LOGISTICS MANAGEMENT INFORMATION SYSTEM SOFTWARE USED IN THE ANTIRETROVIRAL THERAPY PROGRAM IN KARNATAKA STATE, INDIA: RECOMMENDATIONS FOR IMPROVEMENT

Hare Ram Bhattarai

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About SPS

The Strengthening Pharmaceutical Systems (SPS) Program strives to build capacity within developing countries to effectively manage all aspects of pharmaceutical systems and services. SPS focuses on improving governance in the pharmaceutical sector, strengthening pharmaceutical management systems and financing mechanisms, containing antimicrobial resistance, and enhancing access to and appropriate use of medicines.

Recommended Citation

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# CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acronyms</td>
<td>v</td>
</tr>
<tr>
<td>Executive Summary</td>
<td>vi</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Background</td>
<td>1</td>
</tr>
<tr>
<td>Objectives of the Assessment</td>
<td>1</td>
</tr>
<tr>
<td>Methodology</td>
<td>3</td>
</tr>
<tr>
<td>Pharmaceutical Management Framework</td>
<td>3</td>
</tr>
<tr>
<td>Inventory Control Model</td>
<td>6</td>
</tr>
<tr>
<td>Caveats and Limitations</td>
<td>7</td>
</tr>
<tr>
<td>Findings and Recommendations</td>
<td>9</td>
</tr>
<tr>
<td>Logistics Management Information System Software</td>
<td>9</td>
</tr>
<tr>
<td>Computerized Management Information System (NACO)</td>
<td>12</td>
</tr>
<tr>
<td>Computerized Management Information System (Samastha Project)</td>
<td>13</td>
</tr>
<tr>
<td>Areas Identified Needing Improvement, Options, and Recommendations</td>
<td>15</td>
</tr>
<tr>
<td>Monthly Stock Report Format</td>
<td>15</td>
</tr>
<tr>
<td>Inventory Control</td>
<td>16</td>
</tr>
<tr>
<td>Inventory Control Parameters</td>
<td>18</td>
</tr>
<tr>
<td>Removal of Unusable Medicines from Stock</td>
<td>18</td>
</tr>
<tr>
<td>Integration of Patient Data into the LMIS</td>
<td>18</td>
</tr>
<tr>
<td>Requirements for Good Dispensing Solutions</td>
<td>19</td>
</tr>
<tr>
<td>Integration of Link ART Centers into the LMIS</td>
<td>20</td>
</tr>
<tr>
<td>Data Validation</td>
<td>20</td>
</tr>
<tr>
<td>Next Steps</td>
<td>21</td>
</tr>
<tr>
<td>Annex A. List of ART Centers Visited and Persons Contacted</td>
<td>23</td>
</tr>
<tr>
<td>Annex B. Calculation of Parameters For the Inventory Control Model</td>
<td>25</td>
</tr>
</tbody>
</table>
**ACRONYMS**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>AIDS</td>
<td>acquired immune deficiency syndrome</td>
</tr>
<tr>
<td>ADR</td>
<td>adverse drug reaction</td>
</tr>
<tr>
<td>AMC</td>
<td>average monthly consumption</td>
</tr>
<tr>
<td>ART</td>
<td>antiretroviral therapy</td>
</tr>
<tr>
<td>ARV</td>
<td>antiretroviral medicine</td>
</tr>
<tr>
<td>CMIS</td>
<td>Computerized Management Information System</td>
</tr>
<tr>
<td>HIV</td>
<td>human immunodeficiency virus</td>
</tr>
<tr>
<td>ICTC</td>
<td>Integrated Counseling and Testing Center</td>
</tr>
<tr>
<td>KHPT</td>
<td>Karnataka Health Promotion Trust</td>
</tr>
<tr>
<td>KSAPS</td>
<td>Karnataka State AIDS Prevention Society</td>
</tr>
<tr>
<td>LMIS</td>
<td>Logistics Management Information System [software]</td>
</tr>
<tr>
<td>MaxSL</td>
<td>maximum stock level</td>
</tr>
<tr>
<td>MinSL</td>
<td>minimum stock level</td>
</tr>
<tr>
<td>MSH</td>
<td>Management Sciences for Health</td>
</tr>
<tr>
<td>NACO</td>
<td>National AIDS Control Organization</td>
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<tr>
<td>OI</td>
<td>opportunistic infection</td>
</tr>
<tr>
<td>PMIS</td>
<td>pharmaceutical management information system</td>
</tr>
<tr>
<td>SPS</td>
<td>Strengthening Pharmaceutical Systems Program</td>
</tr>
<tr>
<td>USAID</td>
<td>US Agency for International Development</td>
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EXECUTIVE SUMMARY

The Strengthening Pharmaceutical Systems (SPS) Program has worked in the State of Karnataka since December 2009. With field support funds from the US Agency for International Development (USAID) Mission in India, SPS is assisting the Karnataka State AIDS Prevention Society (KSAPS) and other local partners to address issues with the management of antiretroviral therapy (ART)-related medicines.

One area identified for improvement was the Logistics Management Information System (LMIS) software developed by the Karnataka Health Promotion Trust (KHPT) under the USAID-funded Samastha Project. The LMIS software provides vital data for informed decision making in the management of antiretrovirals (ARV) and other medicines. The LMIS software supports inventory management reporting by Karnataka’s ART centers to India’s National AIDS Control Organization (NACO) and KSAPS. SPS responded to a request to assist the KSAPS and KHPT to identify options for enhancing the functionality of the LMIS software.

An SPS consultant conducted an assessment visit to Karnataka during June 6-10, 2011. He observed the use of the LMIS software, met with KSAPS and KHPT to discuss enhancements needed, and visited ART centers to understand patient flow and the information currently being collected by their pharmacies.

Three computerized information systems for the management of ART-related medicines in Karnataka were assessed—

- Logistics Management Information System (LMIS) software
- Computerized Management Information System (CMIS) software developed by the Samastha Project
- CMIS software developed by NACO

The assessment focused primarily on the LMIS software. This software has a good structure and control mechanism, and provides good commodity status information for deciding on quantities to supply or “push” from the central level or to redistribute across ART centers. As it is generic software, not specifically designed to manage only ARV medicines, it can handle health supplies and other medicines, making it possible to use across different vertical health services in Karnataka (e.g., tuberculosis, malaria). However, since the LMIS software is not specifically designed for managing medicines, it needs to be modified to make it more appropriate to use in medicines management of ARVs specifically. It is an extensive system with several useful functions. However, it is not being used to its fullest potential. For example, the transfer module, indenting module, and disposal system are not being used.

Other limitations were noted. Medicine consumption data are manually tabulated and entered into the LMIS on a daily basis, a cumbersome, time-consuming, and error-prone process. Some reports generated by the LMIS, although useful, should be enhanced to add important information needed to support decision making. Patient-centered data is not currently analyzed for use in planning commodity forecasting and distribution. A set of

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1 The software is modular. Access to different modules is controlled with passwords depending on the nature of work and the authority of the user.
recommendations to improve the functionality of the LMIS software is provided in this report.
INTRODUCTION

Background

The Strengthening Pharmaceutical Systems (SPS) Program has worked in the State of Karnataka since December 2009. With field support funds received from the US Agency for International Development (USAID) Mission in India, SPS is assisting the Karnataka State AIDS Prevention Society (KSAPS) and other local partners to address issues in the management of antiretroviral therapy (ART)-related medicines. In the first year, SPS worked with KSAPS, the USAID-funded Samastha Project, and other local partners to strengthen pharmacists’ capacity to appropriately manage medicines (e.g., avoiding stock-outs and expiries), and to strengthen the appropriate use of antiretroviral (ARV) and other ART-related pharmaceuticals.

In 2011, in response to a request for technical assistance from KSAPS and the Karnataka Health Promotion Trust (KHPT), SPS expanded its assistance to identify options for enhancing the functionality of the Logistics Management Information System (LMIS) software. The software was developed by KHPT for inventory management reporting to India’s National AIDS Control Organization (NACO) and KSAPS by Karnataka’s ART centers. The LMIS software does not currently capture any patient information. Medicine consumption data is derived through manual compilation rather than from transactional dispensing to patients. KSAPS and KHPT would like to improve the availability of patient-centered information (programmatic data) at the State-level for use in decision making. They also asked SPS to explore whether the inventory management data currently collected is being fully utilized and to identify options to generate additional indicators and information.

Objectives of the Assessment

The primary objectives were to (1) Assess the LMIS software with respect to its adequacy, appropriateness, functionality, and the use of data that it generates; and (2) Identify options for improving the generation of patient-centered information (programmatic data) at the state-level for use in decision making.

Since there are two other computerized management information system (CMIS) software programs used by the ART centers, the assessment also included exploration of the possibility of adjusting the LMIS software to communicate with these systems.
METHODOLOGY

An SPS technical consultant provided assistance in the following ways—

- Met with KSAPS and KHPT staff to discuss the LMIS software and the enhancements needed.
- Visited three ART centers (both nodal and link) to understand patient flow, learn what information is currently collected by the pharmacies, and conduct semi-structured interviews with staff. (annex A)
- Met the staff of the Kavin Corporation which developed the LMIS and CMIS software (under the Samastha Project) to discuss areas that need improvement and explore the possibility of integrating the CMIS and LMIS software.
- Assessed the LMIS software in relation to the standard inventory control model, its conformity with standard LMIS functionality, and its capability to provide information to support relevant components of the pharmaceutical management framework.

The methodological approach to the assessment and information system design considerations follows.

Pharmaceutical Management Framework

![Pharmaceutical Management Framework](image)

Figure 1. Pharmaceutical Management Framework²

Medicines are the most important commodity in the delivery of health services as they save lives. Medicines can also cause harm if not used properly. The right quantity of the right medicine of the right quality delivered at the right time to the right user are key to success of any health service, and are usually a major determinant of the utilization of health services.

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² Adapted from the work of the Center for Pharmaceutical Management of MSH.
Medicines are special commodities as regards their management. Unlike other commodities, consumers cannot choose them, assess their quality, and know the consequences of not using them properly. Medicines are also costly and require special handling to ensure their cost effectiveness and quality.

Special tools and techniques are therefore necessary for the proper management of medicines. Special knowledge and skills are required to select, procure, and distribute medicines. Consumers need to be informed of the right way to use them and the consequences of not adhering to instructions.

A well-functioning logistics management information system, a subsystem of the pharmaceutical management information system (PMIS), is critical to the effective management of medicines. The design of the logistics management information system should consider all elements of the pharmaceutical management framework shown in figure 1 above.

**Selection** involves: reviewing health problems; identifying interventions and treatments; selecting individual medicines, dosages, and forms; and deciding which medicines and commodities will be available at each level of service delivery. The Ministry of Health is responsible for selecting the medicines and commodities that are used at all levels of the health system.

The design of the logistics management information system needs to include all the recommended medicines in the database. It should be flexible to be able to frequently accommodate changes to the list of medicines.

**Procurement** includes: quantifying requirements; selecting the procurement method; managing tenders; establishing and monitoring contract terms; and assuring the quality of medicines and commodities. The availability and cost of medicines are governed by the effectiveness of the procurement system. Strong procurement processes ensure that medicines selected for purchase are reasonably priced, of high quality, and are of the proper quantity. Procurement strategies vary widely, but most processes include the following critical activities: needs quantification, bid management, supplier selection, and quality assurance. Good procurement practices help countries ensure that the selected medicines are available for distribution to health facilities.

The logistics management information system must be able to generate information to project medicines requirements. For example, medicine consumption data at different health centers are essential to forecast quantities needed. Other information that the logistics management information system may contain is the list of the suppliers and data on their performance.

**Distribution** includes: inventory management, specifically stock control; storage management; and delivery to health facilities. Effective distribution involves clearing pharmaceutical products through customs (in the case of imported products), transporting them safely, delivering them in a timely manner, keeping records, maintaining adequate stock levels, and managing available stock. Store managers monitor expiration dates, inventory levels, and storage conditions, such as light, temperature, and sanitation. When distribution

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3 A PMIS consists of the logistics management information system plus information about adherence, patient statistics, and quality of care.
Methodology

systems function well and are supported by good procurement practices, patients are more likely to receive the medicines they need on time and in good condition.

The logistics management information system needs to be able to accurately record the movement of medicines across the supply chain. For example, all transactions that increase or decrease stock levels should be recorded. The system should also record expiry dates to ensure that only quality products are distributed. Other important information that should be tracked is batch number and brand name so that a medicine may be traced if there is a problem with a specific medicine. Finally, the system needs to be able to record the names and addresses of service delivery points (i.e., health facilities and/or medical stores).

Use includes rational prescribing and proper dispensing of medicines. To ensure the most effective, appropriate use of medicines, patients must receive the correct dosage that best treats their illness. In addition, patients should receive a supply of medicine sufficient to treat their illness, at a low cost to themselves and/or to the health system.

Although use of medicines is beyond the scope of a logistics management information system, it is recommended that the system be able to at least communicate with systems used for dispensing medicines. One vital piece of information is morbidity data, which can be obtained from the dispensing system. Morbidity and consumption data may be analyzed to learn about the functioning of the medicines management system and rational use of medicines.

Management support includes financing, information management, and human resource management, specifically training, monitoring, and evaluation. Management support is at the center of the Pharmaceutical Management Framework and enables each component of pharmaceutical management to function.

The logistics management information system should be able to generate information that can be effectively used for estimating needs, procurement, and distribution. Reports on consumption, stock-outs, stock on hand, expired and shortly expiring stock are very important for making decisions related to management of pharmaceuticals.

Policy, law and regulation form the context in which the pharmaceutical management functions. The context is defined by the government or any authorized agency through policy, laws, regulations, and governance. Medicines policy includes: allocating budgets; prioritizing research and development; promoting education initiatives; and defining the role of the public and private sectors in pharmaceutical development. By establishing pharmaceutical laws and regulations, countries can set quality standards and pricing guidelines for pharmaceuticals, require licensing of pharmaceutical products, and establish production guidelines. The complexity of managing pharmaceuticals, the large number of interested stakeholders, and the value of the products make pharmaceutical systems vulnerable to corruption.

The logistics management information system should comply with the prevailing laws. For example, it should allow for audit trails to enable auditors to trace transactions. Similarly, the system should be capable of generating ad-hoc reports should there be any requests from authorities. The system is important for assuring transparency and providing information for oversight to enforce good governance practices.
Inventory Control Model

Inventory management is the process of efficiently overseeing the constant flow of medicines into and out of a storage facility. The process involves controlling the transfer in and out of medicines to prevent inventory from becoming too high or too low. If the inventory level is too high, a substantial portion of the medicines budget may be tied up, leaving insufficient funds for other important, perhaps lifesaving, medicines or increasing the risk of expiries. If inventory is too low, services may suffer because of stock-outs or shortages of medicines. Effective inventory management is about knowing what medicine is on hand, where it is in use, how much should be ordered and when to ensure an uninterrupted supply to health facilities.

Effective inventory management takes lead time into consideration, meaning how much time on average a supplier takes to deliver after an order is placed. Another factor to consider is how much medicine should be kept in stock to cover consumption if there is an increase in demand for unforeseen reasons. This is called buffer or safety stock. Finally, inventory management involves keeping accurate records of medicines and producing reports to help management make informed decisions.

An inventory control model is presented in figure 2. The parameters used in the model are described in the box to the right of the figure. A formula for calculating the maximum and minimum stock levels is provided in annex B.

![Figure 2. An Ideal Inventory Control System](image)

**Procurement period:** The time between two routine orders.

**Lead time:** The time from when an order is placed and when the medicines are received and ready for distribution.

**Maximum stock:** The number of months of usable stock above which stock levels should not rise in a given facility according to the inventory control system in use.

**Minimum stock:** Stock level at which it is necessary to place a new order.

**Buffer or Safety Stock:** Stock kept in case of an unforeseen increase in demand or delay in delivery.

**Average monthly consumption:** Average quantities of medicines consumed per month.

In an ideal inventory control system, medicines are issued upon demand, and the stock on hand is always kept between the maximum and minimum levels to lessen the risk of expiration and stock-outs. When the stock on hand falls to the minimum stock level, a new order is placed. The model assumes that suppliers deliver the medicines in the agreed-upon time period and in the quantities specified in the contract. A buffer or safety stock is maintained to cover any unexpected increase in demand or delays in delivery. In this model,

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4 Adapted from *Managing Drug Supply* published by MSH.
medicine consumption data is used to estimate the average monthly consumption, and this in turn is used to project future needs.

The logistics management information system should be able to record values for all components of the model: maximum stock, minimum stock, lead time, and buffer stock for each medicine. Please note that the value of these parameters may be different for different medicines. For example, medicine A may have a lead time of 15 days while medicine B may take 12 months to receive after placing an order. The date an order is placed and the date the order is actually received should also be recorded. The system should likewise make provision for the receipt of partial orders. For example, if a health facility orders 20 medicines and this quantity is not available at the time, the store may ship only 19 medicines now and the remaining one later. The system should therefore be able to record if a health facility receives partial shipments.

Caveats and Limitations

The findings in this report are based on a rapid assessment of quite extensive software within a very short period of time, less than one week. The time available to observe the use of the system in an actual setting was also very limited. Only three sites could be visited making the findings less than representative. Moreover, because each visit was brief, access to certain information may have been limited, whether observed or collected in written or interview form. While the consultant made every effort to understand the LMIS software and other CMIS software that are being used, there may be errors due to the time limitations. Findings in this report should be verified as to their accuracy and representativeness, and the recommendations assessed accordingly before they are implemented.
FINDINGS AND RECOMMENDATIONS

The flow of commodities and information is depicted in figure 3 below, and shows that both commodity and patient data are available and are reported.

![Flow of Commodities and Information](image)

**Figure 3. Flow of Commodities and Information**

ARVs are pushed to ART centers from higher-level stores while medicines for prevention and treatment of opportunistic infections (OIs) are procured locally with a pre-allocated budget. The consultant was informed that stock-outs of ARVs were not reported in the project area in the last year. Moreover, no major loss of ARVs due to expiration was reported during the last year.

In addition to the LMIS software, two other information management software is used in the Karnataka ART service delivery system. Findings from the review of all three software systems are presented below.

**Logistics Management Information System Software**

This is a commodity management system developed using web-based technology. Data are stored in cyberspace. Access to the system is controlled by passwords and depends on the authority of the user and the type of user (e.g., health center, district controller, central authority).
Figure 4 below depicts the scope and structure of the LMIS software. As the schematic shows, the system is not electronically connected to dispensing. Consumption data from manually maintained dispensing registers are totaled at the end of the day and manually uploaded to the LMIS. The uploading process was unreasonably slow and keying in data opens the possibility for errors.

**Description**

- The LMIS software is used to manage the movement of ARVs and OI medicines across the supply chain. It has a good design in that the central database is accessible to users through the internet. The system provides good commodity status information such that decisions can be made on what quantities of medicines should be sent to facilities, and also facilitates transfer of stock across ART centers in cases where one center has extra medicines that another center can use.

- The system generates periodic commodity reports. The monthly commodity report contains consumption data. This report needs modification. A modified format is provided in the recommendations section of this report.
Findings and Recommendations

- The system has the capability to export data to Microsoft Excel®. This functionality helps users analyze data and produce various reports.

**Strengths**

- The LMIS software is a web-based system developed with modern technology .NET framework. This makes the software easy to maintain and highly scalable.

- The LMIS software would be easy to integrate with the CMIS software developed by the Samastha Project because they have the same development platform and developers. The LMIS software can handle health commodities and medicines other than ARVs. It may therefore be used to manage essential medicines. This increases the software’s sustainability.

- Good technical support is available locally.

**Challenges/Limitations**

- The LMIS software’s functionality is quite extensive. Using the full potential of the system is challenging primarily because of the difficulty of changing the mindset of users who have worked with manual systems for so long. For example, the transfer module, indenting module and disposal system are not used.

- The control system appears too restrictive. For example, the local purchase of OI medicines requires authorization by the supervisor with his/her password. It was reported that this requirement causes problems as supervisors are sometimes not available or do not authorize the procurement in a timely manner. Similarly, the requirement for authorization to transfer stock from one facility to another has rendered the system’s transfer module practically useless. It is currently disabled. Another problem is that unusable stock (damaged and expired) cannot be separated from the useable stock without authorization, which may lead to a situation where expired medicine is dispensed to patients.

- The software does not have a component to support the physical verification of stock.

- The estimation of medicine requirements is done as for essential medicines. The quantity of essential medicines is estimated based on the average monthly consumption. On the other hand, ARVs are special types of medicines which are used over the lifetime of a patient. More complex methods are used to estimate the requirements for such medicines. Special considerations are not being made in estimating needs for ARVs as is required.

- The software does not allow for recording locally procured medicine.

- The quantity of medicines dispensed is manually entered into the system and uploaded into the central database. The data entry operators reported that they were facing difficulties because of inadequate data verification checks in the system.

- The software needs to be modified to make it more appropriate to use for medicines management. For example, the software should be able to track medicines nearing their
expiration date and alert users through reports or computer notifications. Similarly, there is no standard grouping of medicines which makes it difficult to analyze consumption. For example, without a standard grouping scheme one does not know which types of medicines are the most frequently used.

- Use of the LMIS software is limited to nodal ART centers\(^5\). At the sub-center level (called link ART centers), a manual system is used. Patient medical records are currently kept at the nodal ART centers. When a patient reports to a link ART center and collects medicine, his/her medical records are not updated. They are only updated when the patient visits the nodal center.

**Sustainability**

- A decision has yet to be reached about ownership and maintenance of the LMIS software after support for the Samastha Project is withdrawn.

**Computerized Management Information System (NACO)**

This is a patient record maintenance system developed by the NACO. Large amounts of clinical data are collected by this system. It has minimal pharmaceutical management functionality, which has not been used. A brief review of the CMIS software follows.

**Description**

- The system is used as a back office application where data is not entered in real time. For example, all the manually maintained records (cards) of patients coming to the clinic for service are collected and the information is updated at end of the day or later in the week.

- It has a basic capability to record the use of medicines on a daily basis.

- It captures clinical patient information.

- It can generate periodic reports, e.g., patient counts by regimen and medicine consumption data. However, the latter capacity is not being used.

- It has the capability to export to Microsoft Excel\(^\circledR\) which will facilitate the analysis of data and preparation of graphs, etc. However, there was no evidence of data being analyzed and used for decision making.

**Strengths**

- The system was developed by the highest AIDS authority in the country which can enforce standards and rules to make using the system mandatory.

- The system is in use at all ART centers across the country.

\(^5\) An ART center which has a sub-center (link ART center) where basic checkups are done and ARVs are distributed to patients who are stabilized and do not need frequent checkups.
Findings and Recommendations

Challenges/Limitations

- Maintenance support is reportedly not dependable. For example, at one of the centers visited the system had been down for more than a month despite repeated requests for help.

- It is a stand-alone desktop system developed using a different platform than the LMIS software. It would therefore be difficult to integrate it with the LMIS software.

- It would be difficult to change the functionality of the software as its development is centralized. Obtaining NACO’s approval involves a long administrative process.

- It has weak pharmaceutical functionality. It does not have the capability to record the history of medicine dispensed to an individual patient. It can only record daily medicine consumption.

Sustainability

- NACO is said to be in the final stage of implementing a new system based on smartcard technology. It is not clear how transition to use of the new system will occur. However, it is certain that NACO’s CMIS will eventually be replaced by the new system. Therefore, enhancement of this CMIS is not warranted.

Computerized Management Information System (Samastha Project)

This is an information system developed by the Samastha Project to record data for monitoring its various project activities. Since ART service is one of its service areas, the system records and analyzes various patient-centered data. The software has some pharmaceutical management functionality. The following is a brief review of the software.

Description

- This system is used at ART centers supported by the Samastha Project.
- The software has the capacity to record the use of ARV medicines but the user interface needs improvement. The system is designed for batch processing rather than real time processing.
- It captures basic patient information.
- It has the capability to generate periodic reports, for example, patient counts.
- It has the capability to export to Microsoft Excel®, facilitating the analysis of data.

Strengths

- It was developed with modern technology .NET framework and is web-based. This makes it easy to scale up and reliable as it is not dependent on any particular piece of equipment at the local level.
- This system and the LMIS software were developed by the same developer and use the same platform. It would therefore be easy to integrate it with the LMIS software.
Since it was developed by a local private organization, good maintenance support can be expected.

**Challenges /Limitations**

- It was developed with support of a specific project. It may therefore be difficult to get buy-in from NACO to implement it in sites other than those supported by KHPT.

**Sustainability**

- The fate of this software once the Samastha Project ends in September 2011 is not clear. No decision has been reached or no policy has been established as to who will own and maintain the software, and how and whether the software’s use will continue.
AREAS IDENTIFIED NEEDING IMPROVEMENT, OPTIONS, AND RECOMMENDATIONS

Three software-based information systems for medicines management were assessed. Brief findings from the review of each system are presented above. Because the sustainability of the two CMIS software programs is not clear, recommendations are only offered to improve the current functionality of the LMIS software.

Monthly Stock Report Format

Discussions with Samastha Project staff and users of the LMIS software identified the need to improve the stock report format. The following format is recommended for this monthly report.

<table>
<thead>
<tr>
<th>Health Facility Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Stock Report</td>
</tr>
<tr>
<td>Month: Year:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SN (a)</th>
<th>Medicine Code/Name, Strength (b)</th>
<th>Unit (c)</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stock IN (1=d+e)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stock OUT (2=f+g)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Losses (3=h+i)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Stock on hand (j)=1-(2+3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Short dated stock (k)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Remarks (l)</td>
</tr>
</tbody>
</table>

|          | Opening balance (d) | Received (e) | Dispensed (f) | Issued (g) | Expired (h) | Damage, theft etc. (i) |

**Description:**

a. SN: Serial Number
b. Medicine Code/Name: Code of the medicine or its name or both
c. Unit: Unit of transaction of the medicine. For example, “Tablet” or “Pack of 100 Tablets”

d. Opening Balance: This is the quantity of medicine (in transactional unit) that was in stock at the beginning of the month.
e. Received during the month: This is the quantity of medicine (in transactional unit) that was received by the health facility store during the month. Please note that this is the total quantity received from different sources.

Stock OUT: This is the quantity of medicine (in transactional unit) that was issued from the store or dispensed to patients.

f. Dispensed: This is the total quantity of medicine (in transactional unit) that was dispensed by the health facility to patients.
g. Issued: This is the total quantity of medicine (in transactional unit) that was issued by the health facility store to other facilities or returned to the supplier.

Losses: This is the quantity of medicine (in transactional unit) that was rendered unusable for some reason, e.g., damage, theft or expiry.

h. Damage, Theft etc.: This is the total quantity of medicine (in transactional unit) that was rendered unusable for reasons of damage and/or theft.

i. Expired: This is the total quantity of medicine (in transactional unit) that was rendered unusable due expiry.

j. Stock on hand: This is the quantity of usable medicine (in transactional unit) at the end of the month.

k. Short dated stock: This is the quantity of usable medicine (in transactional unit) that will expire within six months from the reporting month.

l. Remarks: This space can be used for notes to clarify the information entered, as necessary.

Inventory Control

a. Include functionality in the LMIS software to alert the user when stock reaches a minimum or maximum level.

b. Reconsider the authorization requirement for local procurement of OI medicines as it currently causes considerable delays. Make this approval optional thereby allowing procurement to proceed without delay.

c. The LMIS does not currently allow for entry of locally procured commodities. It is recommended that the system be changed to allow the entry so that reports reflect the total amount of medicine in stock, irrespective of the source of supply.

d. The software should also be capable of producing reports desegregated by type of source of supply so that management is aware of the sources of medicines. A report that groups the quantity of medicines received from different sources (locally procured, transferred in from other facilities, received from the medical store, etc.) should be produced. This information may be very helpful in making decisions. For example, if there are a lot of transfers from other facilities, inquiry into the functioning of the distribution system needs to be made.

e. Activate the transfer module. There should no longer be a requirement for online approval of transfers as this is causing delays. A note on the e-mail or letter of authorization to transfer medicines should be sufficient to start the transfer process. Once the transfer process is initiated, block the committed quantities and set them aside. Do not show them as available stock. Close the transfer process once the receiving party acknowledges the receipt of the transferred medicines.

f. In the case of ARVs, consider using the maximum consumption quantity during the last three months rather than average consumption over a three month period when calculating “month stock available”. This is because the majority of ART patients are
expected to visit the facility every month. The later months will have a surge in consumption as new patients come into the system.

g. Because ARVs are provided for a lifetime once a patient starts taking them, when estimating ARV medicines requirements, consider the quantity required for existing patients and also new intakes.

h. The commodity grouping scheme currently used in the LMIS software needs reassessing. Organize a meeting among stakeholders to discuss and decide the commodity grouping scheme. Make this grouping scheme a centrally controlled function to ensure that different service centers do not have different grouping schemes.

i. Add a module to the LMIS for physical verification of stock. The system should force a physical verification at least once per month. The recommended physical verification format is shown below.

<table>
<thead>
<tr>
<th>Health Facility Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly Physical Stock Verification Report</td>
</tr>
<tr>
<td>Month: Year:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SN (a)</th>
<th>Medicine Code/Name, Strength (b)</th>
<th>Unit (c)</th>
<th>Batch No (d)</th>
<th>Expiry Date (e)</th>
<th>Stock on hand (f)</th>
<th>Physical Stock (g)</th>
<th>Difference (h=g-f)</th>
<th>Damaged (i)</th>
<th>Expired (j)</th>
<th>Remarks (k)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Printed by: Date: Checked and Approved by:

**Description:**

a. SN: Serial Number
b. Medicine Code/Name: Code of the medicine or its name or both.
c. Unit: Unit of transaction of the medicine. For example, “Tablet” or “Pack of 100 Tablets”.
d. Batch No\(^6\): Batch number of the medicine. This is also called “lot number”.
e. Expiry date: The date marked on the packaging after which time the medicine is not usable.
f. Stock on hand: Current quantity of the medicine shown in the record (book or computer).
g. Physical Stock: The quantity of medicine actually available in stock. It may differ from the quantity in (f). Please note that only the useable stock is counted here. Damaged and expired quantities are not included in the physical stock figure.
h. Difference: The difference between the quantity actually in stock and the amount that is in the record. The difference could be either positive or negative depending on whether the counted quantity is more or less than the quantity on record.
i. Damaged: The quantity of medicine that is damaged and not usable. Such medicines should be kept separately from useable stock to prevent distributing them by mistake.

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\(^6\) Please note that the same medicine may need to be entered more than once if the batch numbers are different.
j. Expired: The quantity of medicine that is expired and thus not useable. Such medicines should be kept separately from useable stock to prevent distributing them by mistake.

k. Remarks: This space is used to write any comments/remarks that help to better understand the situation. For example, if there is a significant difference between the quantity on record and the physical count quantity, this space may be used to record the reason for the deviation.

**Inventory Control Parameters**

The assessment of the LMIS software revealed that recording of inventory control parameters was limited. It is recommended that the following fields be added in the master file definition of each medicinal product:

- a. Maximum stock
- b. Minimum stock
- c. Lead time
- d. Form (e.g., tablet, capsule)

It is also recommended that the following fields be added in the transaction file to facilitate tracking a medicine by its lot number and brand name:

- a. Batch Number/Lot number
- b. Brand name
- c. Package size (Number of units in a package, e.g., 100 tablets per bottle)

**Removal of Unusable Medicines from Stock**

Unusable medicines are not currently removed from active stock unless the approval for disposal is received. Medicines that cannot be dispensed to patients (e.g., those medicines that have been tampered with, expired, or have reduced potency for various reasons) should be immediately deducted from the usable stock, and separated physically to avoid accidental dispensing. It is not necessary to wait for approval for disposal to separate unusable medicines from usable medicines. Such medicines should be separated from the stock and locked up to avoid distributing them accidently. They should then be destroyed when the approval for disposal is received.

**Integration of Patient Data into the LMIS Software**

ART services are very specialized; patients are provided personalized care. Since ART is a life-long treatment, constant monitoring of the treatment is required. Some of the information vital to providing quality service includes: how many new patients on average are joining the program (to ensure that there is enough medicine to serve them); how many patients and who are collecting medicines as prescribed (to ensure adequate adherence to prevent the development of resistance); and changing medicines from the standard first line treatment to second line treatment. If such data were readily available in the LMIS, the estimation of needs for types and quantities of medicines would be more accurate. Such data would also...
to facilitate the analysis of the consumption of medicines in relation to the number of patients getting treatment, thereby helping to monitor ART adherence by patients.

**Option 1**

Compile, enter, and upload patient statistics (number of new patients, existing patients collecting medicines, patients changing medicines, died, transferred out, transferred in, changing to second line regimen, etc.) every day along with the daily consumption of medicines from the manual register kept at the pharmacy. This option is very demanding on the data entry staff’s time. Daily compiling and uploading of consumption data will not be very useful as it is not analyzed and used on a daily basis. Monthly updating should be sufficient.

**Option 2**

Compile, enter, and upload patient statistics (as described in Option 1 above) every month along with the monthly consumption of medicines. This option would considerably reduce the workload of data entry staff. The analysis of stock and patient information once per month should be adequate for basic decision making.

**Option 3**

Import patient data electronically (monthly or daily) from the NACO CMIS, manually compile medicine consumption data from the dispensing register used at the pharmacy, and enter the pharmacy data into the LMIS. This option would be difficult to operationalize as NACO CMIS and LMIS use different platforms and it would be hard to coordinate with NACO developers. For example, it would be disastrous if NACO makes changes without informing the LMIS developers.

**Option 4**

Modify the CMIS (Samastha Project) software to enhance the pharmacy module and integrate it with the LMIS software. Import basic patient data electronically from the NACO CMIS and capture medicine consumption data at the time of dispensing in real time. This option is the ideal one. The challenge is to provide computers and adequate staffing levels of pharmacists to use the system.

**Requirements for Good Dispensing Solutions**

Good dispensing requires information on the patient, medication history, and information about the medicine itself. By adopting Option 4 suggested in the section above, a good information-based dispensing system can be developed. With this approach, the dispenser will have instant access to basic information about the patient with alerts on adverse drug reactions (ADR), allergies, etc., medication history, and quantity of medicine in stock. Such arrangements would facilitate quality dispensing services.

In cases where Option 4 cannot be adopted, a manual card system can be used to record the patient information and medication history. The card can then be referred to by the dispenser at the time of dispensing.
Integration of Link ART Centers into the LMIS

a. Devise a mechanism to enable the link ART centers to electronically report patient statistics and medicine consumption. E-mail templates can be designed for standard reporting in places where web access is not possible.

b. Patient medical records are currently kept at only nodal centers and can be updated only when a patient visits a nodal center. When a patient reports to a link ART center and collects medicine, his/her medical records are not updated. To ensure that patient records are updated irrespective of whether a patient visits a link ART center or a nodal ART center, one option is to keep the records at the link ART center and make the patient bring his/her medical records along when visiting a nodal center.

Data Validation

There are no formal data validation procedures in place. This could lead to unreliable information which in turn makes for poor decision making. The following recommendations are offered:

a. Most of the data can be validated by incorporating validation rules in the LMIS software itself, such as including data validation functions in data entry modules, inasmuch as possible.

b. Train data managers to check data validity based on cues, like inconsistency or unusual data.

c. Some of the issues to look at to validate data include: missing data, duplicate data, data collection tools not used routinely, random figures added, unlikely values for a variable, contradictions between variables, calculation errors, typing errors, recording data in the wrong place, and transmission errors.
NEXT STEPS

As agreed in meetings with KSAPS, KHPT, and other partners, the next steps are:

1. Discuss this technical report:
   Samastha Project and Kavin Corporation staff will study the technical report and communicate with SPS if any clarification is needed.

2. Incorporate recommendations:
   Kavin Corporation will modify the LMIS software as per recommendations contained in this technical report. KHPT will direct the modification process. SPS will provide remote support to the extent that available resources allow.

3. Test the changed functionality and modules:
   KHPT will ensure that all the changes made in the LMIS software are producing expected results and that they are accurate.

4. Operationalize the system:
   Train the data managers in all the ART centers where the LMIS software will be used. Instruct the data managers at all levels to update the stock balance based on the physical count and put the system into operation.

5. Review after three months of operation:
   KHPT/KSAPS will review the functioning of the system after three months, document the findings, and do the needful to address any issues.
Logistics Management Information System Software Used In the Antiretroviral Therapy Program in Karnataka State, India: Recommendations for Improvement
ANNEX A. LIST OF ART CENTERS VISITED AND PERSONS CONTACTED

KSAPS
- R.R. Jannu, Project Director
- Dr. Suresh G. Shastri, Consultant (Care, Support and Treatment)

KHPT
- Dr. Reynold Washington, Chief of Party, Samastha Project
- Dr. P. Manish Kumar, Deputy Chief of Party, Samastha Project

ART Center, Victoria Hospital, Bangalore
- Ms. Shanti, Data Manager, Victoria Hospital ART Center

ART Center, St John Medical College, Bangalore
- Mr. Santosh, Data Manager, St. John’s Medical College ART Center

Link ART Center, Malur
- Ms. Pooja, Counselor, Link ART Center, Malur

Kavin Corporation, Bangalore
- J. Suresh, Executive Officer
ANNEX B. CALCULATION OF PARAMETERS FOR THE INVENTORY CONTROL MODEL

1. Calculate the **Average Lead Time** in months by looking at past records of orders and deliveries on the stock cards or copies of the requisition and issue voucher, and take the average. If there are very large variations in lead times in your system, it is safer to use the longest lead time rather than the average.

2. Determine the **Buffer Stock/Safety Stock**\(^7\) which is expressed in months and should be equal to at least half the time between regular orders (called the procurement period) or regular deliveries. If there are usually great fluctuations in demand during the year or if deliveries are unreliable, then the safety stock should be set higher.

3. **Average Monthly Consumption (AMC)**\(^8\) is the consumption of a medicine over a period of three months.

4. The **Minimum Stock Level** (MinSL) is equal to the safety stock (in months of supply) plus average lead time (in months).

5. **Maximum stock level** (MaxSL) is equal to the minimum stock level (in months) plus the procurement period (in months).

6. **Maximum stock** = MaxSL * AMC

7. **Minimum stock** = MinSL * AMC

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\(^7\) In the case of ARVs, a higher level of buffer stock may be necessary to be able to serve new patients entering the service. Starting new ART programs where consumption data is not available may require projection using complex formulas. Please refer to appropriate literature if required.

\(^8\) The calculation of AMC presented here is a simple average of consumption over a given period. In the example, a three month period is used. It can be calculated using a different time period, for example six months, if more accuracy is required. The calculation assumes that there is no stock-out of medicines during the period. If a more accurate calculation is required, please refer to the *Managing Drug Supply* handbook published by Management Sciences for Health. In the case of ARVs, the maximum consumption over a period would be more appropriate as compared to the AMC.