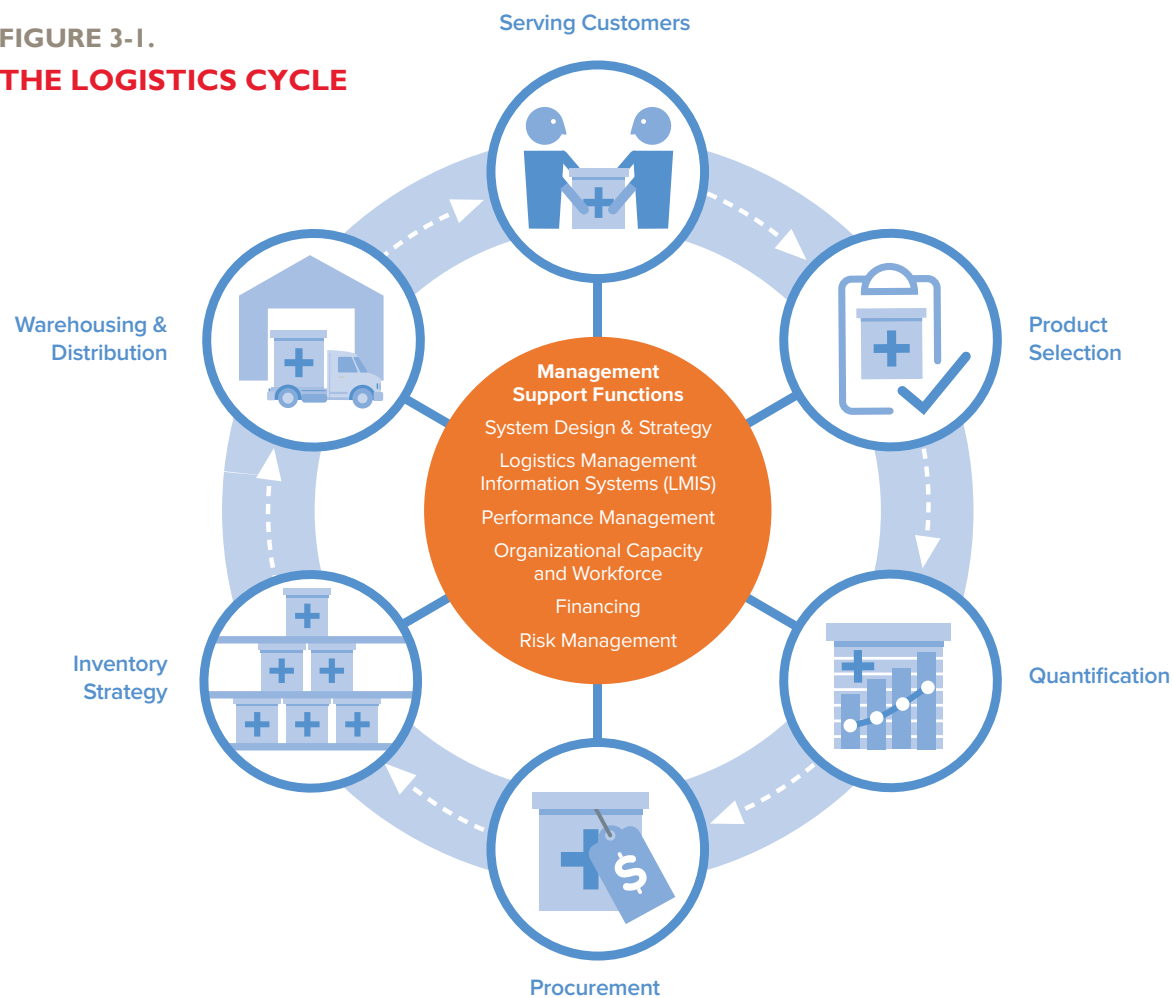




## CHAPTER 3

# LOGISTICS MANAGEMENT INFORMATION SYSTEMS

FIGURE 3-1.  
THE LOGISTICS CYCLE



## WHAT A SUPPLY CHAIN MANAGER NEEDS TO KNOW:

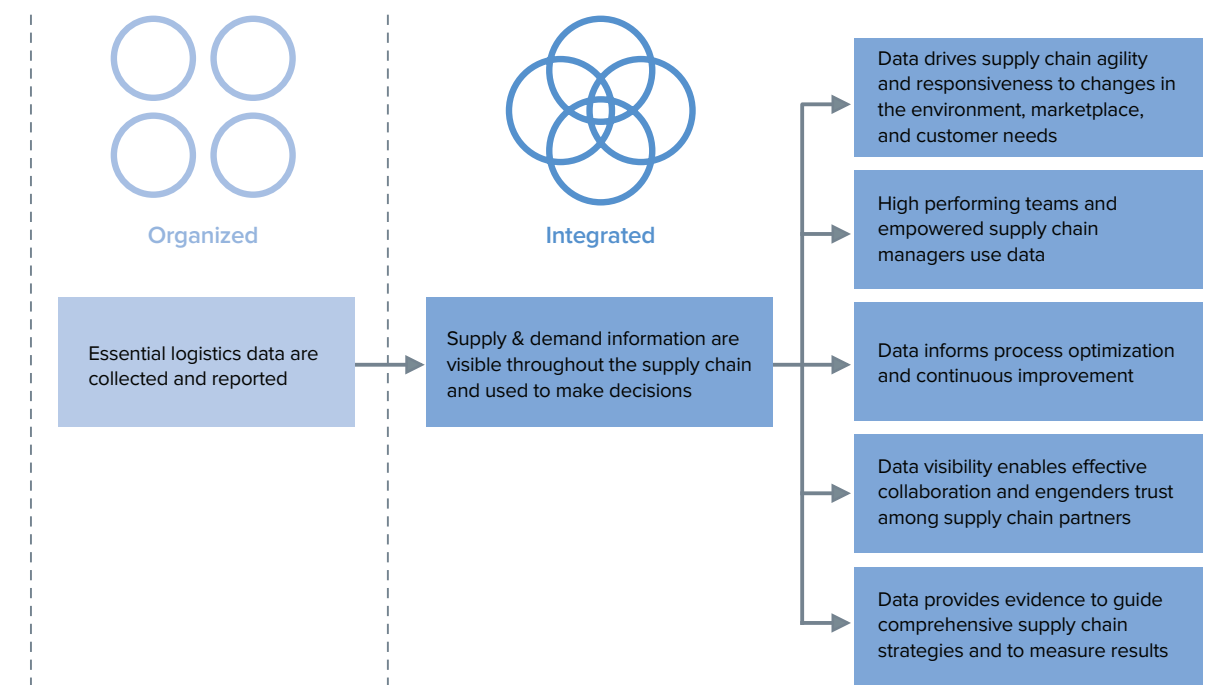
The supply chain manager needs to know the following, which are covered in this chapter:

- The essential data needed to manage a supply chain
- The use of LMIS data
- The tools and processes that enable end-to-end visibility of data
- Considerations for applying technology to improve LMIS

Subsequent chapters will provide further details about how data are used for routine operations, strategic decisions, and monitoring the performance of the supply chain.

Effective supply chains depend on end-to-end visibility of the right data of the right quality at the right time, in the hands of the right people in the right place, to make the right decision and take the right action. A hallmark of supply chain maturity is end-to-end visibility of supply and demand data that are used to make decisions and take effective action. Most supply chains begin with a basic set of forms and reports, often manual forms, and then evolve into digital tools to capture, report, analyze, and present supply chain data.

FIGURE 3-2.  
THE ROLE OF DATA IN SUPPLY CHANGE EVOLUTION



## 3.1 WHAT IS A LOGISTICS MANAGEMENT INFORMATION SYSTEM?

A LMIS is the system of physical- and technology-based records and reports that supply chain workers and managers use to collect, organize, present *and* use logistics data gathered across all levels of the system. An effective LMIS depends on the right combination of *people*, *processes*, and *technology*. Skilled *people* must record, analyze, manage, and use supply chain data at every level. The LMIS must enable efficient business processes and workflows (see annex 3.8 at the end of this chapter for an example)—forecasting, inventory management, distribution planning, reporting and ordering, order fulfillment, temperature monitoring, equipment maintenance, performance monitoring, etc.—and incorporate routine data management processes. And the LMIS must leverage appropriate *technology* that is feasible to deploy and sustain, and is embraced by users at each level (see Annex 3-1 for an example).

**FIGURE 3-3.**  
**SAMPLE LMIS INFORMATION AND SUPPLY FLOW DIAGRAM**

**ROLES**

**MOH Central**

- Forecast needs
- Allocate central funds
- Supervise

**Central & Zonal Medical Stores**

- Procure
- Store
- Receive & enter orders
- Distribute

**Hospitals**

- Serve clients
- Prepare hospital orders & funding

**Districts**

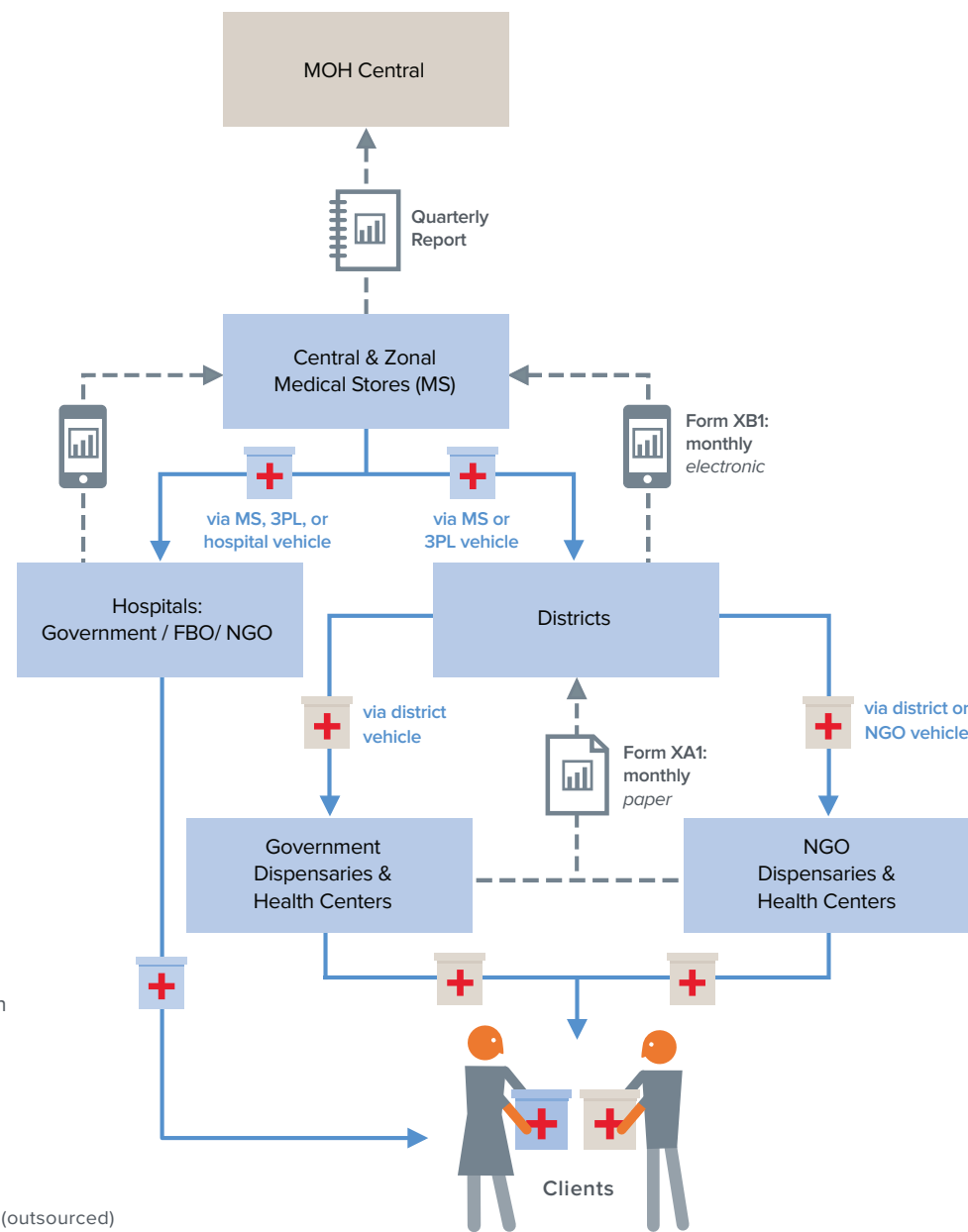
- Review & approve dispensary and health center orders
- Aggregate data from individual orders in Form XA2
- Allocate local funds
- Deliver to facilities
- Store supplies in transit

**Dispensaries & Health Centers**

- Review & approve dispensary and health center orders
- Serve clients
- Record consumption information
- Prepare orders
- Collect local funds



3PL: Third Party Logistics provider (outsourced)



A logistics management information system collects, organizes, and reports data that enables people to make operational and strategic decisions and take informed action.

Technology is changing how health supply chains are managed. Paper-based LMISs are being replaced by digital applications used on cell phones, tablets, and computers, often linked to central databases and online dashboards that provide supply chain managers easy access to data.

In most systems, the transition from paper to digital technology starts with a limited number of uses, such as SMS reporting of stock balances from community health workers, and expands over time to capture more data from different levels of the supply chain to handle a variety of business processes. These digital tools include:

- Dispensing or point-of-service (POS) systems that track consumption at the health facility
- Electronic LMIS (eLMIS) solutions for reporting data, requisitioning or allocating products, visualizing data, and alerting users to performance issues
- Warehouse management systems (WMS) for inventory control
- Fleeting management systems for transport and load planning
- Distribution planning systems for load and route planning
- Enterprise resource planning (ERP) systems that manage many of these core functions, but also include finances, human resources, procurement, sales, and other business functions

Barcode technology and remote temperature monitoring devices are also increasingly used in combination with these systems. GS1 is the emerging barcode standard for pharmaceuticals.

Some countries use a mixture of technologies that are linked to each other. An eLMIS links to a distributor’s ERP to automatically transform a customer’s requisition into a sales order for the distributor’s finance unit and a picking list for the warehouse unit. Dashboards draw data from these systems and display critical operational and performance data for supply chain managers. Customers receive feedback via SMS, email, or in-application notifications. Supply chain workers receive reminders and alerts, such as warnings of impending expiry or stock-out risk, that are generated automatically by the system based on simple business logic.

This chapter will explore paper-based and digital LMISs, which usually serve as the repository of data about the operations and performance of the entire supply chain, and we start with concepts and considerations common to both. We will not present details of other special purpose supply chain management tools, such as a WMS or an ERP, although the concepts presented are applicable to them.



Photo courtesy of R. Hammond/Panos, Liberia



Photo courtesy of IAPHIL

## 3.2. DATA SELECTION

### 3.2.1. HMIS VS. LMIS

Healthcare workers are overburdened with data collection, and managers can be overwhelmed by too much data. So unless data are to be used routinely to inform supply chain decisions and to enable operational or strategic actions, they should not be collected in a LMIS.

Collecting data for managing a supply chain is a separate activity from collecting data about patients and health services; that is what a health management information system (HMIS) collects. A HMIS and a LMIS have a few key differences, which are listed below.

TABLE 3-1.  
HMIS AND LMIS DIFFERENCES

	HMIS	LMIS
<b>What data is collected?</b>	Data about patients' health conditions or health services rendered.	Data about commodities, i.e., quantities issued, dispensed, used, received, lost, stolen, damaged, ordered, etc.
<b>How frequently is data collected?</b>	Data are collected and recorded daily, and usually compiled and reported monthly or quarterly.	Data are collected and recorded daily, and usually compiled and reported monthly, bi-monthly or quarterly. Online systems may enable access to real-time or near real-time data.
<b>How is data used to make decisions?</b>	Data are analyzed periodically to determine disease patterns, monitor program objectives, and plan resources (funding, health workers, facility infrastructure, etc.).	Data are analyzed daily to assess stock status. Data are analyzed and used regularly to determine resupply or order quantities, monitor supply plans, and monitor supply chain status and performance. Data are used periodically to plan or adjust forecasts.

### 3.2.2. ESSENTIAL DATA FOR DECISION MAKING AND ACTION

In order to be effective stewards of supply systems that may involve multiple channels, stakeholders, customers, and suppliers, supply chain managers need data that can be compiled, analyzed, and presented as useful information to inform decisions and enable effective action. To decide what data to collect and how frequently to collect it, let's look at what questions they might ask about the following considerations:

**FORECASTING OR DEMAND PLANNING.** How much of each product do we need to meet annual demand for all products we manage? How much is that going to cost, and do we have adequate resources to meet the demand? How accurate is our forecast compared to recent consumption trends?

**SUPPLY PLANNING.** Do we have sufficient quantities of each product in the pipeline from suppliers? Do we need to reschedule deliveries based on consumption trends? Do we need additional resources or suppliers to fill unexpected gaps in the supply?

**AVAILABILITY.** Do we have sufficient inventories to meet demand? Are inventories positioned optimally throughout the pipeline? If not, how can we reposition inventories most efficiently? Is this a routine or an irregular problem?

**QUALITY.** Are the data I'm using accurate? Is the supply chain able to assure the quality and potency of the products to the last mile? Are vehicles, cold chain equipment, and information systems functioning, and are workers adequately trained at every level to handle vaccines, pharmaceuticals, reagents, and other products that require special care and controlled temperatures?

**PERFORMANCE.** Are the system and the supply chain workforce performing efficiently and effectively? Are there ways to streamline processes, capacitate people, relocate storage nodes, or optimize transport routes to improve performance? How can we minimize costs while maximizing performance? Can we respond effectively to unexpected events?

**RISK MANAGEMENT.** Is there any product loss due to expiry, theft, or damage, and if so, what is its value and where is the loss? Is the loss significant enough to affect our supply plan? Was it preventable, and if so, why did it occur? Are we still at risk for further losses, and how can we mitigate these and other risks? What potential disruptions to our supply chain might occur, how likely are they, and do we have plans to prevent or mitigate the highest priority disruptions?

To answer these questions, supply chain managers must have access to information that is accurate, complete, and timely. There are three data items that are absolutely essential: stock on hand, consumption, and losses and adjustments. Although we may make good use of other data, notably indicators such as days out of stock, these three data items are absolutely required to manage a supply chain system. A LMIS is the system used to record and report them.

TABLE 3-2.  
ESSENTIAL LOGISTICS DATA ITEMS

THREE ESSENTIAL LOGISTICS DATA ITEMS		
Data Item	Definition	Example
<b>Stock on hand</b>	The quantity of usable stock available  <i>Note: Items that are unusable are not considered part of stock on hand; they are considered losses to the system.</i>	The health center has 300 bottles of paracetamol in the store on the last day of the month. On the national level, 780,000 bottles of paracetamol are on hand, based on stock-on-hand data from the health centers, districts, and national warehouses.
<b>Consumption</b>	The quantity of stock dispensed to users or used during a particular time period	During the past month, the health center used 120 Determine HIV tests. During the past month, the health center dispensed 253 antimalarial ACTs to clients.
<b>Losses and adjustments</b>	Losses—the quantity of stock removed from the pipeline for any reason other than consumption by clients or use at the service delivery point (due to expiration, theft, damage, etc.)  Adjustments—are the quantity of stock issued to or received from other facilities at the same level of the pipeline  Also, adjustments may be administrative corrections made to stock-keeping records—for example, when you count stock and find a different amount from the quantity listed on the bin cards. For this reason, adjustments may involve either positive or negative changes to stock.	During the past month, the district hospital had: <ul style="list-style-type: none"> <li>• 30 vials of DPT wasted due to VVM color change (loss)</li> <li>• 4 oral contraceptives stolen (loss)</li> <li>• Loaned another health facility 12 packages of oral rehydration salts (negative adjustment)</li> <li>• Received 20 treated malaria nets from another health facility (positive adjustment)</li> </ul>

These three essential data items are captured for each health product, in each location, and for each reporting period or transaction. A LMIS usually provides additional details about the following:

- Products—unit of measure, pack size, batch number, expiry date, manufacturer, price/value, and sometimes a quality indicator such as a vaccine vial monitor status
- Location—facility or store name and address, sometimes GPS coordinates, bin or shelf location
- Status and capacity of storage facility—number of pallet positions, cubic volume capacity, cold chain equipment functionality, temperature excursions

### 3.3 DATA COLLECTION

From a supply chain point of view, four planned actions can happen in a pipeline; they can be stored, moved (in transit), transformed (kitted/assembled into a new item), or consumed (used). (Supplies can also expire, be damaged or stolen.) Because we want to monitor products at all times in the pipeline, we need three types of logistics records to track the products. In a manual, paper-based LMIS, each record type has a distinct form and use.

Stock-keeping records hold information about products in storage. These include stock or bin cards that contain information about a specific product and batch or lot number, and inventory control cards (ICC) that contain information about all batches/lots. Similar to ICCs, store ledgers are bound like a book, and contain information about all batches/lots of a product. Stock-keeping records are used to record stock balance, receipts, issues, and losses.

Transaction records hold information about products being moved. Transaction records include requisition vouchers, issue vouchers, transfer vouchers, goods received notes, delivery notes, sales orders, bills of materials, and packing lists. Sometimes these records are combined to serve multiple purposes within a transaction process, such as a requisition, issue, and receipt voucher (RIRV).

Consumption records hold information about products being consumed by a client or a patient, or used at the point of service. These include dispensing register, tick sheets, daily use logs, and daily activity registers.

The three types of records, used together, provide accountability and traceability for the products moving through a supply chain. Transaction records document changes to stock-keeping records, and consumption records document quantities leaving the supply chain to customers.

In a well-functioning LMIS, the relationships among data found in records are clear. For example, at the health facility, the consumption data recorded on the dispensing register should be close to the issue quantities recorded on the ICC. Also, the transaction numbers on a RIRV should match the numbers recorded on the ICC. Periodically, supply chain supervisors should verify the quality of the data.

Maintaining accurate records is crucial to good supply chain management. At any level of the system, managers should be able to quickly and easily report the stock on hand for any item. In a small warehouse, this may mean walking to the storage area and reading the numbers from a conveniently located stock card. In a large warehouse, this may mean being able to find the ICC file quickly, or to look up data in a Warehouse Management System.

The entire transaction should be clear—who placed the order and when, when the order was filled and shipped, and when the order was received. If questions arise, a manager should be able to trace a transaction by using the reference number from the stock-keeping records to locate the transaction records.

#### WAYS TO CAPTURE CONSUMPTION

Although this section focuses on consumption records that capture the quantity of products dispensed, there are alternative ways to collect information on consumption. In certain circumstances, system designers may choose to calculate consumption based on stock on hand, using information from a stock-keeping record rather than a consumption record.

In Zimbabwe, for example, the Delivery Team Topping Up system uses an eLMIS that was designed to calculate consumption based on stock-on-hand data from physical inventories. The delivery team arrives at a facility, conducts a

physical inventory, and enters the data into a laptop. The software compares the results to the previous physical inventory to calculate consumption, and recommends the quantity to replenish to reach the maximum stock level. Then the delivery team tops up the facility from the stock on the truck.

Alternatively, consumption can be estimated by using lowest level issues data. For example, a facility store often issues products to the dispensary or wards, and then the store issues data that can be a proxy for consumption.

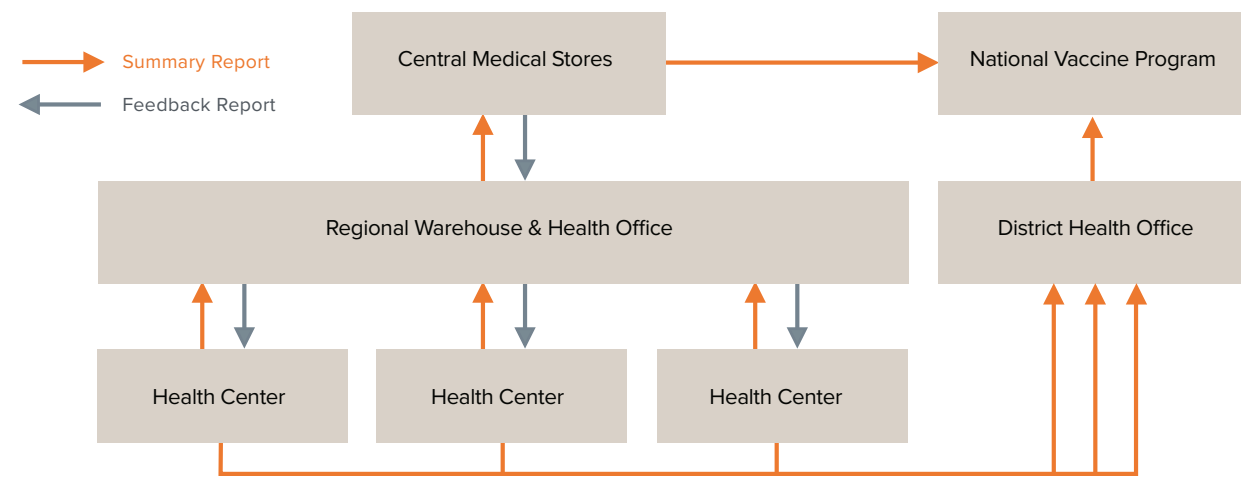
### 3.4 DATA VISIBILITY

Having data collected and recorded is critically important, but it is only the first step. Visibility of data throughout a supply chain is also critical, and it depends on moving the data up and down the supply chain to provide supply chain workers and managers at various levels the right information, of the right quality, at the right time. A paper system moves physical reports; a digital system moves electronic data that are displayed on user interfaces and dashboards or other decision-support systems. Whether paper based or digital, a reporting system must be in place to ensure that information flows correctly and consistently.

A reporting system in a supply chain may include levels outside storage and distribution points. For example, a district health office might not hold stock or be involved in the distribution of products, but this office still needs to receive LMIS reports to ensure that facilities are stocked appropriately to determine if it needs to invest additional funding and/or resources into training, staffing, commodity quantities, etc.

Figure 3-4 is an example of a reporting system that includes summary reports and feedback reports. It also highlights how the different levels that are involved in budget and supervision decisions—but not necessarily in direct stock management and distribution—need logistics information to make decisions.

**FIGURE 3-4.**  
**SAMPLE LOGISTICS REPORTING SYSTEM FOR NATIONAL VACCINE PROGRAM**



Reporting systems typically use summary reports that move up the system and feedback reports that flow down the system.



Photos courtesy of IAPHL



**Summary reports** move all essential logistics data items for products, a specific facility, and a specific time period (monthly, bimonthly, or quarterly) to the decision makers at higher levels in the system.

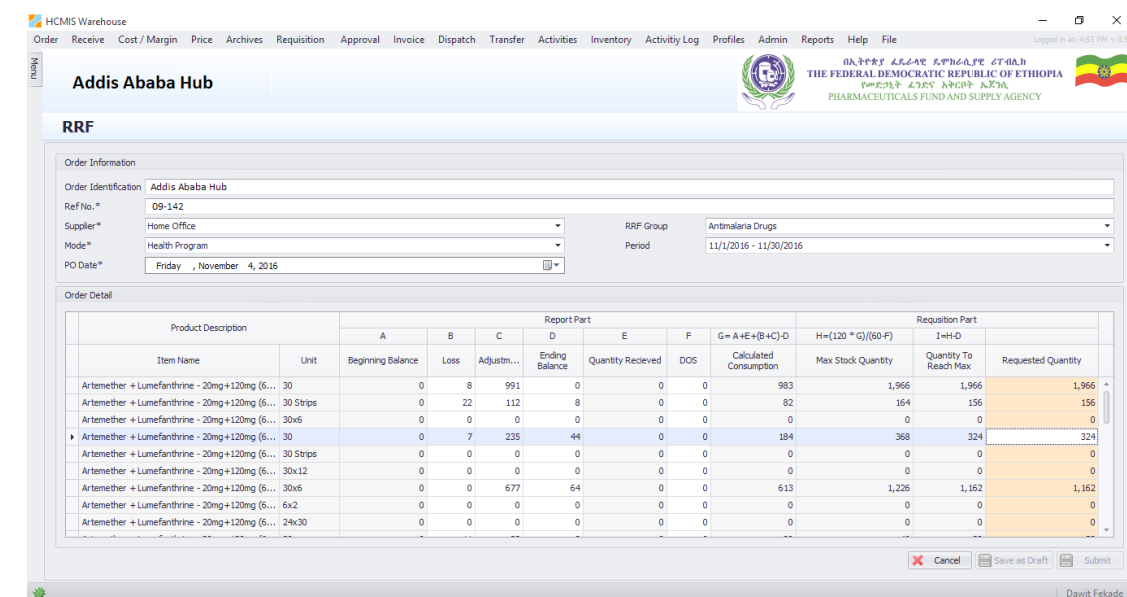
Information in a summary report might also include limited service data, such as the number of patients on a TB treatment, or the number of vaccine doses administered. For a facility managing over 100 products, reporting even three or four data items on paper can be time consuming and burdensome. So only the data required to make specific supply chain decisions should be in a physical report.

**Feedback reports** inform lower levels about their performance, improve capacity, give recognition, and in some cases, provide information about reporting from other facilities. Feedback reports also inform managers at higher levels about how the system is functioning, and they help identify and resolve problems. A key benefit of feedback reports, whether they are sent to a facility or the CMS, is that they increase visibility of information by communicating logistics data to all levels of the system.

### 3.5 DIGITAL LMIS

Preparing summary and feedback reports is easier and less time consuming when the LMIS is automated. Digital LMIS applications can automatically populate report elements, especially if the eLMIS is also used for routine inventory control, and for opening balance, receipts, consumption, losses or adjustments that are recorded with every transaction. With the click of a button, the eLMIS can generate a summary report and a requisition order with suggested replenishment quantities. It also can quickly identify mathematical errors, highlight missed deadlines, list the percentage of expected reports received, and search for data averages, highs, and lows.

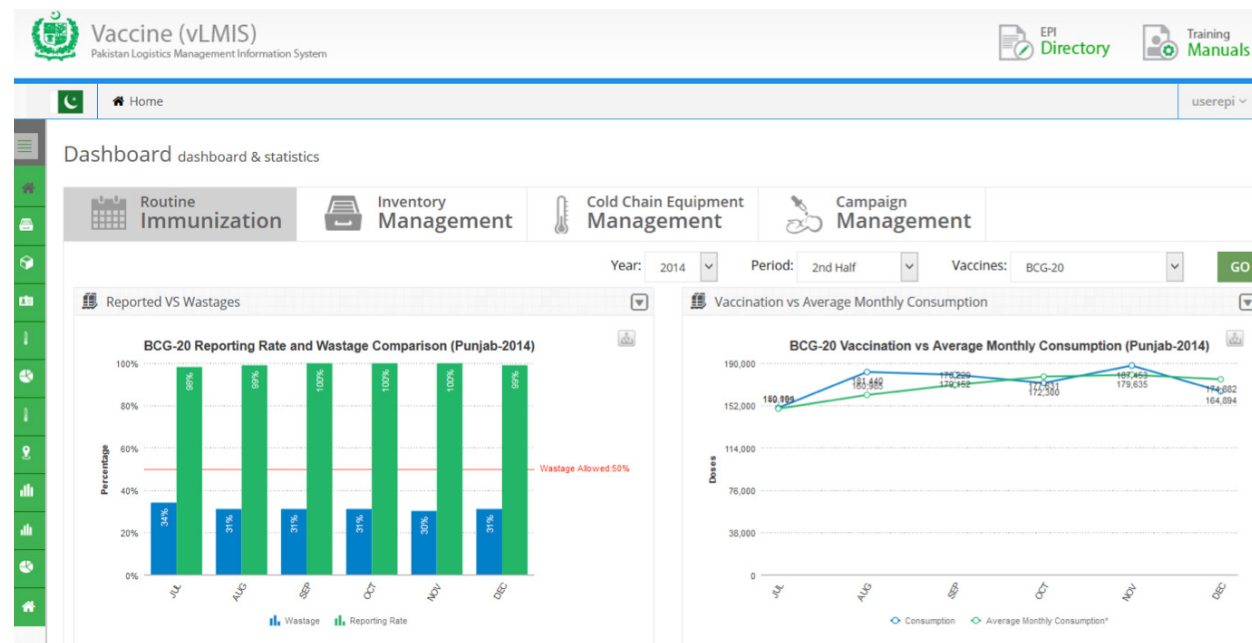
**FIGURE 3-5**  
**DATA ENTRY SCREEN FOR REQUISITIONS FOR HCMIS ETHIOPIA**



Data entry in Ethiopia's HCMIS is modeled on the paper Report and Requisition Form used previously.

Digital LMIS can also streamline and customize feedback reports by generating and transmitting notifications, reminders, and alerts. A notification might be a SMS message to a manager to log in and review and approve a requisition, or to a health care worker that a consignment is ready for pick up or delivery. A reminder can help personnel attend to routine activities, such as conducting physical inventory at the end of the month and submitting their requisition order. An alert can flag a problem, such as a product that has limited shelf life remaining, or an impending stockout. Digital LMIS can also enable routine reporting to other stakeholders, programs and divisions within a ministry of health, development partners, and funding agents.

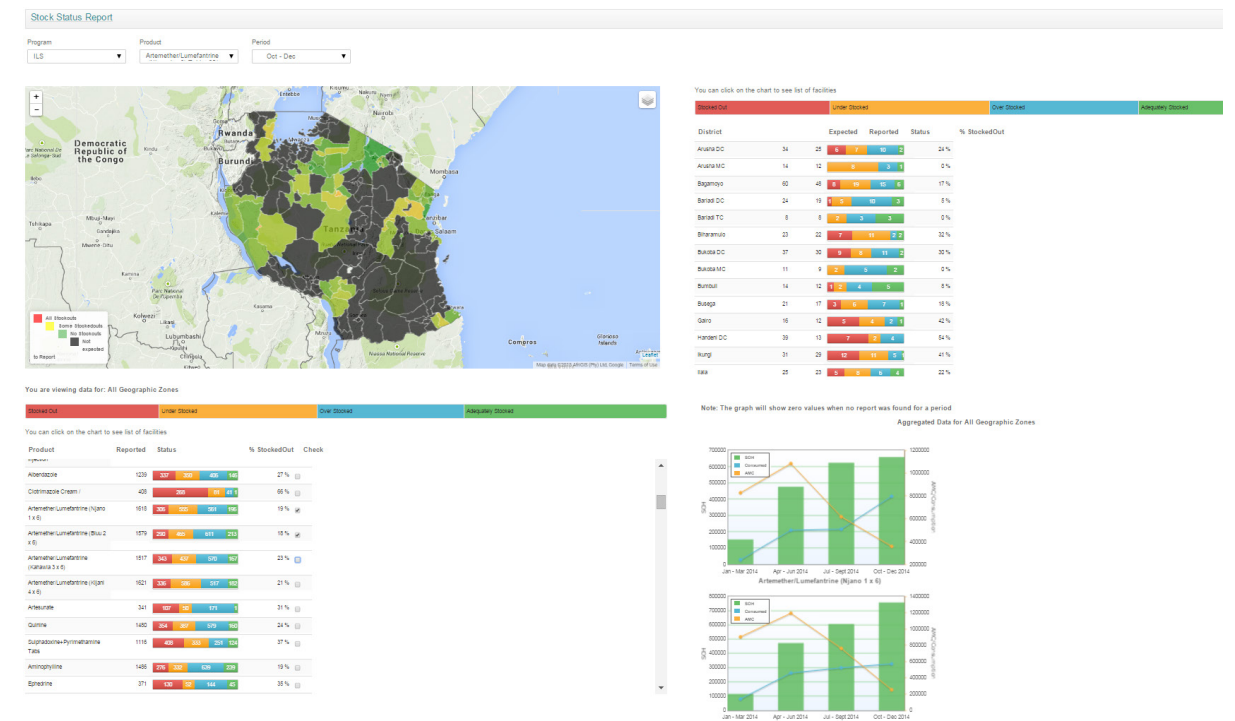
**FIGURE 3-6.**  
**VACCINE DASHBOARD FOR vLMIS PAKISTAN**



The vLMIS dashboard enables the Pakistan EPI program to compare vaccine usage (consumption data) with reported coverage (service) data.

Likewise, a digital LMIS enables analysis of supply chain performance by displaying dashboards that are specific to each user and role within the system. At higher levels, they can help supply chain managers see the big picture based on key performance indicators, and to drill down into specific indicators and levels of the system when they see something wrong. We explore this aspect of data use further in Chapter 9, Performance Management.

**FIGURE 3-7.**  
**DASHBOARD OF STOCK STATUS BY LOCATION AND PRODUCT FOR eLMIS TANZANIA**



The eLMIS enables users to drill down from national level indicators to specific products in specific locations in order to identify performance problems and risks.

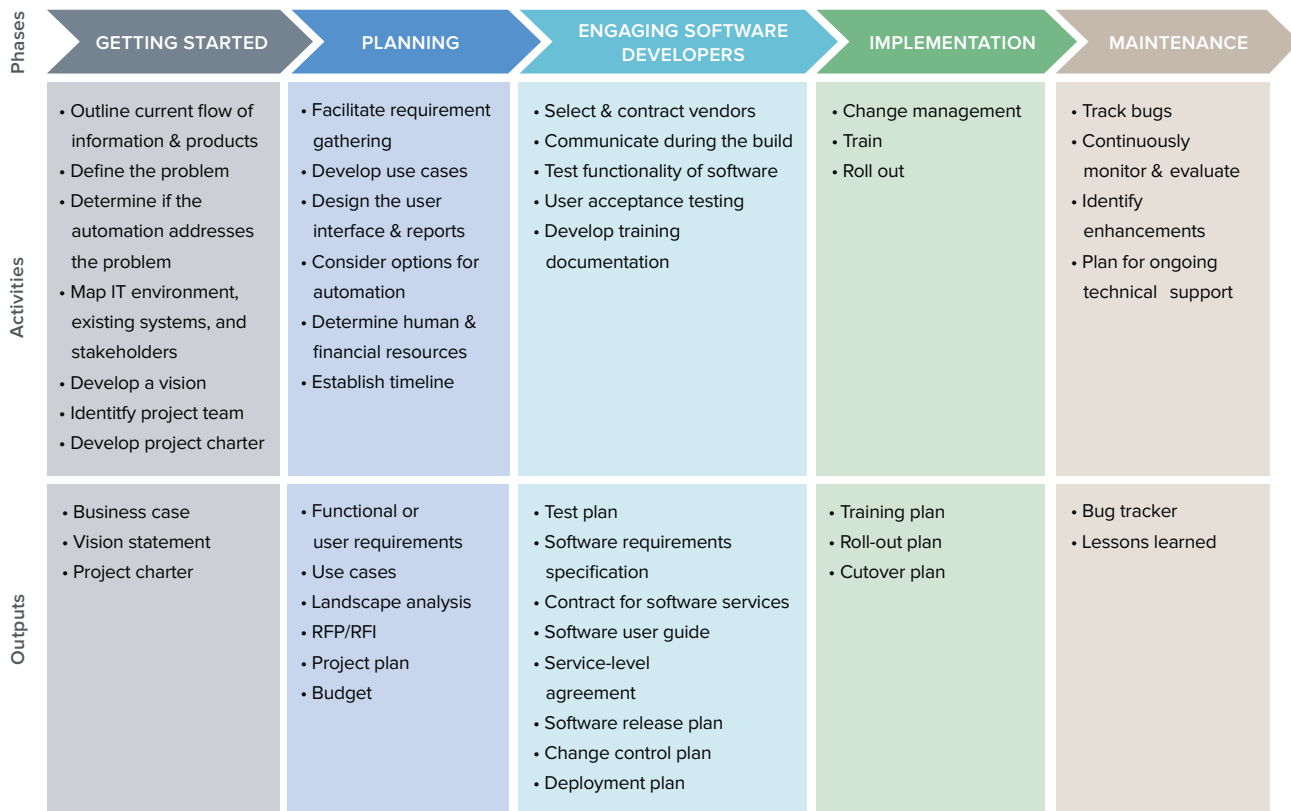
Finally, digital LMIS can be integrated into broader supply chain and health information systems (HIS) to enable deeper analysis, better workflows, and greater visibility across health domains. An eLMIS can be linked with electronic medical records (EMRs) or hospital management systems to automatically gather dispensing data; it also can be linked with supplier ERPs to enable automated ordering and to track the status of order fulfillment. Plus, an eLMIS can be linked with master facility registers, which enable all HIS applications to use the same facility code, and with HMIS applications to enable deeper analysis, such as comparing immunization coverage with vaccine consumption to calculate average open-vial wastage rates.

However, implementing a successful digital LMIS requires careful planning and adequate resources. Software development and, more specifically, computerization of a LMIS should follow project management and information technology (IT) best practices. Before moving forward, it is important to make sure certain factors are in place to ensure the project's success:

- Strong existing logistics business processes, or a commitment to the time and resources needed to improve business processes before or during automation
- A strong multidisciplinary team
- Long-term political and institutional support
- The resources to go the distance

The following graphic provides a high-level overview of the process.

**FIGURE 3-8.**  
**MANAGING THE PROCESS OF DEVELOPING A DIGITAL LMIS**



### 3.6 DATA USE

The purpose of collecting and reporting data is to use them for decisions and actions. Data can be used for a variety of purposes: routine operations, performance management, continuous improvement, and strategic planning. Operational decisions involve the core business functions of a supply chain, including inventory control, replenishment, order fulfillment, forecasting, and procurement. Performance management involves monitoring how well the supply chain is performing and finding root causes of problems. Continuous improvement uses data to identify recurring problems and system inefficiencies, and to guide interventions to address those problems. Finally, strategic decisions involve supply chain resources and governance, stakeholder coordination, and system design options such as outsourcing supply chain functions, optimizing distribution, or introducing new products.

### BUILDING A CULTURE OF DATA USE

Recent advances in data use are combining operational decisions, performance management, and continuous improvement. Commercial sector supply chain control tower models and quality improvement approaches have been adapted to health commodity supply chains. Visibility and Analytics Networks (VAN) and IMPACT Teams are two examples of dedicated teams established at the national and/or local

government level that come together routinely to review supply chain data, make operational decisions, assess key performance indicators, identify problems and analyze their root causes, and determine interventions. These teams build a culture of data use and are empowered to make change, holding each other accountable for improving performance.

Depending on their responsibilities, different supply chain actors require different types of data. Frontline health workers will use data to:

- Track consumption
- Manage inventory
- Calculate replenishment quantities
- Monitor temperatures of cold chain equipment

A health official or district supply chain specialist might use data for to decide where to:

- Send stock
- Send equipment technicians
- Reposition short shelf-life commodities so they are used before they expire

LMIS managers will be focused on monitoring eLMIS performance and use. They need to know if users are:

- Submitting data on time and in full
- Adequately trained or require repeated help desk support
- Accessing and using the system routinely according to their profiles and responsibilities

A supply chain manager or analyst will be monitoring overall supply chain performance and drilling down into root causes of poor performance. That person not only needs to know equipment uptime, make, and model per location, but also if:

- Supplies are positioned appropriately at each storage level and to meet projected demand



- Consignments are delivered on time and in full
- Consumption aligns with reported service data
- Expiry or wastage is within acceptable parameters

### 3.7 DATA QUALITY

This chapter has focused on the essential data needed for supply chain management. Because these data are used to make informed decisions that will improve customer service, quality is critical; in fact, data quality is one of the six rights for LMIS data. Although data quality is often a challenge, there are specific steps that can be taken to improve the quality of LMIS data. They are:

**Data collection.** All staff responsible for maintaining logistics records—whether stock keeping, transaction or consumption—should be appropriately trained and have adequate time to carry out this responsibility. Paper forms or data entry screens should be clear and simple, with sufficient writing space. On-the-job training (OJT) and supportive supervision should be undertaken to ensure the data are entered completely and correctly.

**Data reporting.** Data should be reported regularly, and logistics managers should review the reports to verify the quality of the data. Feedback reports and incentives can be used to motivate lower levels to turn in or transmit complete, error-free reports. Linking reporting with ordering also encourages timely reporting.

**Data analysis.** The data should be validated by comparing it with historical data or with data derived from other sources, e.g., a HMIS. It is important to ensure optimal quality of the raw data that is subsequently analyzed, so that reports are reliable for decision making.

**Digital LMIS.** A digital LMIS can help improve data quality by reducing mathematical errors, highlighting missing information, and facilitating data capture, analysis, reporting, and feedback. Digital LMISs are expensive to implement and require significant inputs (i.e., hardware, programming, electricity, training, etc.); but the costs can often be justified by the quality and performance improvement benefits, such as reduction of costly losses, improved availability of health products, and the resulting health benefits to clients.



#### FOR FURTHER READING

- Common Requirements for Logistics Management Information Systems, (PATH)
- Computerizing Logistics Management Information Systems: A Program Manager's Guide, (USAID | DELIVER Project)
- Considerations for the Integration of HMIS and LMIS, (SIAPS)
- eLMIS Selection Guide: Electronically Managing Your Supply Chain Information, (USAID | DELIVER Project)

#### ANNEX 3-1.

#### SAMPLE BUSINESS PROCESS MAP FOR ORDER PROCESSING FUNCTION

