance Indicator Reference Sheet

OVERVIEW

PURPOSE

The B1 Stockout Indicator measures the percentage of facilities that experienced a stockout of a specific family planning/reproductive health (FP/RH) product/method offered by that facility. It is a point-in-time stockout measurement, based on the stock situation from the ending balance of the most recent logistics report. This indicator is reported separately for each product/method.

Countries using electronic Logistics Management Information Systems (LMIS) have the ability to develop automated reporting and analysis of data that is captured. There are different systems used by different countries, and even different data capture processes depending on how the solution is deployed. The data captured, as well, can have different data structures, but all of these systems have the capability to extract the data for reporting or use in other analysis.

After evaluating the current capabilities of three countries, Pakistan, Malawi and Nepal, a common design for using LMIS to perform stockout reporting emerges that is useful as guidance for other countries that wish to automate stockout reporting. Though there are differences, such as countries collecting real-time data at different levels of the supply chain, or capturing SDP data monthly versus quarterly, a common process is defined that this guidance is based upon.

This document is intended to help countries define, design, and build a robust reporting capability aiming to standardize and automate stockout reporting that feeds DevResults and the USAID annual Performance Plan and Report (PPR). As well, the automation of certain analysis to qualify the stockout data can be implemented with the reporting, improving the quality of the data reported. Again, there will be differences per country and per system, and the guidance takes this into consideration.

The guidance is based on communications from both the in country and HQ M&E teams for stockout reporting. There are also several best practices that have come to light through the requirements gathering phase of this stock out process investigation.

HOW TO USE THIS DOCUMENT

Countries can utilize this document as a roadmap and framework for what is being reported and how it will help the in-country operations become optimized in their reporting, and how to leverage this reporting for improving availability of commodities.

There are several common themes and pain points that also arose from the requirements gathering process, i.e., different ways of including and excluding reporting sites.

This document can be used to align a detailed design specification for automated reporting of stockout data.

REQUIREMENTS AND PROCESS SUMMARY

REQUIREMENTS

The design of the stockout report will follow requirements for B1 Performance Indicator Reference Sheet (PIRS) compliance but will also provide additional capabilities for deeper analysis of the stockout reported data so as to qualify for conditions where SDPs are not providing a specific FP/RH service. In addition, automated systems offer the ability to compare other data with the stockout data. Stockout rate, individually, provides limited information. Additional indicators, such as stock status, stockout duration, order fill rates, and adjustments can provide further information and context to identify causes of stockouts and areas for improvement.

The table below provides a list of requirements the system should meet for developing the stockout report, and for providing additional qualification to the stockout data. There are conditions specific to a country for determining if an SDP is providing a particular service, and if it is determined they are not, then those sites should be removed from the denominator of the stockout calculation. For example, in Pakistan they are examining stockout data for multiple periods (12) of no stock on hand and no consumption being reported, as an indicator that the site is not performing the service for that product. Note that this method is compliant with the PIRS definition in A1 for determining sites that are providing the product. Nepal and Malawi have different models of the same analysis, where Nepal is examining for 3 months (1 Quarter) of stockouts, and the previous quarter having reported no stock. In Malawi, they experience a period-by-period qualifier when it is known that the skilled service provider for a particular method has moved to a different facility.

In all, these methods for qualifying the denominator must be defined for the country's situation, available data, and knowledge of how the supply chain operates. The intent is to define a single, consistent business rule for removing sites from the denominator, but there will also be country-specific business rules, such as knowledge that specific sites are not, or no longer, providing a particular method, or elimination of sites based on public vs private providers that may be comingled in the source data. The single, consistent rule that is recommended and which is compliant with the PIRS definition in A1, is to define a site as offering or providing a product if it has had the product in stock, consumed (issued to clients) the product, and/or ordered the product at any point in the previous 12 months

Allowing for additional country-specific business rules will require governance over how the rules are qualified in the data, how they can be audited based on data present in the eLMIS or BI reporting environment, and how they may change based on changing business conditions or changing data structures in the eLMIS itself. The HQ M&E team will provide the guidance for evaluating and deploying the business rules.

The requirements in the table show whether it is a general requirement or should be defined specific to the country. Country-specific requirements should be redefined for the needs of the country.

Req #	Applicability	Type	Requirement	Comments
1	General	Functional	System shall have the ability to perform stockout reporting in compliance with B1 PIRS	

Req #	Applicability	Type	Requirement	Comments
2	General	Functional	System shall have the ability to capture from each SDP, the data needed to report stockout information, including each product's period ending on-hand balance	
3	General	Functional	System shall have the ability to report stock positions of all SDPs that offer the service	
4	Country-Specific	Non-Functional	SDP stock reporting data needs to be entered into the system in a timely manner to facilitate quarterly reporting	Countries will have different methods for data entry of SDP reporting
5	General	Functional	System shall have the ability to capture from each SDP, the cumulative consumption data for the reporting period.	
6	General	System	Map the products being reported in country systems to the Tracer Products specified for DevResults	
7	General	System	When more than one (1) product is mapped to the Tracer Product, the system will be able to determine if the method is supported by stock available of any products mapped to the method/ Tracer Product.	
8	General	User	M&E reporting team must be able to extract data from system with tools that allow analysis of the data	
9	Country-Specific	Functional	System shall have the ability to extract data from LMIS to map to the DevResults reporting fields, including: • Reporting Period End Date • Country • Country Program • GHSC-PSM Support • Task Order • Tracer Product • # of SDPs that Reported (Stockout Denominator) • # of SDPs Stocked Out (Stockout Numerator) • Data Source	Countries will have different software tools, data design and data presentation layers for reporting this data.

Req #	Applicability	Type	Requirement	Comments
10	Country-Specific	Functional	System shall have the ability to analyze stocked out facilities to determine through analysis of multiple **periods of stockout** reporting if the SDP is not providing the service and therefore should be eliminated from the # of SDPs in the denominator of the stockout formula	Countries will support the single, consistent business rule of eliminating inactive sites with no stock or consumption for 12 months from the stockout analysis, but may also have different business rules for determining is a site is not providing the service
11	Country-Specific	Functional	System shall have the ability to analyze stocked out facilities to determine through analysis of multiple **periods of consumption** reporting if the SDP is not providing the service and therefore should be eliminated from the # of SDPs in the denominator of the stockout formula	Countries will support the single, consistent business rule of 12 months analysis, but may also have different business rules for determining is a site is not providing the service
12	General	System	Calculate for each SDP, the average monthly consumption of each product and store this value for reporting purposes	
13	General	Functional	System shall have the ability to compare consumption data with stock data for deeper analysis of stockouts where stockout days do not represent the entire reporting period (e.g., month, quarter)	Being able to identify sites that are fulfilling demand for all or part of a period, though stocked out at the end of the period

Table 1 - Stockout Reporting System Requirements

The last two requirements in the table are examples of additional analysis that can be performed against the stockout data using other commonly data available in automated systems. Using consumption data, a calculation of the average monthly consumption (AMC) for each site is stored in the system. The AMC can be used to evaluate each stocked out facility to roughly determine the days of stockout experienced at the facility, as well as determine which facilities are consistently reporting consumption of AMC.

PROCESS OVERVIEW

Following is the stockout processing overview, which describes how stockout reporting data is extracted from eLMIS with business rules implemented either directly in eLMIS or in a separate BI reporting environment.

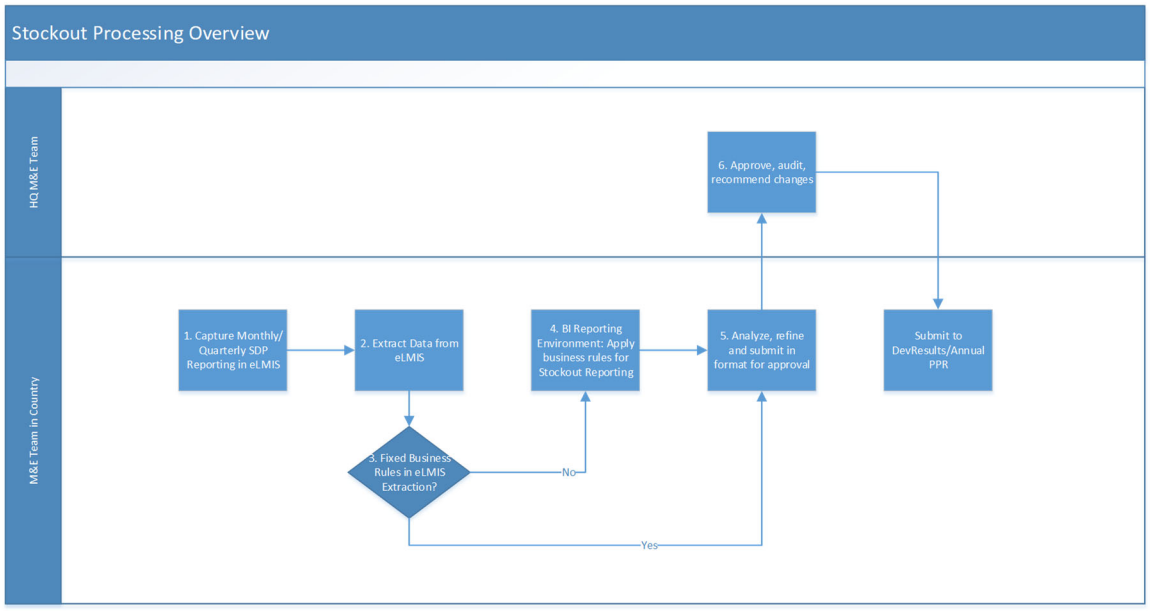


Figure 1 - Stockout Reporting Process Overview

The process overview steps are as follows:

1. The M&E team in-country use eLMIS to capture monthly/quarterly reporting from SDPs which contain stock balances and consumption data. This data contains the Denominator (# of Facilities Reporting) and the Numerator (# of Facilities stocked out).
2. Extract Data from eLMIS
3. Are the Fixed Business Rules in eLMIS Extraction? Some countries will implement the fixed business rule of 12 months no demand and 12 months no consumption directly in the eLMIS reporting. In this case, the data is prepared for final analysis and refinement in the format that will be used for HQ M&E team approval and ultimate loaded directly into DevResults.
4. If not in the eLMIS extraction, use a BI reporting environment to apply the business rules for stockout reporting. In this case, the extractions from the BI reporting environment will prepare the data for final analysis and refinement, and in the format that will be used for HQ M&E team approval and ultimate loaded directly into DevResults.
5. Analyze and refine the reporting data and submit it in the format for approval and later entry directly into DevResults. The formatting of the data can be performed as part of the extract from eLMIS (Step 2) or as part of the extract from the BI reporting environment (Step 4).
6. The HQ M&E team will: Approve, audit, or recommend changes to the reported data.
7. Once approved by the HQ M&E team, the M&E team in-country will enter data into DevResults or prepare the annual PPR.

The alternative methods for applying the business rules, either in the eLMIS reporting directly, or in a separate Business Intelligence reporting environment, speak to a structured process in the former, or a more flexible process in the latter.

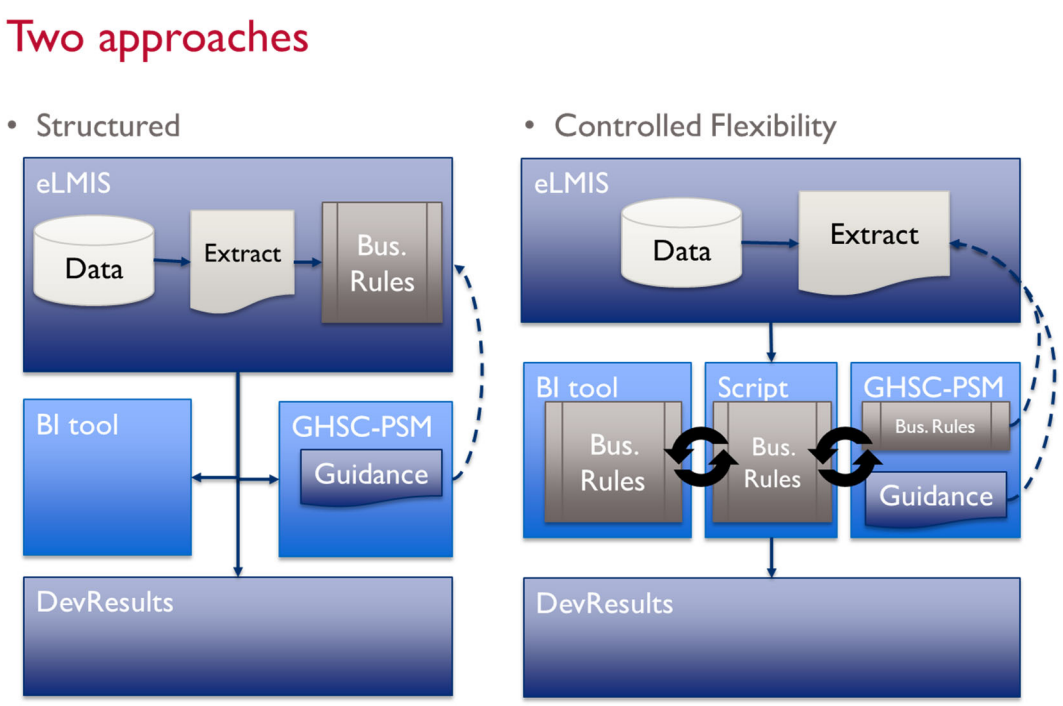


Figure 2 - Two approaches to deploying automated business rules

The structured process of having the business rules built directly into eLMIS are possible when the business rule can be 1: distinguishable data criteria in the system, 2: a steady/stable business rule that reporting guidance has recommended to be a fixed business rule. Until then, the business rules would be better implemented in a business intelligence framework that allows for the most flexibility, but in a controlled environment.

PROCESS DESIGN

The process design provided here is an example for how the process can be defined with steps to add business rules for qualifying the denominator, finalizing the reporting data, and submitting to DevResults when complete. It is important that the business rules used to qualify the stockout reporting are managed through a reporting governance structure with the HQ M&E team, so that it is known how, and using which system data, the denominator is being modified and how those business rules can be audited to ensure that the reporting can be backed-up with the raw data.

An optional process is added that describes an example of additional analysis that can be performed where consumption data and average monthly consumption values can be used to qualify sites that have consumed product during the period but were stocked out at the end of the period. This reporting can be stated as a qualifier to the numerator in the formula, offering countries a view of the number of sites that are actually delivering services in the period. Or it could be used to calculate the number of days of stockout at the site by comparing actual consumption to AMC, and then determining the average daily consumption that was actually used. Additionally, Pakistan and Nepal have added an "On Order Qty" to their monthly/quarterly reporting so that they can identify sites that may be stocked out but have taken action (or not) to replenish the inventory. This added reporting and analysis is intended to show how inventory is moving through the supply chain and where patient demand is being met.

When countries set up the automated process for stockout reporting, the priority is to deliver the DevResults reporting capability, and the USAID annual PPR capability. However, designing the overall system functions should allow for additional analysis the country plans in order to deliver deeper understanding of supply chain performance.

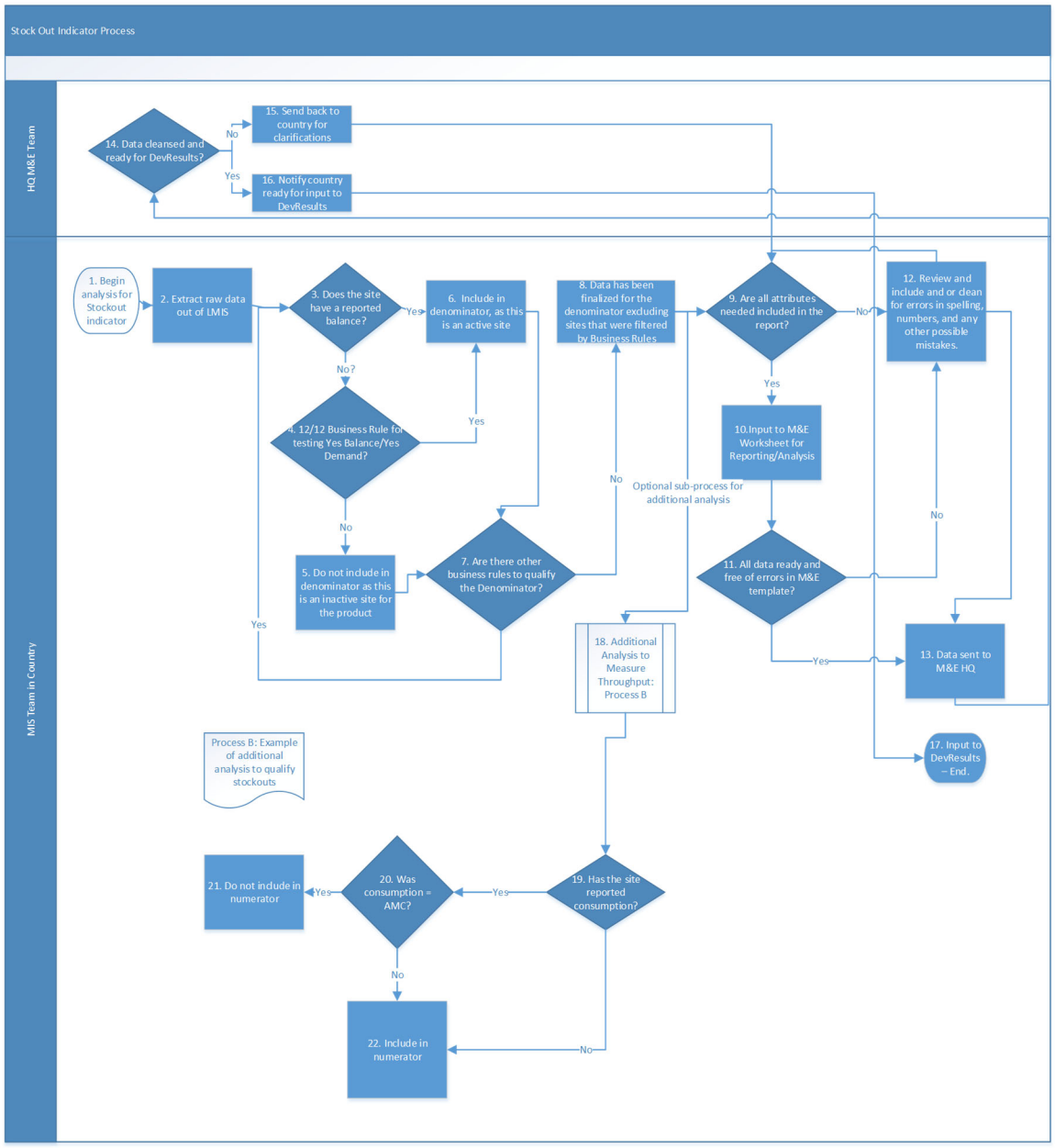


Figure 3 - Example Stockout Reporting Process

Explanation of Stock Out Indicator Process – Implementation of Data Integration for Stock Out Indicator

Step Number	Process Step	Description
1.	Begin analysis for Stockout indicator/rate	The MIS Team in country begins the exercise of analyzing and compiling the stockout data.

Step Number	Process Step	Description
2.	Extract raw data out of LMIS	The MIS Team in country will extract the raw data out of LMIS through the system export process. Some countries may perform analysis in Excel, others in a business intelligence platform.
3.	Does the site have a reported balance?	Does the site have any inventory on hand?
4.	12/12 Business Rule for testing Yes Balance / Yes Demand	If no to step 3, then we clarify if the site has had any inventory on hand or reported consumption at some point in the past 12 months. *These rules are often implemented in Excel, or in a BI platform. There are also business rules that can be built into the extract from LMIS, but these should be easily qualifiable business rules/filters*.
5.	Do not include in denominator as this is an inactive site for the product	Sites that are filtered out based on the business rule will be removed from the Denominator in the stockout rate calculation
6.	Include in denominator as this is an active site.	This is ensuring that the site has had the item being evaluated for stockout in a recent period. This site will be included in the denominator.
7.	Are there other business rules to qualify the Denominator?	If Yes go back to Step 3, if No go to Step 8. Some countries will have additional fields that help qualify the denominator from the data. For example, the LMIS may be tracking private sites not supplied by the government, but USAID and GHSC-PSM are not reporting those sites. This should be filtered based on a flag in LMIS, or it may have to be filtered in Excel or the BI platform, in which case countries must provide a method for auditing these additional business rules.
8.	Data has been finalized for the denominator excluding sites that were filtered by the business rules.	The number of sites to be included in the denominator is clarified and the analysis should continue for final data cleaning.
9.	Are all attributes needed included in the report?	All necessary data is compiled in the report (all provinces, stakeholders, products, quantity counts, etc.).
10.	Input into M&E Worksheet for Reporting/Analysis	The M&E team in country will then compile all finalized data necessary for the stockout indicator into the defined format for entering into DevResults.
11.	All data ready and free of errors in M&E template?	Ensure data validity and quality.
12.	Review and include and or clean for errors in spelling, numbers, and any other possible mistakes.	Data cleaning for errors or erroneous symbols that could have been transferred in reformatting the report.

Step Number	Process Step	Description
13.	Data sent to M&E HQ	M&E team receives the data from the M&E team in country in the desired format via either email, or other electronic data transmittance.
14.	Data Cleansed and ready for DevResults?	HQ M&E team reviews the country reported data. If errors are found, send back to country M&E team, Step 15.
15.	Send back to country for clarifications.	The data is sent back to the M&E team in country and reviewed once more with comments from the HQ M&E team to ensure data compliance.
16.	Notify country ready for input into DevResults	Report is formatted correctly, and data is not showing any questionable inputs/errors/evident misunderstanding of guidance. Notify country M&E team that the data is ready for entry into DevResults.
17.	Input into DevResults End.	Country M&E team enters data or saves as .csv file to load into DevResults. Some countries will have the data already formatted and saved as .csv file that can be copied directly into DevResults. End of main process.
18: [OPTIONAL]	Numerator classification for throughput analysis: Process B	This process identifies a deeper level of understanding of the stockouts that are occurring. When sites are consistently reporting stockouts but are also consistently reporting consumption, it may identify a different supply chain problem – a forecasting problem. If a site has reported a stockout but also has reported Average Monthly Consumption, we can identify sites that are contributing to throughput of inventory. In another example, some countries are including "Requested Quantity" in their monthly reporting, and this may provide an indicator that a site which has not requested any quantity of the product in the previous 12 months is no longer providing a service or is not actively restocking the commodity. Electronic LMIS solutions will allow deeper analysis that can help identify and correct other problems in the supply chain.
19.	Has the site reported consumption?	Has the site reported consumption of the product in the previous 12 months? In the case of consistent stockouts reported alongside consistent consumption, the site may be included in the official stockout reporting, but this may indicate that there is a different problem in the supply chain (i.e., supply of stock not meeting the demand).
20.	Was consumption = AMC?	Was the consumption reported in the period equal to the Average Monthly Consumption for the site (or within 75% of AMC, as this would account for forecast error)?
21.	Do not include in numerator	If step 19 and 20 is yes, do not include this in the numerator as demand was met and the contributed normally to inventory throughput.
22.	Include in numerator.	If the answer to 19 or 20 is no, then the site has not contributed to inventory throughput. The net result of this additional reporting could be reported as Sites Contributing to Throughput. For example, the official stockout rate might be 20%, but the throughput might show that only 10% of stocked-out sites are contributing to throughput.

Step Number	Process Step	Description
23.	Report Throughput Analysis as # of Sites Meeting AMC / # of Reporting Sites	This analysis will show the number of sites that are using their allotted inventory and contributing to the throughput of inventory – product being given to patients. While stockout indicator may suggest that 20% of sites were stockout on a given product, this analysis might show that only 10% of sites did not have enough product to report average monthly consumption.

Table 2 - Example Stockout Reporting Process Definitions

IMPLEMENTATION

Mapping the requirements and business processes described in Section 2 and 3, to the current system capabilities will be different for each country implementing an automated stockout reporting program. A detailed design will need to conform to the specific system capabilities, the technologies supported, and the data presentation capabilities. Business rules for qualifying the number of facilities reporting (the denominator) will require validating the proposed business rules with the M&E HQ team. The goal is to conform to a common set of business rules that can be implemented within the system for better, more accurate reporting.

DESIGN THE PROCESS AND REPORTS

The process and reports used to perform stockout reporting should be designed to support the B1 Performance Indicator Reference Sheet. The basic design should provide for the reporting of all sites that provide service, by each family planning product or method, and the number of those facilities that were stocked out of each family planning product or method. Mapping data from the automated LMIS system to the products/methods may be able to be accomplished in the system, using a reference field in the system's item master, or they can be mapped directly in the data extraction tool. Additional fields to be reported may be defaulted or determined in the report. The complete list of fields is included in the attachment in Annex A, B01 Stockout Rate at SDPs.

For designing the qualification of sites that provide service, the system must be able to examine stockout data together with consumption data. It is important that the system is able to differentiate between a site that has not reported on a product and those that have reported zero stock on hand and zero consumption. For example, in Nepal, the system was designed so that after users enter a value in the report, the flag is checked on the data row indicating that the site reported the data. When zeros are actually reported by the site, the user is able to flip the 'reported' flag so that the site is included in the reporting. Once the data on zero stock on hand is being reported correctly, next steps are to execute the business rules that then further clarify the number of sites providing the service. Here, the examination of multiple of periods of no activity of supply or demand (consumption) will require looking at past reporting results for at least 12 months of historical data to support the primary business rule of 12 months of no stock/no consumption.

The specific business rules defined should be evaluated with the HQ M&E team to provide guidance before being deployed in quarterly reporting. All business rules implemented, whether directly in the automated LMIS or in a BI reporting platform, should have audit traceability so that rows eliminated from the denominator can be traced to the specific business rule executed.

Most automated LMIS systems have good business intelligence and reporting capabilities that will support the design of this report. The cost to develop the report will have minimal to moderate cost and timeline to develop. Additional reporting, as suggested for deeper analysis of stockout reporting, can be implemented in the same reporting model, but with options at run-time for actual DevResults reporting or for more detailed analysis. As well, most systems will have dashboarding capabilities that may make accessible the stockout reporting rates directly in the application.

The finished output of the stockout reporting can be extracted into the exact format used in DevResults. Reporting this to an Excel .csv format will allow for the in-country M&E team to simply read this file into DevResults for quarterly reporting, once approved.

TESTING THE PROCESS AND REPORTS

The process and reports should be tested to validate that all information is being extracted and reported correctly. The quality of data in the system, too, should be assessed so that the reporting is accurate. For example, the 'reported' flag described earlier for Nepal, was designed to enable users of the system to more accurately reflect when a site is reporting zeros versus not reporting that product at all. How the flag was set by the system, or user, was an effort to improve data quality.

IMPLEMENTATION

Implementing the new reporting process can be done incrementally, with the standard report available first, while the business rules inside the report are still being developed and approved. Considering what rules will be implemented, and then how those rules can be tested and validated, can take longer. Each country that has implemented separate business rules for qualifying the denominator has implemented slight variations and needed to validate first that the business rules are working properly.

If the automated system has business intelligence framework to make the data more accessible, then there are also possibilities to implement dashboards that can show some of the additional analysis capable from the data. For example, adding the consumption data to differentiate between sites that are consistently reporting stockouts, but which are also consistently reporting consumption. As this analysis can point to different problems in the supply chain, such as having a forecasting problem versus a distribution problem, having this data accessible to users of the system can become a very powerful tool for improving overall supply chain efficiency.