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CHAPTER 49

Pharmaceutical management information systems

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SUMMARY

The planning process for a new or revised pharmaceutical supply system should include a pharmaceutical management information system (PMIS). The PMIS is an organized system for collecting, processing, reporting, and using information for decision making. Information for each subsystem is collected by means of—

- Record-keeping documents, a combination of registers, ledgers, and filing systems that typically are not circulated
- Information reporting forms, such as periodic status reports, that transmit data to other departments or levels for use in making management decisions
- Feedback reports, also called analytical reports, that are usually provided to the units that collected the data

Design or revision of a PMIS should be based on the differing information needs of users at each level of the system and should build on existing forms, reports, and procedures as much as possible. Any forms should be designed through a participatory process and field-tested with staff who will use them.

Other issues to consider include—

- Selection of indicators to monitor system performance and intended results (discussed in Chapter 48)
- Integration of the PMIS with other data collection systems
- Computerization at appropriate levels

A successful PMIS requires effective use of the information generated, which includes—

- Efficient data processing to reduce large amounts of data to a manageable number of key indicators, often in summary tables
- Presentation of information in graphic form to simplify interpretation
- Interpretation of information to identify trends and potential problems
- Appropriate use of technology (for example, e-mail, websites) to present and share information with a wider audience in less time
- Action in response to both positive and negative results
- Effective mechanisms to provide and receive feedback

49.1 Importance of a pharmaceutical management information system

A good PMIS provides the necessary information to make sound decisions in the pharmaceutical sector. Effective pharmaceutical management requires policy makers, program managers, and health care providers to monitor information related to patient adherence, drug resistance, availability of medicines and laboratory supplies, patient safety, postmarket intelligence, product registration, product quality, financing and program management, among other issues.

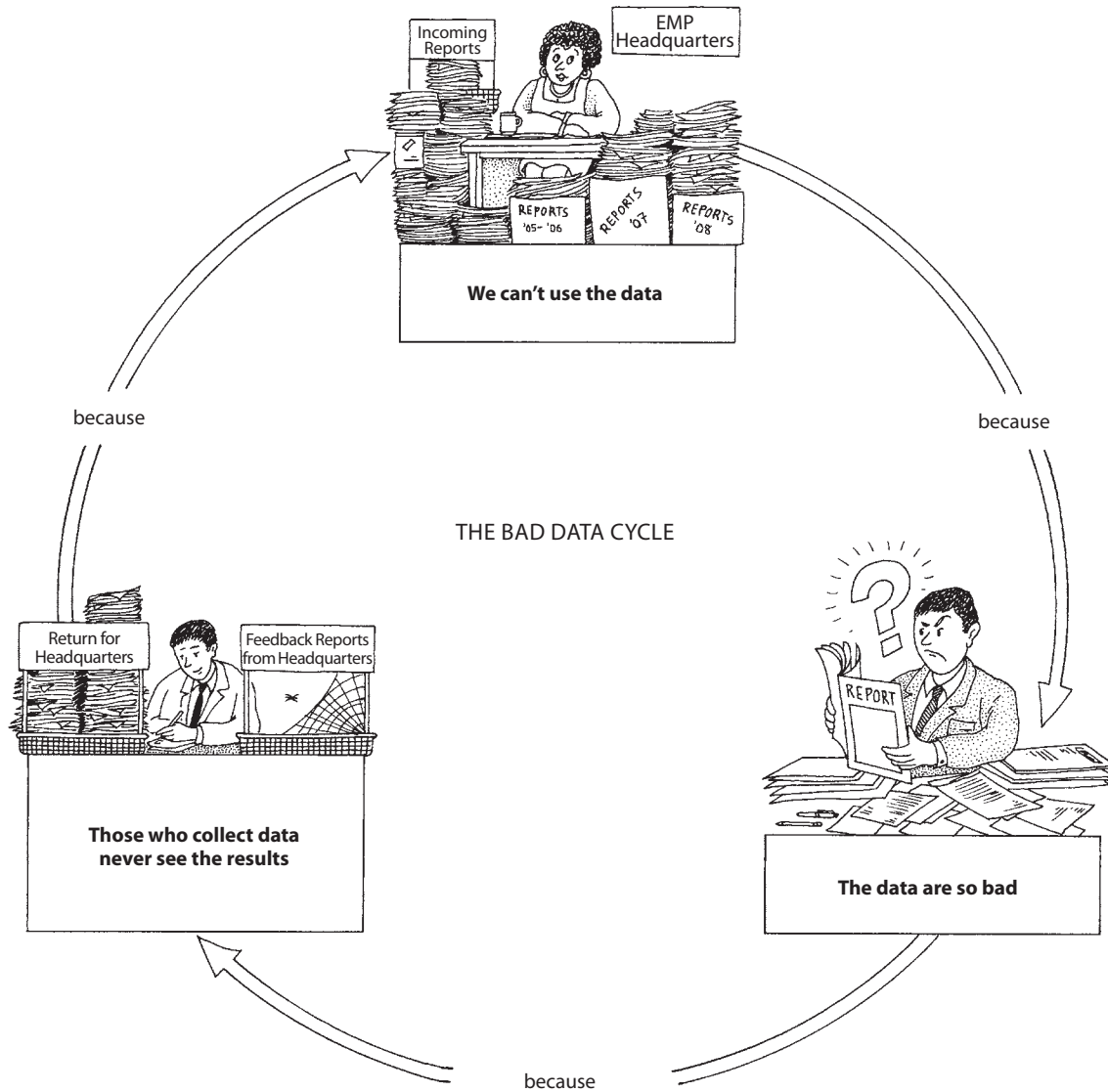
Coordinating the elements of a pharmaceutical supply system requires relevant, accurate, and timely information. Increased funding for HIV/AIDS, tuberculosis, and malaria programs has contributed to the need for accurate and timely information on a variety of parameters that affect the ability to conduct accurate quantification, procurement planning, budgeting, resource mobilization, and program management. In addition, multiple donors require different data reports, complicating program management. Because a pharmaceutical supply system uses many forms and other documents, managers often feel as if they are buried under mountains of data and that filling in the forms and producing reports ends their

responsibility. They are unable to analyze and use many of these data for improved decision making. Many factors affect the usability of these data, including data quality and quantity (for example, missing or incomplete data or too much data to analyze effectively) or a manager's lack of analytical skill. Therefore, many managers find themselves making decisions based not on information but on intuition.

This chapter focuses on the practical aspects of organizing and managing a routine pharmaceutical management information system. It should be read in conjunction with Chapters 48 and 50. Chapter 48 puts information management into the broader context of monitoring and evaluating program performance against long-term goals and objectives and against medium-term workplans and targets. Chapter 50 presents a variety of tools for analyzing data produced by the PMIS.

Definition of a pharmaceutical management information system

The PMIS integrates pharmaceutical data collection and the processing and presentation of information that helps staff at all levels of a country's health system make evidence-based decisions to manage pharmaceutical services.



The features that distinguish a PMIS from a logistics management information system include—

- The incorporation of patient-specific data in addition to product-centered data
- A focus on decision making for pharmaceutical services, not just resupply
- Information on outcomes related to medicine use, such as adherence, adverse drug reactions, and pharmacovigilance, that affect pharmaceutical policy and selection decisions, including individualized treatment options
- Overarching information about the pharmaceutical sector, such as a summary of available professionals/personnel, outlets, legislation status, and distribution of personnel and facilities
- Varied data sources from the whole pharmaceutical

sector, not just activities related to procurement and inventory management

- The ability to triangulate consumption data with clinical and patient-specific data

Functions of a pharmaceutical management information system

An effective PMIS is able to synthesize the large volume of data generated by pharmaceutical management operations. It then processes the data into information for use in planning activities, estimating demand, allocating resources, and monitoring and evaluating pharmaceutical management operations. This information is often in the form of a few key indicators. Indicators should be targeted toward staff at all levels so that they can monitor both their own performance and that of the units for which they are responsible.

Another important function of a PMIS is to improve accountability. Much of the recording and reporting in a PMIS is intended to create an audit trail for products as they enter or leave a pharmaceutical supply system.

Data and information

An understanding of the distinction between data and information is necessary to appreciate how a management information system functions. *Data* represent real-world observations or measurements. Data, in and of themselves, often have little value and take on meaning only after they are processed into a more usable form. *Information* is a meaningful aggregation of data that can be interpreted for a specific use. In other words, information is processed data that contains sufficient context to make it meaningful. The tools in Chapter 40 are intended primarily to aggregate data into useful information.

For example, data from a health center reveal that 3,000 co-trimoxazole tablets were distributed last month. Is this consumption level abnormal? Without analysis, this question would be difficult to answer. The data can be converted to information by comparing the 3,000 tablets distributed with the number distributed the previous month, say 1,000. This interpretation could then be expressed as a 300 percent increase in co-trimoxazole distribution. But information is indicative, not prescriptive. The manager must analyze the complete context and make decisions.

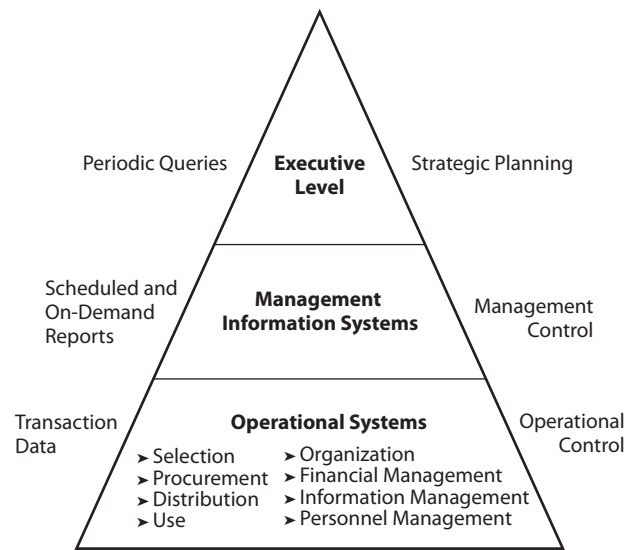
In a PMIS, data are routinely collected on a common set of indicators, usually expressed as proportions or rates. Some of these indicators measure performance toward objectives, whereas others may measure process efficiency.

The information systems pyramid

Viewing information systems as a pyramid may be helpful (Figure 49-1). At the base of the pyramid are operational systems. These include subsystems—procurement, distribution, financial management, medicine use—that handle data at the transactional level. Every item that moves in and out of inventory must be tracked, and decisions must be made about how much to supply to a health facility, when to reorder, and how much to bill. This level is characterized by a high volume of data that must be recorded and processed, usually daily and at the time of transaction. Data recording accuracy is very important at this level because every unit of medicine matters.

The next level of the pyramid is formed by management information systems (MIS). These systems typically provide summaries of operational data on a periodic basis (for example, monthly or quarterly) to help managers of specific departments monitor the performance of their units. Annual reports often summarize information on key indicators from many different operational subsystems, such as

Figure 49-1 The information systems pyramid



procurement, personnel, financial management, or stock control (see the sample report format in Annex 49-1). Information provided by the MIS helps managers answer questions such as the following—

- How do expenditures compare with the budget at a given level of operation?
- How effective is the inventory control system in eliminating stockouts and cutting stock losses?
- What is the delivery performance over the last period?
- Are the trends generally favorable, or are indicators worsening?

Information at this level may demonstrate reduced accuracy because errors might be introduced during the consolidation of data, so a certain level of variation is normal.

The highest level of the information systems pyramid is the executive level. At this level, the system further summarizes management information for use in strategic planning and policy making. The executive level of the MIS typically generates program-wide information on how effective the organization is in accomplishing its mission. Systems at this level track a limited number of indicators, less frequently. They provide users with the tools, such as total cost analysis and price comparison analysis (see Chapter 40), to perform periodic queries on data at every information-system level, either to investigate the causes of problems or to perform “what if” analyses to test the effect of changes in strategy. Some of the strategic questions that can be answered with executive-level information include the following—

- Should the transport and delivery function be contracted out?

Table 49-1 Information users and information needs

Level and function	Users	Information needs
National		
Selection	National essential medicines committee	Morbidity patterns Standard treatment strategies
Procurement	Procurement unit	Medicine-use rates Lead times Supplier performance Prices Funds available for procurement
Medicine-use education	Training unit	Number of staff trained in essential medicines use Number of public education messages developed and campaigns conducted
Financial management	Finance unit	Operating costs Revenues Value of inventory Stock turnover rates Stock fund growth or loss
Provincial/district		
Warehousing	Medical stores manager	Medicine-use rates Maximum and minimum stock levels Lead times for requisitions from the national level Shelf life Warehouse maintenance and equipment needs Stock losses
Distribution	Logistics manager	Distribution schedules Vehicle-use records Maintenance and fuel costs
Facility		
Use	Medical director, pharmacist	Prescription patterns Patient adherence Pharmaceutical availability Patient load
Inventory control	Storekeeper	Maximum and minimum stock levels Lead times for requisitions Prices Medicine-use rates Shelf life Cold-storage temperature variations

- Could savings be obtained by combining orders with those of another large buyer?
- Which districts are the best served?
- Would targeting underserved areas with more marketing and training be worthwhile?

49.2 Meeting the information needs of users with different requirements

Staff at every level and position use information to make decisions that affect the overall functioning of a pharmaceutical supply system. For example, a storekeeper can monitor the temperature chart on a vaccine refrigerator and save thousands of dollars' worth of vaccine from spoiling when the refrigerator begins to malfunction. The chief pharmacist may be unaware that large quantities of a medicine are due to expire in the warehouse. But if the pharmacist had information about expiration dates and could match that

information with data on the stock levels in health facilities, medicines could be dispatched to facilities that are running low, thereby averting waste of money and medicines.

A good PMIS alerts staff to problems and triggers critical actions at all levels. Usually, this systemwide usage means that a strict separation does not exist between data collectors and information users. Analysis and use of data are encouraged at every level of the system (see Country Study 49-1). Table 49-1 summarizes key information users and some of their most important information needs at each level of the system.

49.3 Typical components of a pharmaceutical management information system

The operational systems level of a PMIS can be examined further using the analogy of the information systems pyramid. This level typically contains four subsystems: selection,

Country Study 49-1**Using the Electronic Dispensing Tool to manage pharmaceutical information at different levels of the health care system**

Although all medicines need to be carefully managed, antiretrovirals (ARVs) need special attention because they are expensive and because health care professionals in developing countries lack long-term experience with them. As part of a lifetime treatment regimen, patients must be carefully monitored for their adherence to the medicines. To maintain an uninterrupted supply of ARVs, pharmacy staff must collect timely information on medicine consumption and patient characteristics so they can accurately forecast the amount of medicines needed.

As antiretroviral therapy (ART) programs began scaling up in developing countries, assessments showed that pharmacies in ART centers did not have adequate systems in place to gather the needed data. What record keeping existed was done through manual registers that were impractical. This lack of adequate systems prevented staff from maintaining a patient's medicine consumption history and compiling the information on medicines and patients needed to support management decisions. In addition, the cost of these expensive medicines is often shared by multiple donor agencies that require different reports at different times.

The Rational Pharmaceutical Management Plus Program developed a simple, Microsoft Access-based electronic tool for pharmacy staff to use to track patients and inventory. The Electronic Dispensing Tool maintains the basic patient profile, a history of medicines dispensed, and other information that is relevant to the patient, such as adverse drug reactions. The tool also maintains consumption records that are needed to quantify pharmaceutical needs and to make other program management decisions.

Summary of data and reports*Commodity management*

- ARV and opportunistic infections medicine inventory, stock consumption, short-dated stock

Dispensing

- Medication dispensing history
- Patient characteristics (other medicines, allergies)
- Change of regimen

Patient management

- Basic patient profile with contact address
- Patient schedule of visits
- List of patients (for example, by different donor support, by age, by gender)
- Current status of patient (e.g., active, lost to follow-up, deceased)

- Number of active patients by regimen
- Number of new patients by regimen
- Age, weight, sex distribution of patients
- Patient enrollment trend

Examples

The tool is used at different levels of the health care system to manage inventory and patient information in multiple countries in Africa and the Caribbean.

Below are examples of three levels of use in Kenya—

- Many ART centers use the tool in adherence monitoring by regularly printing out the list and contact information of the patients who missed their scheduled appointments. Pharmacy staff, social workers, or nurses can then check up on the patients. Facilities also track various trends in the ART program, such as the rate of patients starting ART and the rate of patient attrition. ART sites use this information as a basis for decision making and for developing interventions; for example, Kenyatta Hospital in Nairobi changed its protocol after data identified that 63 percent of inpatients started on ARVs were dropping out of the ART program.
- The Eastern Deanery AIDS Relief Program, a faith-based organization in Nairobi, has nine satellite ART sites serving more than 5,000 patients but manages the inventory on one personal computer, using the Electronic Dispensing Tool. Each satellite site has a person responsible for record keeping; drivers pick up the previous day's data every morning, and the data are entered into the database at the central data management office. Using the tool, the data management team is able to create different reports for management and for monitoring and evaluation; in addition, the organization must submit different reports to the Ministry of Health and to donors. Once a month, the data are reconciled with the pharmacy inventory. Eventually, each site will have its own computer for individual data entry.
- The Mission for Essential Drugs and Supplies (MEDS) provides medicines and supplies to facilities serving tens of thousands of patients on ART all over Kenya. RPM Plus Kenya closely monitors MEDS ARV distribution activities by using the tool to help track pharmaceutical consumption, which is needed to quantify orders for all of its client sites. In addition, this tool has been used to create reports needed for monitoring and evaluation efforts.

procurement, distribution, and use. Information is necessary within each of these subsystems to efficiently manage finances, pharmaceutical stocks, and personnel.

The documents that form the basis of the information system can be grouped into three areas: record-keeping documents, information-reporting forms, and feedback reports.

Record-keeping documents

A combination of registers, ledgers, and filing systems (manual, computerized, or both) is used to maintain data about the activities of a specific organizational unit. Normally, records stay in one place and are not circulated to other departments or levels. An efficient record-keeping system enables its users to quickly retrieve information about activities and simplifies the job of aggregating data for reporting purposes.

Data compilation/aggregation tools

These tools are in specially designed formats (manual or computerized) that facilitate data processing. Examples include tally sheets, summary registers, and computer programs to compile data.

Data-reporting forms

Forms for reporting information differ from the data records described above because they are designed for transmission to other parts of an organization. Copies of forms filed at various points in the distribution network help establish the audit trail for tracking the flow of pharmaceuticals and funds. These forms typically include requisition/issue vouchers to document stock transfers and periodic status reports, such as monthly or annual reports (see Annex 49-1). Status reports can be descriptive and principally qualitative forms, or they can be standardized, quantitative forms designed to transmit data on specific indicators to others. In a standardized reporting chain, individual health facilities typically report to district offices. These, in turn, report to provincial offices, which report to the central office to project future pharmaceutical needs, revise budgets, and assess medicine use at the central level.

Feedback reports

Analytical reports are produced from data reported by other units. These feedback reports have two main purposes: to address issues highlighted by status reports, and to analyze how each reporting unit has performed relative to other similar units. The reports are usually fed back to the units that first collected and provided the data. Experience has shown that regular and corrective feedback is one of the best ways to improve data quality and reporting compliance.

When staff members see that their data are being used, they become much more conscientious about data collection and reporting.

A good information system also includes procedures to govern the use and flow of information up and down the pharmaceutical supply network. These procedures typically include details about how and when to collect data, the schedule for report preparation, and to whom the documents should be sent. Figure 49-2 illustrates the flow of documents in a basic PMIS, and Table 49-2 describes the types of documents prepared and maintained.

If parts of the information system are computerized, clear guidelines must exist for the entry, maintenance, and archiving of data, as well as for the preparation and distribution of standard feedback reports. In addition, procedures are often needed for conducting periodic analyses and sharing data among different levels of the organization.

Data collection methods can take various forms in a PMIS. Although routine collection of data from all levels and facilities for monthly, quarterly, or annual reports is most common, sample surveys, rapid assessment techniques, and sentinel reporting systems are also important (see Chapter 48). In many cases, these collection methods provide data for decision-making support that are more reliable than routine data.

49.4 Steps in designing or revising a pharmaceutical management information system

When a new pharmaceutical supply program is started or an old program is revised, the basic planning should include establishing a complete information system. All necessary forms should be available, and all staff should be trained to use these forms before pharmaceuticals start moving through the system. Without this preparation, recording of pharmaceutical consumption and forecasting of medicine needs quickly breaks down. The principal steps in designing or revising a PMIS are shown in Box 49-1.

A PMIS should be based on the information needs of the users at each level. To the extent possible, it should build on existing forms, reports, and procedures. Adding as few new forms and data elements as possible and removing unnecessary forms and reports will simplify the system and increase the chances that information will be reliably recorded and reported. In some cases, worksheets may need to be developed to facilitate the collation of data from records into summary report forms.

Users need to be empowered through procedures and training to perform appropriate data analysis, understand key trends within their own units, and use information for decision making at the local level. Depending solely on feedback reports from higher levels may not be effective because

Figure 49-2 Flow of documents in a basic supply system PMIS

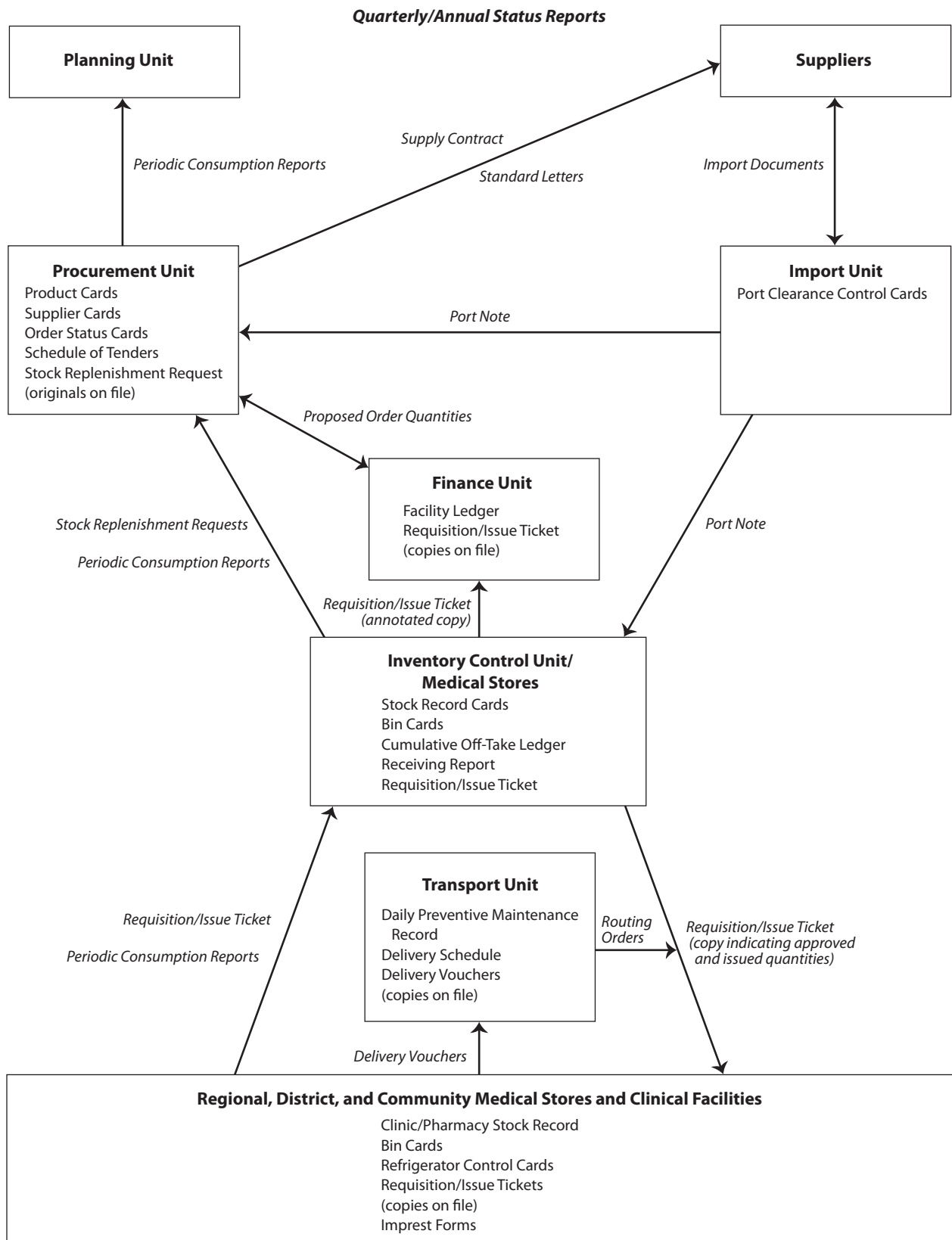


Table 49-2 Forms and records for a basic supply system PMIS

Type of document	Originated/maintained by
Forms	
<i>Supply contract</i> —statement of the terms of supply, usually publicized with the call for offers, specifying exact pharmaceutical requirements, dosage forms, quality standards, labeling and packaging, delivery date, and other supply details	Procurement unit
<i>Standard letters</i> —form letters used in correspondence with suppliers to provide and obtain information regarding outstanding orders	Procurement unit
<i>Import documents</i> —used to confirm the supply contract, guarantee payment, and certify the quantity and quality of shipment contents, and to provide other types of trade information	Procurement, supplier, shipper, banks
<i>Port note</i> —notification from import unit to procurement and medical stores that a specific shipment has arrived and has been cleared from port	Import unit
<i>Receiving report</i> —notification to inventory control that a specific shipment has been received; indicates damages, short shipments, and other problems	Medical stores
<i>Requisition/issue ticket</i> —request for specific quantities of standard items from medical stores; amended by inventory control if stocks are low; orders filled by medical stores; copies provide audit trail; return copy is packing slip	Medical stores, health facilities
<i>Stock replenishment request</i> —request to procurement to begin the procurement cycle for specific items; sent at reorder level or reorder interval	Inventory control
<i>Proposed order quantities</i> —proposed order quantities for a single procurement cycle; finance unit estimates cost and adjusts if needs exceed available funds	Procurement
<i>Routing order</i> —delivery order for drivers; provides a record of vehicle movements, indicates the order of deliveries (planned to minimize travel)	Transport unit
<i>Delivery voucher</i> —signed receipt indicating that a specific shipment of pharmaceuticals has been delivered intact	Medical stores, health facilities
<i>Imprest forms</i> —simplified supply requisitions for use by smaller clinical facilities and individual health workers	Health centers and workers
Records	
<i>Product cards</i> —product specifications and supplier history for each item; used to prepare bid specifications and select suppliers	Procurement unit
<i>Supplier cards</i> —record of experiences with individual suppliers, including delivery record, adherence to contract, pharmaceutical and packaging quality, and other performance factors; used in supplier selection	Procurement unit
<i>Order status cards</i> —used to monitor the status of outstanding orders to reduce lead times, supplier defaults, and port delays	Procurement unit
<i>Schedules of tenders</i> —summaries of offers from each supplier on each product in a tender purchase	Procurement unit
<i>Port clearance control cards</i> —used for a manual control system to monitor port-clearing activities and thereby shorten port delays	Import unit
<i>Stock record cards</i> —cards or a ledger used to record stock balances, issues, receipts, and outstanding orders; essential in inventory decisions such as when and how much to order	Medical stores, health facilities
<i>Bin cards</i> —similar to stock record cards but kept in medical stores with the physical stock to record supply movement in and out of the stores	Medical stores
<i>Facility ledger, cumulative off-take ledger</i> —records indicating the quantity and cost of pharmaceuticals issued to individual facilities; used for budgeting, billing, and/or estimating future needs	Finance unit, inventory control
<i>Daily preventive maintenance record</i> —checklist of daily vehicle maintenance activities; used to promote preventive maintenance	Transport unit
<i>Delivery schedule</i> —monthly timetable for requisitions and deliveries; prepared for maximum staff and vehicle efficiency	Transport unit
<i>Refrigerator control cards</i> —temperature and maintenance log to ensure proper cold-chain storage	Clinical facilities
Reports	
<i>Quarterly and annual status reports</i> —to national level	
<i>Feedback reports</i> —from national level to warehouse/facilities	

Box 49-1 Steps in designing or revising a PMIS

1. Identify information users.
2. Identify information needs for each user, including selected indicators (see Chapter 48).
3. Review existing record-keeping and reporting procedures.
4. Match existing information with information needs to identify overlaps, gaps, and items that can be deleted.
5. Draft record-keeping and reporting procedures to fill the gaps.
6. Develop tools and procedures to help users do simple data analysis and present key trends.
7. Prepare or modify the instruction manual.
8. Field-test any newly designed or revised records and report forms, including instruction manuals.
9. Make modifications to record-keeping forms, reporting forms, and/or the instruction manual, based on field-test results.
10. Develop procedures for preparing feedback reports.
11. Train information users at all levels in data collection, reporting procedures, and use of information.
12. If the PMIS is computerized, provide training for staff in general computer use and specific applications.
13. Monitor the system's implementation, including the quality and regularity of reporting.
14. Adapt the records, report forms, and software as information needs evolve.
15. Continuously monitor the relevancy and sufficiency of the existing PMIS and make necessary changes through a participatory process.

of delays and a lack of local context. For example, a storekeeper may wish to maintain a graph of the average number of days out of stock of selected products to see whether stock control is improving or getting worse rather than wait for someone at a higher level to send graphs drawn from local data.

It is essential to field-test any newly designed records and report forms with staff from the units that will eventually use the new system. Staff at actual work sites can almost always suggest better ways of doing things, as well as point out places where the new forms or procedures are unclear. Computerized procedures and feedback report formats should also be field-tested and revised. Chapter 50 contains more information about computerization.

49.5 Key issues in designing or revising a pharmaceutical management information system

Overall, political support for making changes is crucial. Many other key issues need to be considered to ensure the success and sustainability of the PMIS.

Involve users in design and pilot testing. The usefulness and sustainability of a PMIS increase with user involvement. To embrace the system, users need to know how the PMIS can answer their questions and solve their problems. In addition, users should be trained to manage the system's evolution.

Be selective in choosing indicators. To save time and money, use proxy indicators when they make data collection

more efficient and are likely to be accurate. For example, although knowing the average number of days each medicine is out of stock would be useful, reporting the number of pharmaceuticals out of stock at a particular moment may be more practical. Chapter 36 introduces the concept of performance indicators, and Chapter 48 discusses their use in monitoring. In general, indicators should be designated in areas such as selection, procurement efficiency, product and service quality, distribution efficiency (stockouts, overstocks), rational use, financial management, human resources management (training activities, for example), and reporting compliance with the PMIS. Table 49-3 illustrates a set of indicators for rational medicine use and the associated information for data collection for a PMIS in Namibia.

Strive for representativeness, not comprehensiveness. A comprehensive set of data appears to provide more accurate information, but, in fact, a statistically representative set of data can provide equally good information for less cost and in a shorter time. Representativeness can be achieved by using sentinel data collection systems or sampling methodologies either to select subsets of facilities to survey or to monitor lot quality to focus on the best- and worst-performing service units.

Choose appropriate data collection methods. When possible, use available data sources and rapid assessment methods to collect information on medicine use at the health service and household levels. Qualitative data collection methods include focus group discussions, in-depth interviews, structured observation, questionnaires, and simulated patient surveys (see Chapter 28). Use supervisors to gather observational data, complete checklists, and

Table 49-3 Proposed PMIS indicators for building a pharmaceutical supply system in Namibia: Rational use of medicines and quality of care

Indicator	Numerator/denominator	Data collector	Where data collected	Tool	Level	Frequency
Percentage of vital reference materials available in the pharmacy	Number present/total number	Pharmacy assistant (PA)/hospital pharmacist	Reference books	Tally sheet 1	District, regional, national	Annually
Percentage of essential reference materials available in the pharmacy	Number present/total number	PA/hospital pharmacist	Reference books	Tally sheet 1	District, regional, national	Annually
Average number of medicines per outpatient prescription	Number of medicines prescribed/number of outpatient prescriptions	PA/hospital pharmacist	30 outpatient prescriptions	Tally sheet 3	District, regional, national	6 months
Percentage of generic names per outpatient prescription	Number of medicines prescribed generically/number of medicines prescribed	PA/hospital pharmacist	30 outpatient prescriptions	Tally sheet 3	District, regional, national	6 months
Percentage of outpatient prescriptions with an antibiotic	Number of prescriptions with an antibiotic/number of prescriptions	PA/hospital pharmacist	30 outpatient prescriptions	Tally sheet 3	District, regional, national	6 months
Percentage of therapeutics committee meetings held and minuted out of number planned	Number of therapeutics committee meetings held and minuted/number of therapeutics committee meetings planned	PA/hospital pharmacist	Therapeutics committee meeting minutes		District, regional, national	Quarterly
Percentage of patients returning on time to collect refill prescriptions (ART)	Number of patients returning on time for refill/number of patients expected to collect refill	PA/hospital pharmacist	ART records		District, regional, national	Quarterly

Source: Lates 2005.

provide immediate feedback and support to staff. Finally, use sentinel systems to generate higher-quality but fewer data from a subset of health facilities (see Chapter 48).

Common errors at different points in the recording and reporting process are noted in Table 49-4, which also describes common sources of problems and possible solutions.

Integrate the PMIS with other data collection systems.

System integration is particularly important in the health sector when information about service delivery is being collected. Health workers are often overburdened by multiple or vertical reporting systems for immunizations, family planning, disease control programs, and so on. In this case, try to collect data through existing reporting systems or other means, such as medical record reviews and sample surveys, rather than by introducing additional routine reports.

One important factor for computerization is the adoption of standard coding systems for medicines, health facilities, diseases, and geographic areas. A uniform coding system is essential to ensure efficient aggregation across facilities or geographical regions. In addition, standard data file structures often need to be developed to promote compatibility among different software programs in use (see Chapter 50).

Develop practical analysis methods to facilitate data interpretation and use. Users should be taught the graphics techniques described in Section 49.7 for use with two to four key indicators and should use them to monitor their own performance. Worksheets can help staff aggregate data and calculate indicators manually from existing records.

Computerize at appropriate levels. Achieving the right mix of computer and manual systems is critical, as is ensuring that they are fully integrated so that units without computers can produce their reports manually. Keep in mind the adage: “If you can do it by hand, the computer might make it more efficient, but if you can’t, the computer is likely to make it worse.” Decisions about computerization should take the following factors into account—

- Availability of a dependable source of electricity, secure physical space, and adequate consumables (for example, paper, ink, CD-ROMs, backup media).
- Local human resources to support computer hardware and software installation, maintenance, and training.
- Volume of data to be processed. If the volume of data is manageable manually, computerization will only add to the cost. Computers are useful if storage

Table 49-4 Improving recording and reporting accuracy

Kinds of problems	Sources of problems	Possible solutions
Errors in recording	Too many data items are on a single page	Limit number of data items per page Use checklists wherever possible
	Data items are not clearly labeled	Label data items in large letters
	No instructions exist for data entry	Provide instructions for each data entry
	Data need to be recopied several times on different forms	Use carbons if multiple copies are necessary
Errors in deciphering	Data are not verified for accuracy	Make periodic checks on the validity and accuracy of data
	Entries are illegible	Use checklist to avoid illegible handwriting
Errors in tabulating	Data entries are abbreviated because of insufficient entry space	Leave sufficient space to avoid abbreviations
	Columns are too long	Add summary lines in long columns
	A single page has too many columns	Limit number of columns to five per page
	There is no place to tally page summaries	Add a sheet for page summaries

and retrieval or compilation of a large database is required.

- Complexity of analysis required. Computers are excellent tools that can be used to solve complex mathematical problems and produce various analytical reports, including graphical representations.

Use software appropriate for needs. The software needs of a PMIS will depend on the size of the data set and complexity of analysis. For example, a spreadsheet program may be adequate, or a database application may be the better choice, depending on the size of the data set and the types of reports needed. A spreadsheet is simpler to set up and navigate, but it is primarily designed for manipulating numbers and making calculations. Spreadsheets are very useful for doing “what if” analyses and generating graphs and are more straightforward to understand. However, a spreadsheet usually requires more redundancy in data entry, which becomes increasingly difficult to handle as the number of records increases. In addition, querying data sets is difficult in a spreadsheet. Keep in mind, however, that data can be converted from a spreadsheet to a database and vice versa.

A database program is designed for collecting, storing, and organizing data. It is more complex to set up, but data entry is generally easier and can be better controlled and validated than in a spreadsheet. A database program has more powerful querying features, which facilitate the manipulation of complex data. Modern databases, usually called relational databases, have improved techniques to efficiently store data that are complexly related. Getting the database structure right is critical to having an effective system, so expert advice may be necessary.

Any system needs to be able to create graphics, such as charts (as discussed in Section 49.7). A Web-based system, as shown in Country Study 49-2, allows many different facilities at different levels of the health care system to access needed information and other resources easily. Software can be an off-the-shelf package or a package custom designed in-house or by consultants. Developing software in-house is a tempting option when an off-the-shelf package does not appear to meet all needs. However, developing software in-house or through a consultant is a difficult task that requires very careful planning. In most cases, using an off-the-shelf package and compromising on some of the desired functions may be a better solution.

Ensure that information is communicated effectively. Key decisions need to be made about what, how, and with what frequency data will be communicated to higher levels. Do all data need to be transmitted and analyzed at a higher level, or only summary data? Do raw data need to be reviewed by line managers before being submitted for analysis, or can line managers rely on analyzed feedback from a central information clearinghouse? For computerized systems, can some data be entered in decentralized computer centers and transmitted in batches, using disks, or through the Internet? Can parts of the system be designed for online use from remote locations? However data are transmitted, careful attention must be paid to setting up and monitoring reporting schedules so that timely information can be produced.

Hire or train staff with appropriate skills. Hiring and keeping knowledgeable and skilled human resources to maintain a PMIS is a challenge; skilled staff members may take positions in the private sector, where remuneration is generally better. Knowledge and understanding of the health system in general and the pharmaceutical management system in particular are important attributes

in someone who is designing or overseeing a PMIS. The level of technological expertise needed will depend on the system, but the person should have a good understanding of information system design principles. Being able to communicate with decision makers to determine the information requirements is more important than simply being a computer expert.

If the required expertise is not available in-house, contracting out the development of a PMIS and computer system may be the best option. Employees already working in pharmaceutical management should also participate in the design of the PMIS; however, some people are reluctant to learn a computerized system, which may be a constraint. Box 49-2 reproduces a job description, including the qualifications and skills, for a PMIS manager in Kenya.

49.6 Implementing a pharmaceutical management information system

Implementation of PMIS changes should be more successful with proper field-testing, phased implementation, flexibility, and adequate training. Field-testing should involve not only the well-performing sites but, more important, the average or worse-performing sites.

A modular approach may be useful. Develop stand-alone modules that can be applied and tested as they are completed, rather than developing the entire system from start to finish before the users ever see it. These modules can later be integrated to form the complete system.

Flexibility is also important. Build in flexibility to add or reduce data elements, or change reporting formats, data entry screens, and feedback reports. Staff members need to

Country Study 49-2

Building a data management information system for MDR-TB surveillance in Brazil

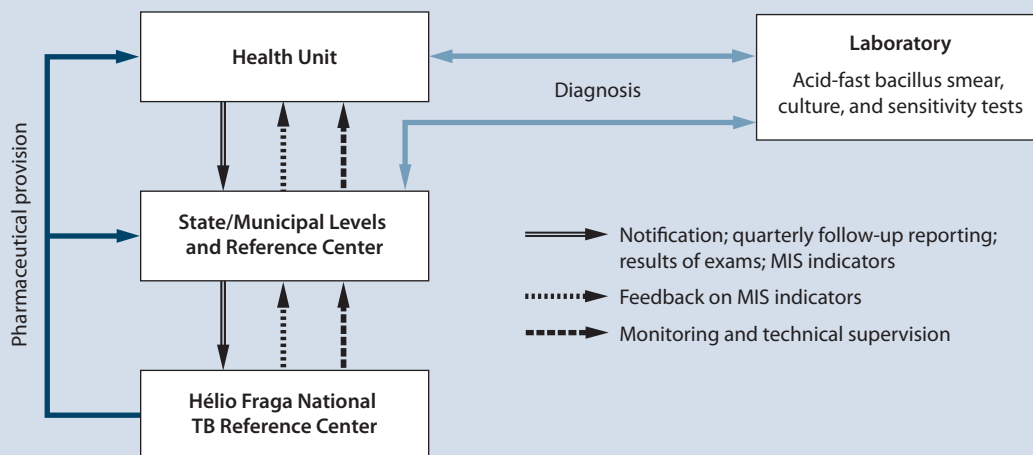
In Brazil, the Hélio Fraga National TB Reference Center, the National TB Program, and the Rational Pharmaceutical Management Plus Program developed a new data management information system as part of a larger effort to decentralize surveillance of multi-drug-resistant tuberculosis (MDR-TB) to the states. The PMIS tracks treatment of MDR-TB patients—diagnosis, case management, and pharmaceutical provision and distribution—including second-line medicines.

The process of creating the PMIS included a stakeholder working group with representatives from decentralized sites that developed and field-tested standardized procedures, defined indicators, and implemented epidemiological and operational reporting. The information

system is Internet-based, so all tools and reports are available online, making information available to users at all levels of the system (see figure below). The MDR-TB surveillance PMIS was designed to integrate into existing governmental health surveillance systems.

The Internet-based components of the PMIS include—

- Case notification data sheet
- Quarterly follow-up data sheet
- Follow-up data sheet after treatment success
- Request for MDR-TB medicines
- Quarterly report on stock turnover for MDR-TB medicines
- Customized reports
- Data extraction tool



Box 49-2**Job description for a pharmaceutical management information officer in Kenya****Overall responsibilities**

The Pharmaceutical Management Information Officer provides assistance to selected Ministry of Health (MOH) divisions in planning and coordinating information on reproductive health and HIV/AIDS commodities for health facilities in line with the Kenya Health Sector Strategic Plan. The Pharmaceutical Management Information Officer assists in strengthening the capacity of pharmacy and laboratory staff in terms of information management for medicines and commodities at both the national and service delivery levels. The Pharmaceutical Management Information Officer also assists with the monitoring of project activities, including collecting and analyzing data related to key indicators established within the MIS, identifying and reporting problems, implementing solutions in coordination with other members of staff, and writing periodic activity reports.

Specific responsibilities

1. Act as the commodity information management liaison to MOH and Rational Pharmaceutical Management Plus (RPM Plus) staff.
2. Support RPM Plus staff to perform the commodity information management functions, which includes but is not limited to the following—
 - a. Receive and collate commodity consumption data and assist with analyzing data related to key indicators established within the MIS
 - b. Identify and report problems; implement solutions in collaboration with staff from the divisions
 - c. Support activities to ensure quality of data
 - d. Develop reports that will inform commodity resupply to sites, stock status audits, and quantification
 - e. Support the database reporting routines for reporting to stakeholders
 - f. Mentor division staff in their monitoring and evaluation (M&E) and MIS roles
3. Participate in commodity distribution planning for and in collaboration with MOH divisional counterpart staff.
4. Participate in commodity management systems strengthening and training activities that target staff in the public health sector–assisted sites. Troubleshoot problems and facilitate progress as necessary.
5. Support the MOH staff in the adaptation, updating, implementation, and dissemination of commodity management standard operating procedures and MIS and M&E tools with the goal of ensuring the effective ordering, storage, distribution, and use of pharmaceuticals and commodities in support of selected priority health care delivery programs.
6. Participate in supportive supervision, M&E, and site assessment activities as conducted by staff of the public-sector program divisions and RPM Plus staff.
7. Participate in the development and submission of appropriate monthly and other ad hoc technical and progress reports, achievements, and challenges faced in implementing the MIS to stakeholders on a timely basis.
8. Assist in the implementation and documentation of Kenya public health sector program activities with specific reference to the information management of the pharmaceutical and laboratory commodities.

Qualifications

1. Graduate degree in public health, pharmacy, or other health-related field or relevant equivalent experience.
2. Experience in pharmaceutical and commodity management systems is preferred.
3. Knowledge and skills in pharmaceutical and commodity management for ART is an added advantage.
4. Long-term working resident experience in Kenya with an understanding of the Kenya public health system.
5. Demonstrated ability to write lucid technical reports.
6. Experience in strengthening pharmaceutical management systems, including pharmaceutical policy development and implementation, supply chain management, dispensing pharmaceuticals, and counseling patients, is preferred.
7. Excellent interpersonal skills and demonstrated ability to interact professionally with a diverse staff, clients, and consultants.
8. Proficiency in English and Kiswahili, including reading, writing, and speaking skills, is preferred.
9. Computer skills, including spreadsheet, database, word processing, presentation, and electronic mail; Microsoft Office preferred. Knowledge of other graphics packages is an added advantage.
10. Ability and willingness to travel extensively in Kenya.

adapt a PMIS and perform ad hoc analyses as information needs evolve.

Many electronic tools exist that can be used in implementing a PMIS; for example, personal computers are now being used in even the most resource-limited settings, and special software packages are being developed to facilitate data analysis and reporting in pharmaceutical management (Country Study 49-1). In addition, other technologies such as personal digital assistants and geographic information systems are being used as tools in MIS (see Chapter 50).

Finally, staff at all levels need sufficient training for their roles in the information system, which may include design and development of an MIS, data collection, computerized data processing, and use of data.

49.7 From information to action

The most fundamental element of a successful PMIS is the effective use of the data generated by the system. Figure 49-3 illustrates the process of transforming data into information and interpreting them for use in decision making. The key steps are processing data, presenting information, interpreting information, and taking action.

Processing data

Data processing can take many forms, ranging from simple data aggregation by district, calculation of averages, or trend

analysis over time to the use of sophisticated statistical techniques such as analysis of variance. The objective of data processing is to reduce large amounts of data to a manageable amount, often using summary tables. It is important to remember that a computer is not necessary for data processing. Tally sheets can be developed to help users gather data from many sources and to compute totals, counts, and averages.

Presenting information

Some people have difficulty interpreting information presented in tables. Simple techniques for graphing tabular data can help simplify interpretation. However, complex tables with many elements are not good candidates to present graphically. A computer spreadsheet or graphics program can make creating these presentations easier and clearer. Some common graph types and their uses are—

- Bar graphs: comparison of values for different items or for the same item at different physical locations
- Line graphs: presentation of trends over time
- Pie charts: demonstration of the relationships among the parts of a whole
- Maps: demonstration of the geographic distribution of indicators

Figure 49-4 illustrates some common graph styles and their key uses.

Figure 49-3 PMIS information stages

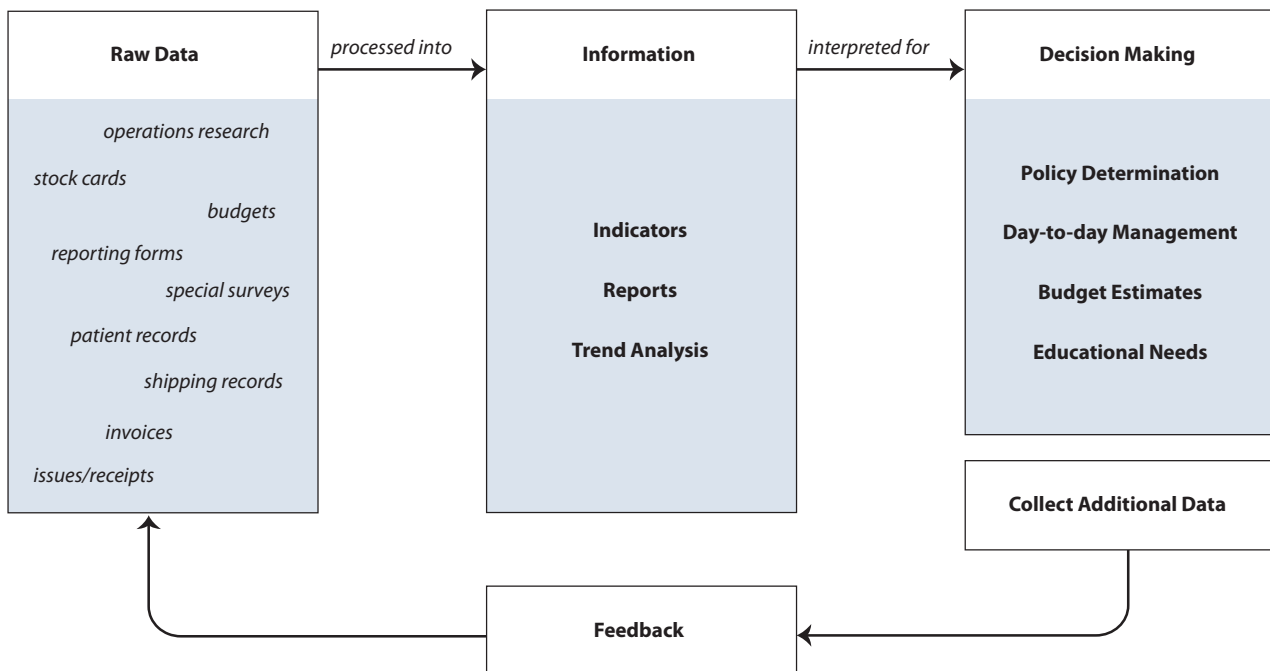
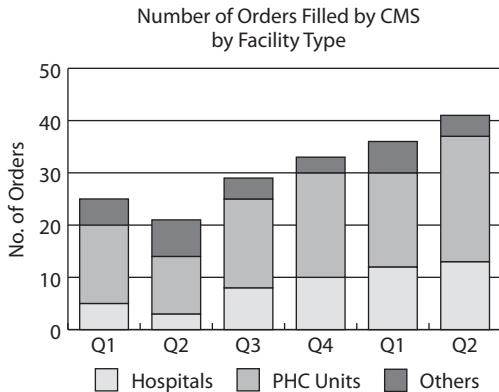
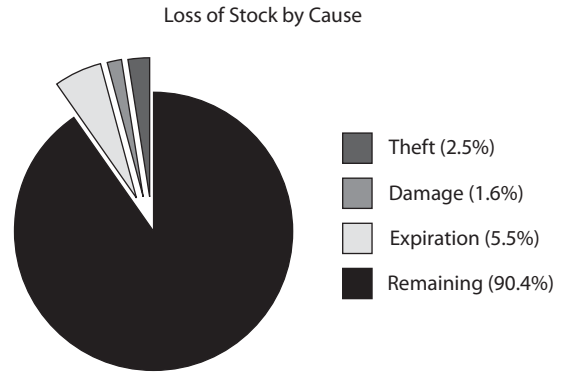


Figure 49-4 Graph styles

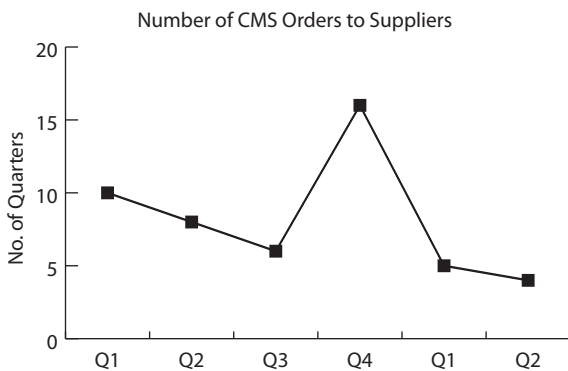
Bar Graph



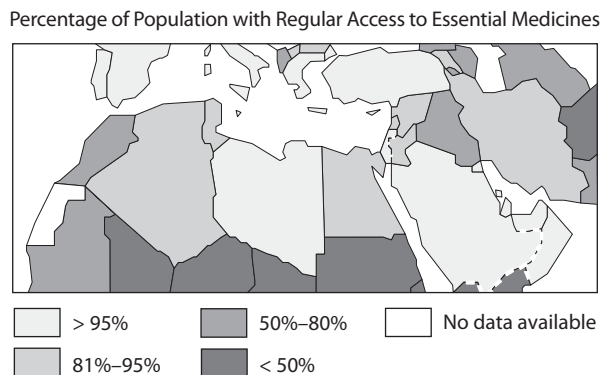
Pie Chart



Line Graph



Map



Interpreting information

Interpreting the information is often the most interesting part of using data. Interpretation is based on context, so creating detailed guidelines for interpreting data is not possible. However, listed below are some of the points to consider in this process.

Are the data correct? If the sources (registers, for example) were reviewed again, would the same figures result? Were the calculations made correctly? Procedures for validating the data should be in place to ensure their accuracy and completeness; for example, pharmaceutical inventory data should be periodically reconciled with physical stock counts. Because verifying all the data may not always be possible, periodic verification based on sampling would greatly improve data quality.

Are the data representative? Ensure that aggregation and analysis are based on a representative sample of data by ensuring that a majority of units are reporting on time. If only the best-performing units are reporting, the data interpretation may be misleading.

Do any of the figures seem improbable? In absolute terms—without making any calculations—do any num-

bers seem strange? Do expenditures seem too high or too low? Are too many essential medicines out of stock? Are too few orders from facilities being filled? Does the number of emergency purchases seem too high? (Small variations from month to month may be insignificant and should be disregarded.)

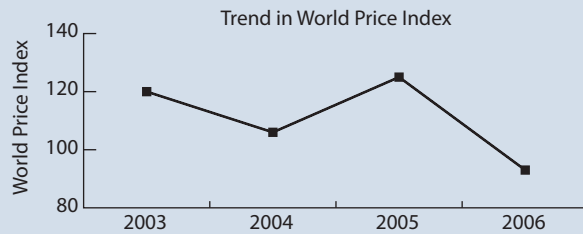
How do the figures compare with previous figures? Is a trend toward improvement evident although the figures may not seem good in absolute terms? For example, even though some revolving drug fund decapitalization may exist, is it lower than the previous year's? Using a simple graph or a wall chart can help identify such trends.

How do the figures for different geographic areas compare? Are some districts more successful than others? Do some need extra help building up their clientele or reevaluating procurement or quantification methods? Does more targeted training, education, and communication work need to be done for staff or clients?

What might be the causes of problems identified in reports? Could external factors (such as clients' economic problems or seasonal variations) be responsible for problems? What could their internal causes be (for example, poor estimation of pharmaceutical requirements or delays

Box 49-3 Example of information interpretation and use

Year	Essential medicines program price	World price	World price index
2003	3,600	3,000	120%
2004	3,300	3,100	106%
2005	3,800	3,050	125%
2006	2,800	3,000	93%



Observation: The difference between the price that the Essential Medicines Program (EMP) has been paying for its pharmaceuticals and the world price has been decreasing steadily, except in 2005.

Possible interpretations

An increasing proportion of central medical stores' pharmaceuticals are being purchased in bulk competitive tenders.

A greater share of the priority pharmaceuticals are now manufactured within the country, so the costs of transport and clearance are decreasing.

The jump in price in 2005 was caused by serious delays in the arrival of major international orders. As a result, the EMP had to replenish stocks with emergency purchases from local pharmacies.

Possible actions

The overall trend is very positive. Ensure that procurement officers are congratulated for a job well done.

Continue to focus on identifying local manufacturers to bid for large orders.

Get more information about why the large procurement was delayed. If the delay was caused by vendor performance, look for a different vendor. If caused by poor planning within the EMP, set earlier deadlines or order more stock so that the pipeline can be shortened.

in processing orders or clearing items through the ports)? Use a table similar to the one in Box 49-3 to list possible interpretations of the information on key indicators.

Taking action

Interpretations of the information provide possible courses of action for each scenario.

Discuss reports with colleagues. When reports are first prepared, discuss them in a staff meeting. Other staff members may offer useful insights into why specific indicators are getting better or worse, and they may have helpful suggestions about changes that could be made.

Provide feedback. When reports are sent from other units, simple feedback can be given, such as acknowledging receipt of the report and providing a response on any issues that require action. Better yet, a routine mechanism can be developed to provide some analysis of data on key indicators in reports received from all reporting units. This analysis should help people compare their performance with that of other units. Automating the preparation of feedback reports is an important use for computers in a PMIS.

For each interpretation, identify possible actions. Note that action should not be limited to dealing with problems; focusing on positive results is also important. If one quarter had especially good results, see what can be learned from

staff about what went right and try to share it with others and replicate it (see Box 49-3).

Gather more data. If reports based on routine data indicate that a problem might exist, confirmation can be obtained through an alternative data collection method, such as a survey or a special supervisory visit.

Correct the problem. Many problems can be corrected through supervision and retraining, but situations may occur in which sanctions and disciplinary action are required. The survival of the program may depend on it. ■

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★ = Key readings.

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ASSESSMENT GUIDE

Information system design

- Does the overall plan for the pharmaceutical supply program include an information management plan?
- Does the information management plan support strategic, program, and work-planning needs? Does it support monitoring and evaluation for assessing the implementation of these plans?
- Have key information users been identified at all levels? Have their needs for information related to management decisions been specified?
- Are data-reporting forms, such as periodic status reports, designed to be easily completed from existing registers, ledgers, and filing systems?
- Have key indicators been defined? Are their uses understood by staff at all levels?
- Is there at least one indicator for each key area of activity?
- Is the PMIS integrated with other information systems? If not, how much duplication of data exists between systems?
- If computerized systems exist, are they integrated with manual systems?
- Is the PMIS well documented? Is there an instruction manual on how to use the system? In computerized systems, are data structures and dictionaries documented?
- Are there enough trained staff? Do entry-level and in-service training schemes exist? Do staff have the capability to adapt the PMIS if necessary?

Data collection, reporting, and use

- Is an institution/unit(s) responsible for managing any health information systems? What type of information is collected and compiled by these systems?
- Are any of the systems automated? Which levels are automated and which levels are manual?
- Does the same system cover more than one vertical program (for example, tuberculosis, HIV/AIDS, immunization)?
- Are data collection methods appropriate for the types of data being collected?
- How long do staff take to fill in the reporting forms

each month, quarter, and year? Can these times be reduced?

- Are report forms standardized? Are instructions available for filling them in?
- Is the quality of data entered into forms validated?
- Do any overlaps exist in the data being reported at different intervals? Are any types of data collected that are never used?
- Do staff use any data to complete report forms before sending the forms on to higher levels?
- Where does data get aggregated and/or compiled?
- What type of reports exist?
- Are feedback reports provided routinely to the units that collected the data? Do they incorporate graphical as well as tabular information?
- Does a schedule exist for report preparation, data transmission, and feedback reporting? What percentage of facilities reports information in a timely manner?
- Is a supervisory system in place that oversees the quality of management information?
- Is the information generated by the PMIS used for management decisions? Who are the key users of data on pharmaceutical management? Have their needs for information related to management decisions been specified? What are the examples of information being used in decision making?

Computers and communication of data

- Are any pharmaceutical management data entered or compiled using a computer? At what levels of the system is a computer used (for example, hospital, clinic, warehouse)?
- What kind of software is used to enter or analyze data?
- Do any facilities lack access to reliable electricity? Telephone connections?
- Is Internet access available to facilities if desired? Are there any issues related to Internet access?
- Can computers and communication systems be locally maintained? If not, what arrangements can be made?

Annex 49-1 Sample annual EMP status report

A. Identification				C. Procurement			
1. Year of report				1. Contracts awarded this year:		Number	Value
2. EMP office name				a. Competitive tender			
3. State				b. Restricted tender			
B. Staffing positions in EMP units				c. Others			
Location	No. Approved	No. Filled	No. Transferred	d. Total contracts awarded			
a. EMP office				2a. Contracts awarded to local manufacturers			
b. CMS				2b. Percent of total procurements (2a/1d) x 100			%
c. Total				3. World price index for selected priority medicines			%
D. Training				No. of Participants			
Workshop Course Type	Number Held	Total Days		Professional	Paraprofessional	Other	
1. Rational procurement							
2. Stores management							
3. Quality assurance							
4. Financial management							
5. MIS/computers							
6. Rational use							
7. Information, education, and communication							
8. Training of trainers							
E. Inventory control (from inventory audit report)							
1. Average lead time for filling stock requisitions from district stores and health facilities (days)							
2. Total value of stock at end of year inventory							
3. Stock lost due to:				Value	% of Total		
a. Expiration							
b. Damage							
c. Theft							
F. Comments							
G. Signatures							
CMS manager				Date			
Financial accountant				Date			
EMP project manager				Date			
H. Local supplier performance for deliveries completed this year							
Name of Local Supplier	No. of Deliveries Completed	Total Value	Value of Rejected Medicines	Avg. Lead Time	Avg. Delay of Deliveries		
Average lead time for local suppliers (sum of avg. lead times/no. of local suppliers)							
I. Foreign supplier performance for deliveries completed this year							
Name of Foreign Supplier	No. of Deliveries Completed	Total Value	Value of Rejected Medicines	Avg. Lead Time	Avg. Delay of Deliveries		
Average lead time for foreign suppliers (sum of avg. lead times/no. of foreign suppliers)							
J. Financial management							
1. Expense summary			Amount	% of Total			
a. Stock procurement				%			
b. Transport costs				%			
c. Workshops and IE&C				%			
d. Fellowships and ext. training				%			
e. Supplies and equipment				%			
f. Maintenance and repairs				%			
g. Other expenses				%			
Total expenses				100%			
2. Income summary							
a. Sales of CMS stock				%			
b. Other income				%			
Total income				100%			
3. Financial data							
a. Total value of stock issues (from J2a)							
b. Total operating costs (1b+1c+1d+1e+1f)							
c. Total value of stock at end of year (from E2)							
d. Value of prepaid pipeline orders							
e. Other debts							
f. Stock fund value at end of previous year							
4. Financial indicators							
a. Operating costs as % of sales ((3b/3a) x 100)							
b. Number of stock turns (3a/((3c+3f)/2))							
c. Stock fund value at end of last year (3c+3d-3e)							
d. Stock fund growth ((4c-3f)/3f x 100)							