CHAPTER 22

Managing distribution

ILLUSTRATIONS

COUNTRY STUDIES

SUMMARY

The primary distribution management goal is to maintain a steady supply of pharmaceuticals and supplies to facilities where they are needed, while ensuring that resources are being used in the most effective way. Distribution costs, which include costs related to storage and transportation, are a significant component of the expense of running a public health supply system. Transportation costs alone can represent a significant percentage of the value of medicines distributed to remote locations. Designing a system for storing and distributing pharmaceuticals, medical supplies, and equipment is complex and important.

Effective pharmaceutical distribution relies on good system design and good management. A well-designed and well-managed distribution system should—

- Maintain a constant supply of medicines
- Keep medicines in good condition throughout the distribution process
- Minimize medicine losses caused by spoilage and expiry
- Maintain accurate inventory records
- Rationalize medicine storage points
- Use available transportation resources as efficiently and effectively as possible
- Reduce theft and fraud
- Provide information for forecasting medicine needs
- Incorporate a quality assurance program

The distribution cycle begins when pharmaceuticals are dispatched by the manufacturer or supplier. It ends when medicine consumption information is reported back to the procurement unit.

The distribution cycle includes the following steps—

- Port clearing (for imported products)
- Receipt and inspection
- Inventory control
- Storage
- Requisition of supplies
- Delivery
- Dispensing to patients
- Reporting consumption

Designing a new distribution system or, as is more likely in practice, evaluating and planning improvements to an existing system, requires systematic cost-effectiveness analysis and operational planning. The basic characteristics of a distribution system include its degree of centralization, the number of levels in the system, and the geographic or population coverage.

A distribution system has four major elements—

1. *System type* (geographic coverage, population coverage, or both; number of levels in the system; push versus pull system; degree of centralization)
2. *Information system* (inventory control, records and forms, consumption reports, information flow)
3. *Storage* (selection of sites, building design, materials-handling systems, order picking, layout)
4. *Delivery* (collection versus delivery, in-house versus third party, dedicated or shared arrangements, choice of transport, vehicle procurement, vehicle maintenance, routing and scheduling of deliveries)

Whenever a new system is designed or an existing one is modified, cost analysis (comparing the total costs of using various options) can help ensure that available storage, transport, and human resources are used effectively. After implementation, a program of performance monitoring should ensure that the distribution system works as intended.

Centralized distribution is one option; some countries procure and distribute medicines regionally, and some use commercial supply systems, which often exist in parallel with public systems. Collaboration between private and public systems may occur at any level.

Operational planning and logistics skills are the key to developing a cost-effective and efficient distribution system. It is therefore important to have a logistics management staff composed of qualified professionals.

The steps in planning a distribution system are as follows—

1. Determine whether distribution operations would be carried out most effectively in the public or private sector, or a combination of both
2. Determine whether a push or pull system is to be used
3. Plan store locations and delivery routes—
    - Map the demand for medicines and estimate future demand based on population growth or program scale-up
    - Locate supply entry points
    - Rationalize primary storage points
    - Plan primary distribution routes and locate new intermediate stores, as necessary
    - Plan secondary distribution routes, if necessary
    - Size the stores
4. Plan delivery schedules and the required transport infrastructure

5. Establish staffing levels
6. Establish information flow

In some countries, private or parastatal distribution companies can provide cost-effective alternatives for the storage and distribution of medicines, especially at the national and regional levels. Contracting out to such a company involves—

- Assessing the cost of the existing system
- Determining what functions to contract out
- Specifying service requirements for the contract
- Preparing tender documents
- Evaluating the tender participants
- Agreeing to and signing a contract
- Monitoring the contractor's performance

22.1 Goals of distribution management

The primary distribution management goal is to maintain a steady supply of pharmaceuticals and supplies to facilities where they are needed while ensuring that resources are used in the most effective way. Distribution costs, including storage and transportation costs, are a significant expense of running a public health supply system, often second only to personnel costs. Transportation costs alone may exceed the value of the medicines distributed to some locations, especially in countries with low population densities that cover large geographical areas. Reducing these costs can mean that more money is available for medicine purchases and clinical care. A good distribution system is a *cost-effective* system that provides an acceptable level of service.

Public health authorities are rarely in a position to create a pharmaceutical distribution system from the ground up; rather, the challenge is to evaluate and improve existing systems.

In many public health systems, senior officials do not consider pharmaceutical distribution a high priority; it is too often placed in the hands of poorly trained and inexperienced staff members who are given responsibility but little authority. Under such circumstances, management tends to react to problems and crises rather than take a long-term, strategic view. For example, to save money, a decision may be made to close an apparently costly warehouse, without considering the potential result of increased costs in other areas, such as transportation.

In planning distribution systems to maximize service while minimizing total cost, it is important not to fall into the trap of improving one part of the system to the detriment of the overall system. In the example above, reducing the number of warehouses will decrease operating and inventory costs. However, with fewer warehouses, transport costs for both the central medical stores and hospitals are likely to increase because of the greater distance to travel to either deliver or collect supplies; therefore, the distribution planner will want to ensure that warehouse and inventory savings are not negated by the increase in transport costs. The effect on customer service will also have to be considered. Inventory costs may be reduced, but if customers must wait longer to receive supplies or if availability deteriorates, broader health system objectives will be undermined. This concept of trade-offs and searching for overall system improvement is important for distribution system planners to understand and apply.

Ideally, a public sector with inefficiencies in its distribution system would perform a wholesale evaluation of the existing structure to find solutions that would be optimal for the entire supply and broader health system. To do this, however, requires that the government deem the distribution function important and make available sufficient financial and expert human resources to conduct the technically demanding strategic reviews. Whereas in some situations existing management will be able to conduct such reviews, in many cases management will have neither the time nor the required expertise to carry them out; therefore, public health authorities may find it more efficient to appoint specialized consultants.

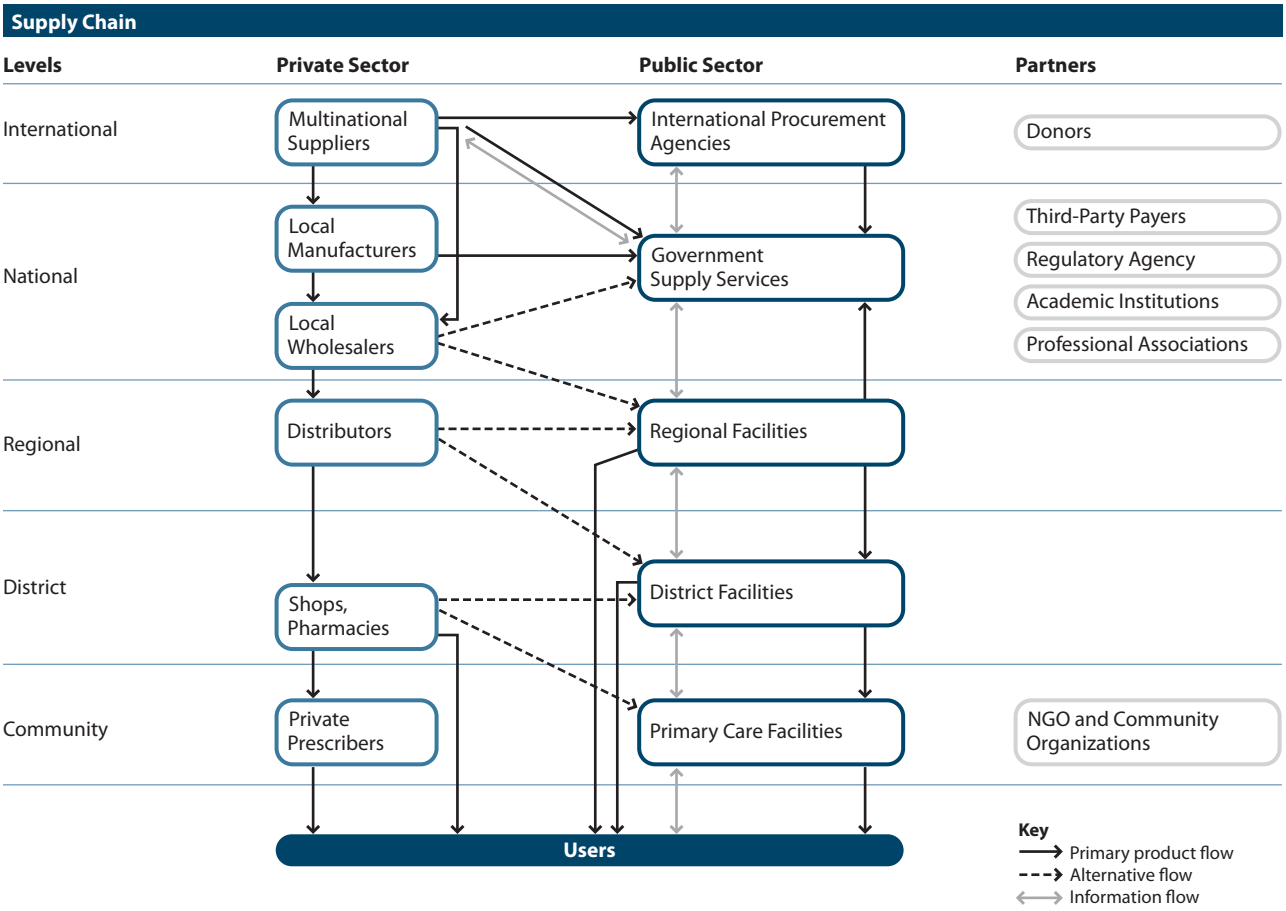
Health programs are frequently managed by well-qualified health personnel who lack logistics experience. *Logistics* is defined here as the "science (and art) of getting the right amounts of the right things to the right places at the right time" (Foster 1990, 207). Warehouse and transport managers, storekeepers, and drivers may possess these skills but may have little influence on decision making. The best way to use their knowledge and skills is to make them part of a logistics team that manages the system design process.

A well-run distribution system should—

- Maintain a constant supply of medicines
- Keep medicines in good condition
- Minimize medicine losses caused by spoilage and expiry
- Rationalize pharmaceutical storage points
- Use available transport as efficiently as possible
- Reduce theft and fraud
- Provide information for forecasting medication needs
- Incorporate a quality assurance program

Senior management should regularly monitor the cost and performance of the distribution system as important indicators of the health care system's operations. Major alterations in the system should be introduced only after careful evaluation and planning, taking into account available human

Figure 22-1 Typical pharmaceutical distribution system



and material resources. A strategic review should begin with evaluating the following factors (which do not, however, comprise an exhaustive list of considerations)—

- Underlying assumptions and strategy of the medical stores organization
- Current and future customer service needs (products, service)
- Basic structure, costs, and performance of logistics system: processes, location and number of warehouses, movement of stock between warehouses
- Product range and sources
- Operating efficiency
  - Space utilization—area, cube, seasonality, pharmaceutical storage requirements
  - Equipment and vehicle use—time, capacity, seasonality
  - Staff performance—throughput per warehouse staff, sales per employee
  - Inventory—stock turn, availability, expiry
  - Order processing—volume of orders, costs, processing time

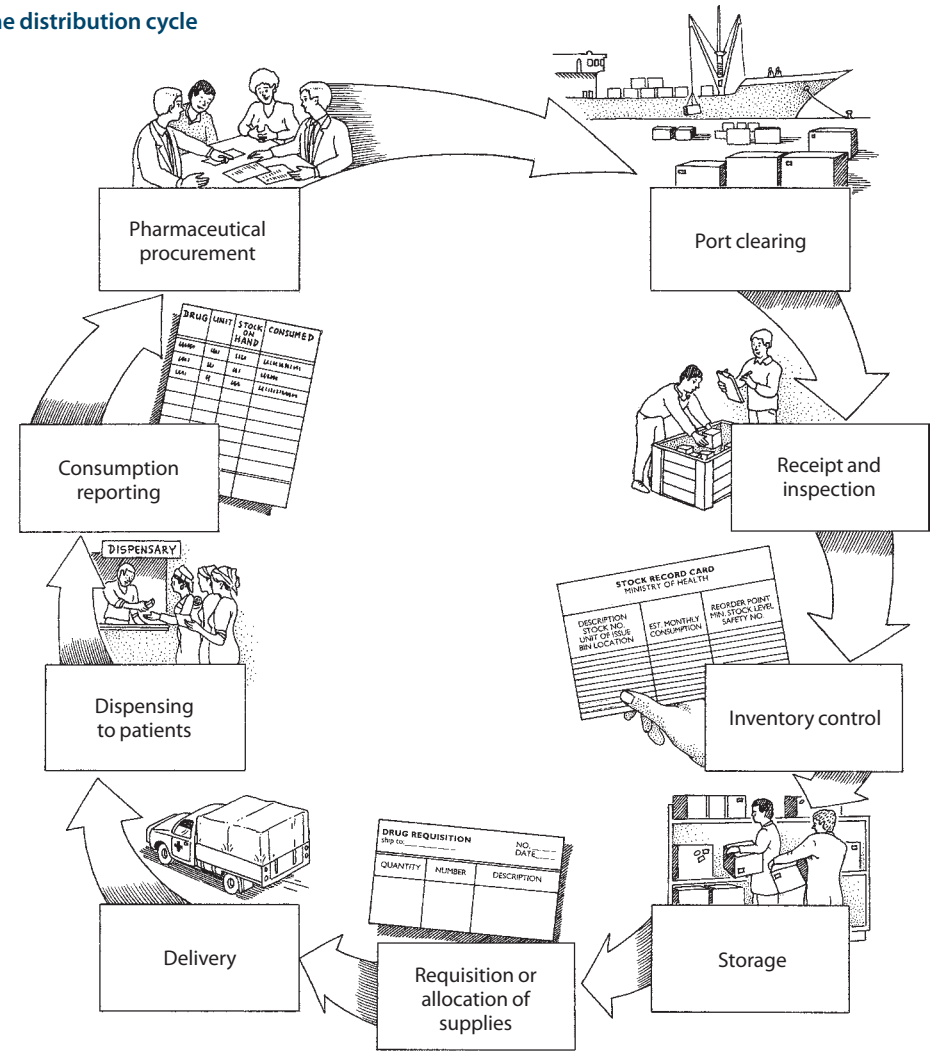
The key to an effective strategic review is exercising rigor in considering all of these areas but not getting mired in precisely analyzing each factor. Appropriate tools to use as part of a strategic review include ABC analysis focusing on order frequency (Chapter 40) and a weighted distribution analysis that identify the most cost-effective distribution strategies using global positioning system (GPS)–based mapping.

Following a review, the alternative options should be evaluated for suitability (main problems are solved, strengths of organization are exploited, option fits with organization and health-sector objectives); feasibility (available funding, skills and operational capacities available, technology available and supportable); and acceptability (preferred solution meets wider expectations and meshes with culture).

22.2 The distribution cycle

The distribution cycle begins when pharmaceuticals are dispatched by the manufacturer or supplier. It ends when medicine consumption information is reported back to the

Figure 22-2 The distribution cycle



procurement unit. Figure 22-1 illustrates a typical public-sector pharmaceutical distribution system and its interactions with the private sector.

The major activities of the distribution cycle are summarized in Figure 22-2. They include—

Pharmaceutical procurement (see Chapters 18–21): The distribution sequence intersects the procurement process at the point at which medicines and commodities are available for delivery to the health facilities.

Port clearing (see Chapter 24): Unless the medicines are acquired locally or the international supplier takes responsibility for port clearing, it is the purchaser's first step in making medicines available for distribution. Port clearing involves identifying shipments as soon as they arrive in port, processing all importation documents, completing any customs requirements, storing medicines properly until they leave the port, surveying the shipment for losses and signs of damage, and collecting the medicines as soon as they have been cleared. Port clearing may be managed directly or through a separate contract with a port-clearing agent.

Receipt and inspection (see Chapter 44): Central stores staff must carry out a complete inspection of every shipment as soon as it is received from the port or local supplier. The shipment must be kept separate from other stock until this inspection has been completed. Inspectors should check for damaged and missing items and for compliance with the contract conditions concerning drug type, quantity, presentation, packaging, labeling, and any special requirements. Prompt and accurate inspection of all shipments is essential to ensure that suppliers fulfill their contracts. Insurance companies will demand an accurate record of any losses incurred before settling a claim.

Inventory control (see Chapters 23, 44, and 46): Establishing and maintaining effective inventory records and procedures are the basis for coordinating the flow of

pharmaceuticals through the distribution system and the primary protection against theft and corruption. The inventory control system is used for requisitioning and issuing medicines, for financial accounting, and for preparing the consumption and stock balance reports necessary for procurement. Record keeping must be sufficiently detailed to provide an "audit trail" that accurately traces the flow of medicines and funds through the system. This audit trail must be designed to satisfy the requirements of government auditors (and sometimes donor agencies) as well as program managers. An appropriate inventory management system should be adapted to suit the capacity and needs of personnel at all levels in the health program. Inventory records must be monitored regularly by supervisors to ensure accuracy and to avoid or detect losses. Careful inventory control is a key to providing a cost-effective and responsive distribution system.

Storage (see Chapters 42, 44, and 46): Storage facilities may range from large mechanized warehouses at the national level to small wooden boxes sitting in health centers or carried by community health workers. Proper location, construction, organization, and maintenance of storage facilities help maintain medication quality, minimize theft and loss through damage, and maintain regular supply to health facilities.

Requisition of supplies (see Chapters 23, 44, and 46): Pharmaceutical supply systems may operate under a push or a pull system (see Section 22.3). The forms and procedures for requisition are a key part of the inventory control system. They may vary from country to country and from one level to another within the same country. The requisition system may be manual or computerized or a combination of both, but it should always be designed to simplify distribution by facilitating inventory control, providing an audit trail for tracing the flow of medicines, assisting in financial accounting, and listing medicines issued.

Delivery (see Chapter 25): Medicines may be delivered by warehouse staff or collected by health facility staff. Transport may involve air, water, railway, or on- and off-road vehicles, porters, or a combination of means. Cost-effective choices between public- and private-sector carriers need to be made. Transport managers should select methods of transportation carefully and schedule deliveries realistically and systematically to provide punctual and economic service. Vehicle breakdowns; availability of fuel, lubricants, and spare parts; seasonal variations in access routes; safety along specific supply lines; the availability of private-sector services; and other local factors must all be considered in transport planning.

Dispensing to patients (see Chapter 30): The distribution process achieves its purpose when medicines reach hospital wards, outpatient clinics, health centers, or community health workers and are appropriately prescribed and dispensed to patients.

Consumption reporting (see Chapters 20 and 23): The closing link in the distribution cycle is the flow of information on consumption (which takes into account actual demand—that is, what would have been consumed if not stocked out) and stock balances back through the distribution system, to the procurement office, for use in quantifying procurement needs. When adequate inventory and requisition records are kept, compiling consumption reports is straightforward.

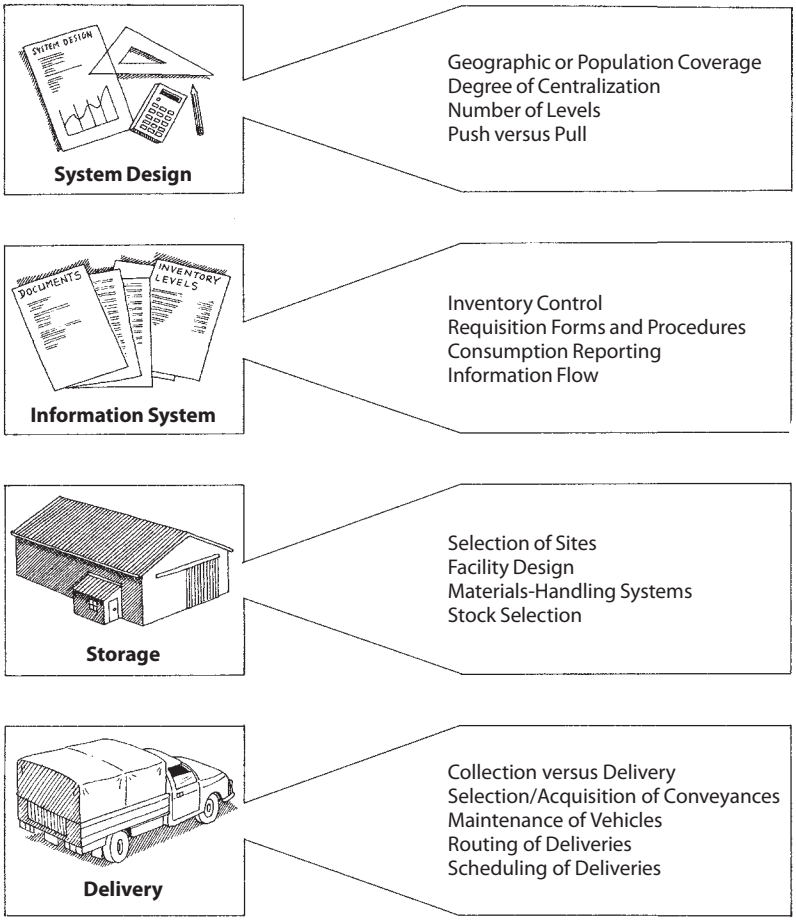
22.3 Distribution system design

Designing a new distribution system or, as is more likely in practice, evaluating and planning improvements to an existing system, requires systematic cost-effectiveness analysis and operational planning. Some guiding principles include—

- Managing and evaluating distribution and logistics as an integrated activity (for example, receipt, storage, distribution, and customer service operating together as a single system rather than as self-contained microsystems unconnected to one another)
- Ensuring distribution system operations are linked to the overall objectives of the medical stores and the broader public health system
- Ensuring customer service needs are understood and accommodated
- Balancing the trade-offs between costs and service (for example, although every hospital might like to have a medical store on its premises, the increases in inventory-holding and operating costs are unlikely to make such an option cost-effective)
- Keeping stock moving
- Minimizing lead times, inventory, and costs
- Analyzing ways to improve effectiveness (for example, reduce number of warehouses, contract out transport, invest in new information systems) as well as efficiency (for example, ensure full transport loads, minimize inventory, mechanize materials handling, automate order processing)
- Minimizing the steps in storage and handling, which decreases the opportunity for damage and loss

When the system is in place, regular performance monitoring is needed to ensure that the system functions as intended. The major design characteristics for a distribution network (see Figure 22-3) are considered in detail in subsequent chapters and are mentioned only briefly here.

Figure 22-3 Design characteristics of distribution networks



Basic design features

The basic characteristics of a distribution system include its degree of centralization, the number of levels in the system, and the geographic or population coverage. Country Study 22-1 highlights the challenges of supplying tuberculosis (TB) medicines in the sparsely populated, mountainous country of Nepal. Comparable problems are faced by small island states, such as those in the Pacific, and geographically large countries with small, partially nomadic populations, such as Mongolia.

In a typical central supply model, pharmaceutical procurement and distribution are coordinated at the national level. Medicines received at the central medical stores (CMS) are distributed to lower-level warehouses and onward to the health facilities. In a decentralized system, the districts or regions are responsible for receiving, storing, and distributing medicines according to their needs; in some cases, they may also be responsible for procurement. Chapter 8 discusses various options for providing medicines to the public sector, some of which require in-house storage and some of which eliminate part or all of public-sector supply system warehousing.

In designing a distribution system or redesigning an existing system, the following important steps have to be taken—

1. Determine the number of storage levels in the system
2. Determine the location of storage sites
3. Decide at which level of the supply system decisions will be made concerning orders
4. Fix resupply intervals or frequency of placing orders
5. Select a collection or delivery method for distributing medicines to user units
6. Select an appropriate mode of transport
7. Determine the amount of inventory to be held at each level in the system
8. Develop a set of feasible and economical delivery routes and work out a practical delivery schedule and appropriate modes of transport to service these routes; determine whether it is more efficient to keep and maintain vehicles or contract out the delivery service

Country Study 22-1
TB medicine distribution challenges in mountainous terrain

In the mountain kingdom of Nepal, the government is succeeding in treating TB and preventing thousands of deaths a year. Starting with four pilot projects in 1996, the DOTS program has been extended to reach all institutions (including primary health care centers, health posts, and 99 percent of sub–health posts), and treatment success rates more than doubled during the program expansion. But success has not been easy. Much of Nepal is remote mountainous and hilly terrain, and many areas are sparsely populated, making pharmaceutical distribution extremely difficult. Medicines are distributed from the central level to regional stores and then supplied to the district, usually by vehicle or plane. From there, the medicines have to be carried by bicycle or on foot to some remote treatment centers. In some areas, additional lower-level health posts are used to provide DOTS to maximize population coverage. Patients can be treated there and only have to go to a larger, more distant health center for occasional monitoring.

Sources: WHO n.d.; SEARO 2010.

9. Estimate the operating costs and assess the cost-effectiveness of contracting for storage and transport at one or more levels
10. Establish a warehouse management system based on a set of standard operating procedures

Distribution network

A public pharmaceutical distribution system may require several layers of stores, each with distinct functions.

In a typical three-level distribution system, purchases from a supplier are received by one or more *primary stores,* which generally serve a whole country or region and may or may not supply health facilities directly. The physical size of the primary stores is determined by national or regional demand for medicines and by the supply frequency. In some countries, this level has been eliminated, with direct delivery from suppliers to intermediate stores.

Medicines are distributed from the primary to the *intermediate stores*. Their size is determined by the demand of the area health facilities and the frequency of supply by the primary stores. Intermediate stores may be independent but are often on the site of a regional or district hospital. Intermediate stores distribute medicines to individual *health facility stores.* This would be a four-level system.

Sometimes two layers of intermediate stores are needed, with first-level intermediate stores supplying second-level intermediate stores. For example, a regional store might supply district stores. Determining the optimum number of levels should be done individually according to program needs and resource constraints, weighing benefits against cost considerations. Some countries eliminate both intermediate levels of store in favor of direct delivery to facilities from suppliers or a primary distributor (see Chapter 8). Having fewer warehouses can decrease the opportunity for losses, and enhances control. Additional factors to consider in determining the number of storage levels are—

- Geography
- Population
- Availability of storage space
- Staff
- Availability and cost of transport
- Political and other resource constraints

Table 22-1 compares the three- and four-level systems in terms of management complexity, setup costs, operating costs, inventory costs, and applicability according to location and density of clinical facilities. Three-level systems are easier to manage and may be less expensive to set up and operate. However, when clinical facilities are widely dispersed and travel times are long, the four-level system may provide better service and may even prove less expensive to operate when all costs are considered.

Figure 22-4 gives examples of four different distribution networks and shows how the quantity and, therefore, the value of stock held in the system tend to increase as more levels are added. Note that the relationships between costs and number of levels are not always as direct as shown in the figure; efficient inventory management in a CMS system might result in lower total inventory costs than would be found in a regional stores network with less efficient inventory management.

No foolproof method exists for establishing the optimal number of levels and facilities in the distribution system, but the following steps may provide a useful way of arriving at the best hierarchy for an individual country or program—

1. Diagram the existing distribution hierarchy (include all clinical and storage facilities and the supply lines connecting them).
2. Diagram three or four feasible alternative hierarchies (include patterns based on different linkages between existing facilities as well as patterns that require additional facilities).
3. For each of these alternatives, estimate as accurately as possible the values for the factors listed in Table 22-1 (management complexity, setup costs, operating costs, inventory-holding costs, delivery times, and so forth).

Table 22-1 Comparison of three-level and four-level distribution hierarchies

Factors	Three-level	Four-level	Comments
Management complexity	Less complex	More complex	Four-level systems are more likely to have problems with transport, communications, and performance monitoring.
Setup costs • Buildings • Equipment • Vehicles	Lower	Higher	In regions where clinical facilities are relatively numerous or widely dispersed, the costs of a four-level system may be justified.
Operating costs • Personnel • Utilities • Fuel • Expendable supplies	Lower	Higher	The same observation as above.
Inventory-holding costs	Lower	Higher	If a four-level system results in more dependable delivery, lower safety stock is needed, and inventory-holding costs are not as high as expected.
Distribution of clinical facilities	Preferable with denser distribution	Often useful with sparser distribution	Distance can be measured in kilometers (miles), time, or transportation costs. Thus, an area that is small in square kilometers but is burdened with long travel times may benefit from a four-level system.
Quality of service • Number of stockouts • Ratio of interim and emergency to regular deliveries	Variable, depending on the location of storage and clinical facilities and the reliability of transportation between facilities		Inventory control and delivery are harder to manage in extended systems, but with good management, such systems are more responsive to the needs of remote facilities.

Total cost analysis is a good way to model these costs (see Chapter 40).

4. Diagram the current and proposed information flows.
5. Select and implement the system that provides the best quality service with available funds.

This systematic approach may identify previously unrecognized possibilities for improving distribution. Furthermore, the information generated can be used to substantiate requests to senior officials or external aid sources for additional funds, to implement a more costly, but more effective, plan.

Push and pull systems

Distribution schemes can be defined by which levels of the system order medicines and which, if any, passively receive medicines distributed from higher levels. The two basic alternatives are—

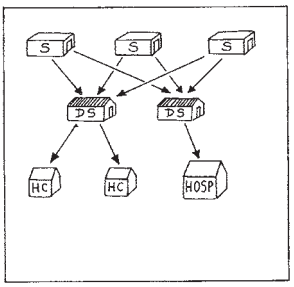
1. *Pull system:* Each level of the system determines what types and quantities of medicines are needed and places orders with the supply source (which may be a warehouse in the system or a commercial supplier). This type of system is sometimes called an independent demand or a requisition system.
2. *Push system:* Supply sources at some level in the system determine what types and quantities of medicines will be delivered to lower levels. A delivery plan is made at the beginning of a planning period, usually a year, and supplies are delivered according to the plan. This type of system is also known as an allocation or a ration system—the best-known example in pharmaceutical supply is the ration kit system (see Chapter 26).

When using a pull system, managers of operational units are expected to work out their own demand estimates and buffer stocks and submit requisitions to central stores indicating their requirements. In a push system, operational units are expected to supply certain stock and consumption information to the supply source so that issuing officers can plan allocations.

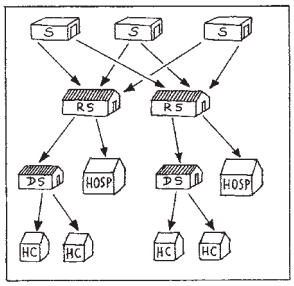
As discussed in Chapter 26, pull systems are preferred whenever the capacity exists to manage them effectively. However, a push system can be useful in certain situations, such as for disaster relief and when the supply pipeline does not function at all levels of the system. Some countries use a mix of push and pull, with primary health medicines being supplied routinely in a kit, while district and regional hospitals determine their own needs. Making the transition from a push to a pull system may be the ideal, but it is not an easy undertaking and can involve complex and demanding changes in inventory management, warehouse operations, and distribution. Country Study 22-2 shows the challenges Tanzania is facing as it moves from supplying essential medicines kits to a direct requisition system.

Conditions that tend to favor push and pull distribution systems are presented below.

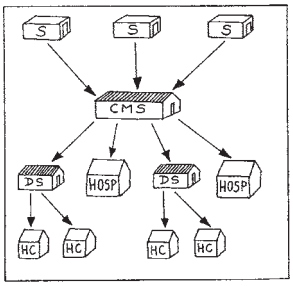
Figure 22-4 Comparison of four distribution networks



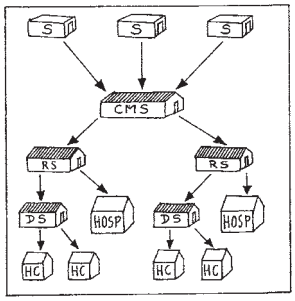
Total Inventory Value	Network Features
$260,417	**Two-Level Regional Stores Network** 20 district stores with $166,667 20 hospitals with $62,500 200 health centers with $31,250



$927,084	**Three-Level Stores Network** 2 regional stores with $666,667 20 district stores with $166,667 20 hospitals with $62,500 200 health centers with $31,250



$1,510,417	**Three-Level CMS Network** 1 CMS with $1,250,000 20 district stores with $166,667 20 hospitals with $62,500 200 health centers with $31,250



$2,177,084	**Four-Level CMS Network** 1 CMS with $1,250,000 2 regional stores with $666,667 20 district stores with $166,667 20 hospitals with $62,500 200 health centers with $31,250

Key

S	supplier	DS	district store
CMS	central medical store	HOSP	hospital
RS	regional store	HC	health center

Conditions favoring a pull system. Conditions favorable to a pull system of inventory management include—

- Lower-level staff members are competent in assessing needs and managing inventory.
- Sufficient supplies are available at supply sources to meet all program needs.
- A large range of products is being handled.
- Field staff members are regularly supervised, and performance is monitored.
- Good data are available to decision makers.

Conditions favoring a push system. Conditions favorable to a push system of inventory management include—

- Lower-level staff members are not competent in inventory control.
- Demand greatly exceeds supply, making rationing necessary.
- A limited number of products is being handled.
- Disaster relief is needed, or the situation calls for short-term supply through prepacked kits (see Chapter 26).

Resupply interval

The resupply interval determines whether deliveries are made to user units quarterly, monthly, weekly, or at any other time. If deliveries are made weekly, average stock levels will

Country Study 22-2
Transition from primary health kits to a direct requisition system in Tanzania

The Tanzanian Ministry of Health (MOH) is instituting a policy of replacing essential medicine kits with an indent (direct requisition) system in order to tailor medicine orders to fit the needs of each particular health facility and to reduce waste. The MOH introduced a pilot project in the Morogoro region in 1999, where health facilities placed their orders with the medical stores department (MSD) through the District Medical Officer. The pilot has since been rolled out to five of the country's twenty regions.

The scaling up of the indent system is placing MSD operations under some strain, contributing to a slower rollout than planned. Inventory management, warehousing, and picking and packing operations all need to be re-engineered. The primary health care kits comprise four prepacked stock items that require only simple block stacking in the warehouse. Replacing the kits with the indent system means that instead of distributing more than 3,000 prepacked kits every month, MSD has to pick, pack, and deliver items according to customized orders, which is having a significant impact on the size and nature of MSD's inventory, storage, and distribution operations.

Source: SEAM 2003.

be low and the likelihood of stockouts will decrease, but transport costs will be very high. If deliveries are made only once a year, transport costs will be low, but the average stocks and storage costs will be high. See Chapter 23 for discussion of the relationship between delivery frequency and stock levels (and associated costs). (See Country Study 22-3 on how an imprest system of resupply is being used in Ghana.)

The optimum resupply interval should be worked out to suit individual program needs. Most public programs use intervals of one to three months. The following are helpful factors to consider before making a decision—

- Storage capacity at each level of the system
- Availability, order size, carrying capacity, and cost of transport
- Seasonal factors that influence transport reliability
- Staffing levels and competence of staff at each level of the system
- Other factors, such as expiration dates, security against pilferage, cash flow, and other locally relevant concerns

Storage

Geographic distribution of population and health facilities determines where medicines are needed. Storage planning starts with an analysis of existing and future supply requirements to establish the type and quantity of medicines required by each facility and the overall volume to be handled by the distribution system. Suitable locations and sizes for the central and intermediate stores can then be determined. Store locations should be chosen to make the most cost-effective use of existing public and private transport networks. Chapter 42 covers planning for storage facilities in detail.

Buildings can be renovated, purchased, rented, or built. The design of large storage buildings should take into account the storage conditions required for different products and the need to move large volumes of material efficiently. Stores at health facilities may consist of a simple storeroom with shelving. However simple the store, storage facilities should always protect against theft and damage by water, pests, or fire.

Another type of facility that can play a role in the distribution system is the regional cross-docking center (or stockless distribution center). As can be inferred, the centers do not hold or manage stock. They can serve primarily as data warehouses to collect, assure the quality of, and report on inventory and order information. They also receive picked and packed orders for each health facility in the region from the central supply and deliver the orders within the prescribed time frame.

Well-sited stores are vital to the success of a distribution system. However, no such thing as a perfect site exists. Needs often conflict: a location may be close to a good road but too far from the health centers it must serve. It is the responsibility of the logistics team to balance these needs. The following steps will facilitate the decision-making process.

Map the demand for medicines. Map the geographical distribution of medicines demand. Where are the hospitals, clinics, and aid posts? Which ones serve the most people? Estimate the volume and weight of each facility's annual pharmaceutical requirements using morbidity data, medicine requisitions, and delivery records. Plan for expansion. Where are new or expanded health facilities likely to be located? Are new public health programs going to be scaled up? Are any recommended treatments changing? How will these changes affect the geographical relationship between existing facilities and storage sites?

Country Study 22-3
Improving pharmaceutical management using an imprest system in a clinic in Ghana

The adoption of a top-up system of pharmaceutical supply has improved the pharmaceutical supply management at the Bank of Ghana Clinic, a parastatal outpatient health facility in Accra. A top-up system is a type of imprest system where running stock is replenished with quantities equal to those used. With the top-up system, the total responsibility for supply is given to the supplier, in this case, the clinic's pharmacy unit.

The maximum (imprest) level of stocks is agreed upon with the department in charge. The content of the list of stocks to be held is based on the regularly used medicines, and the final list is agreed on by the user and the pharmacy. The stock level of each medicine is based on the known average use of the medicine and the interval between stock replacements. In the Bank of Ghana Clinic, an initial survey determined the actual weekly consumption pattern of injectable medicines, with a 10 percent safety margin added. This information was the basis of the maximum weekly stock levels (imprest levels). New supply forms were designed to provide data on quantity used, top-up quantity, and expiry dates. At the beginning of the week, the nursing staff fills in the current stock levels and sends the forms to the pharmacy, where the technician notes how much of each medicine is needed to make the stock up to the imprest level. The pharmacy staff then delivers the items to the department.

In this system, there is no need for the department staff to order; the stock is automatically renewed by the pharmacy. After the clinic instituted this new supply system, their trend toward overstocking was reversed, and there was a significant reduction in inventory value, and therefore, expenditure. The success of the clinic's initial trial with injectables was expanded to other medications and commodities. A successful system depends on good communication and trust between user and supplier.

Source: Marfo 1998.

Locate supply entry points. Most countries have a limited number of entry points capable of handling pharmaceutical imports. These include major seaports and international airports, railway terminals, and cross-border customs posts. The logistics team should decide which points are the most appropriately located and best equipped for handling pharmaceutical shipments. Some countries have several suitable entry points for medicines, and it may be efficient for pharmaceuticals to be delivered through more than one port to more than one primary store. Multiple primary storage points may be justified in large countries or where physical barriers exist, such as mountain ranges or wide rivers without bridges.

Another option to consider is a regional distribution center, which uses regional warehouses as a consolidation point to regulate the flow of pharmaceuticals into a country's central supply. Using a regional distribution center reduces the risk of holding large amounts of stock, such as expiry, damage, or theft (SCMS 2010).

Select primary storage points. Review the location of the existing primary stores and consider whether they are well placed for current and future needs. The most suitable location for a primary store depends on geographic, demographic, and communications factors. A good choice is a point on the national transport network centered in the region with the highest population density. Using this location will help reduce overall transport costs. It is not essential for the primary store to be located in or near a major city. A city location may be administratively convenient but logistically inefficient.

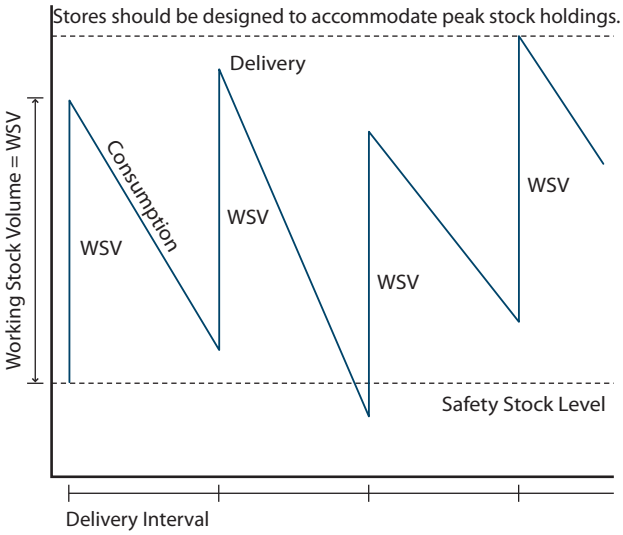
The location of in-country pharmaceutical manufacturers and suppliers may affect the location of stores. Medicines received from those sources are generally delivered directly to primary or intermediate stores, and the transport portion of the pharmaceutical prices can be reduced if stores are located near a large concentration of local suppliers.

Plan primary distribution routes and locate intermediate stores. Good transport routes between the primary and intermediate stores (including any second-level intermediate stores) are crucial. These routes handle the largest quantities of medicines and must be reliable. Intermediate stores should therefore be located on good, all-weather roads or close to railway stations or navigable waterways.

Depending on the volume of pharmaceuticals to be delivered, a supply route that serves two or more intermediate stores on a circuit is usually cheaper than a route that serves only one. However, lengthy primary delivery circuits should be avoided where roads are bad, where overnight security is a problem, or where quality of medicines may be at risk through long exposure to unacceptable temperatures (see Chapter 25).

Plan secondary distribution routes. Secondary distribution routes link intermediate stores to health facilities. The planning of these routes requires detailed knowledge of rural road conditions, travel times, and available transport. Local input is essential. Medicines can be delivered from the intermediate store, collected from the intermediate store, or collected from a convenient health facility on a delivery circuit. The most practical solution for each health facility will vary.

Figure 22-5 Stock volume in store design



Size the stores. The previous steps establish which of the existing primary and intermediate stores are suitably located (or cannot be relocated) and where new stores are required. The volume of medicines to be held in each store can be estimated as described in Chapter 42. The maximum volume to be held depends on supply frequency: programs that receive single annual medicine deliveries require larger primary stores than those supplied more frequently. Estimates for maximum stock levels must also take into account the safety stock volume. However, deliveries do not always arrive exactly on time, and consumption is not entirely predictable (as shown in Figure 22-5). Available storage capacity should always be greater than the calculated maximum stock holding to allow for emergencies and for program expansion.

The capacity of each existing store should be assessed. If the existing storage capacity is insufficient, five possible solutions are available—

1. Reorganize the store by changing the shelving, changing the layout, or introducing pallet racking (see Chapters 42 and 44).
2. Build or rent additional warehouse space. This option involves capital costs for warehouse construction or recurrent costs for warehouse rental.
3. Increase the supply frequency to eliminate the need for additional storage space, probably at some increase in administrative costs. Suppliers may also charge extra for more frequent delivery. If the supply interval is already short, decreasing it may not be practical.
4. Upgrade one or more underused lower-level stores to higher-level status.
5. If insufficient space at the primary level is the problem, consider holding larger stocks at the intermediate level, assuming the capacity exists. A system based on regular transfer of stock between stores at the same level should be avoided in most cases, because it is difficult to record such movements. However, some supply systems can manage redistribution, depending on the qualifications and motivation of the personnel involved.

Delivery systems versus collection systems

Basically, supplies are moved between the warehouse and the receiving facility in two ways: collection or delivery. In the case of a collection system, the receiving facility takes on the responsibility of collecting supplies from the warehouse. In a delivery system, the warehouse is responsible for delivering supplies by either in-house transport or a private-sector contract, or a combination of both. In planning a public health distribution system, considering all transport costs incurred in getting supplies to health facilities is important—not only the costs incurred by the medical store, but also those of each hospital and health facility that sends staff to collect supplies from a medical store depot or is responsible for distribution to lower levels. Although modifying medical stores' distribution systems might reduce costs, the financial impact on hospitals or local health authorities should also be considered before making final decisions.

Each method has advantages and disadvantages; the choice should be based on individual program needs and constraints. General advantages and disadvantages associated with collection and delivery are shown in Table 22-2.

Transport

Transport is frequently the least reliable link in the distribution system and is often a source of great frustration. Transport planning requires the selection of appropriate means of transport and the procurement and maintenance of vehicles or other conveyances. Issues to be considered include—

- Using private-sector alternatives
- Evaluating fleet capacity
- Planning transport system improvements
- Acquiring and disposing of vehicles
- Managing vehicle use
- Maintaining vehicles
- Maintaining medicine quality during transport

Transport managers should make the best use of available transport through careful route planning and delivery scheduling, and should carefully consider private-sector alternatives; these issues are addressed in Chapter 25.

Table 22-2 Comparison of delivery and collection systems

System	Advantages	Disadvantages
Delivery	• If proper delivery routes, order intervals, and delivery schedules are in place, the total cost of transport will be less. • Deliveries of supplies can be combined with other important scheduled and compulsory visits to the field. Also offers an opportunity to supervise fieldwork. • Medicine selection, assembly, and packing operations can be scheduled and accomplished efficiently. • Security and control can be enhanced by a well-managed, well-maintained transport fleet.	• Needs reliable transport facilities. Outright purchase or leasing of vehicles gives rise to high capital and operating costs. • If the delivery route is long, there is the possibility of breakage and loss of quality. • Security lapses may occur because of a lack of a responsible officer accompanying goods in many instances. • Health facilities may be closed when the delivery truck arrives, or a responsible officer may not be on hand to receive supplies. • The delivery truck may be in a hurry to get to the next destination, making it difficult to check for short shipments, damage, and other problems before the truck departs. • Not always possible to make economic use of larger vehicles if delivering to individual hospitals and health facilities.
Collection	• Provides an opportunity for issuing personnel to meet people from the field and discuss common problems, and for field officers to meet and exchange ideas among themselves. • Frees central-level staff from providing transport facilities to the field. • Provides greater incentive to obtain supplies regularly, since the facility is responsible for collecting supplies. • Allows field personnel to attend to other business in town. • Offers the possibility of a greater choice of methods of transport. • Allows for better checking, handling, and security of goods received.	• Takes up a lot of health facility staff time. • Time may be wasted waiting for assembly of supplies, or supplies might not be ready for collection on the first visit. • Total cost of transport may be high. • Health center personnel may tend to increase the frequency of visits for various reasons. • Health staff might become frustrated with the supply system if they find stockout situations at the end of a long trip to the sales depot.

Delivery schedules

Good planning is needed to ensure that each facility receives supplies regularly and on time. For example, an intermediate store may be responsible for forty clinical facilities with a delivery interval of one month. The total time required to supply all these facilities using available resources must not exceed one month. If analysis shows that a longer period is required to supply all facilities, then the delivery schedule must be changed or additional transport resources acquired. Figure 22-6 illustrates this concept.

When determining the appropriate delivery intervals for each store and health facility, consider the following factors.

Storage capacity of primary, intermediate, and health facility stores. Deliveries must never exceed the holding capacity of any store. This situation is more likely to occur with irregular or infrequent deliveries. Analysis of product throughput and delivery frequency can address this issue.

Increased transport costs per unit supplied for deliveries to small, remote facilities. An obvious solution is to supply these areas infrequently. The disadvantage is that this policy increases maximum stock levels at these facilities and may also increase the risk of stockouts in places where environmental conditions make storage for extended periods difficult or expensive.

Efficient vehicle usage. If delivery intervals are too frequent, vehicles may travel half empty. If delivery intervals are long, large vehicles will be needed. Vehicles owned by the health service may stand idle for much of the time.

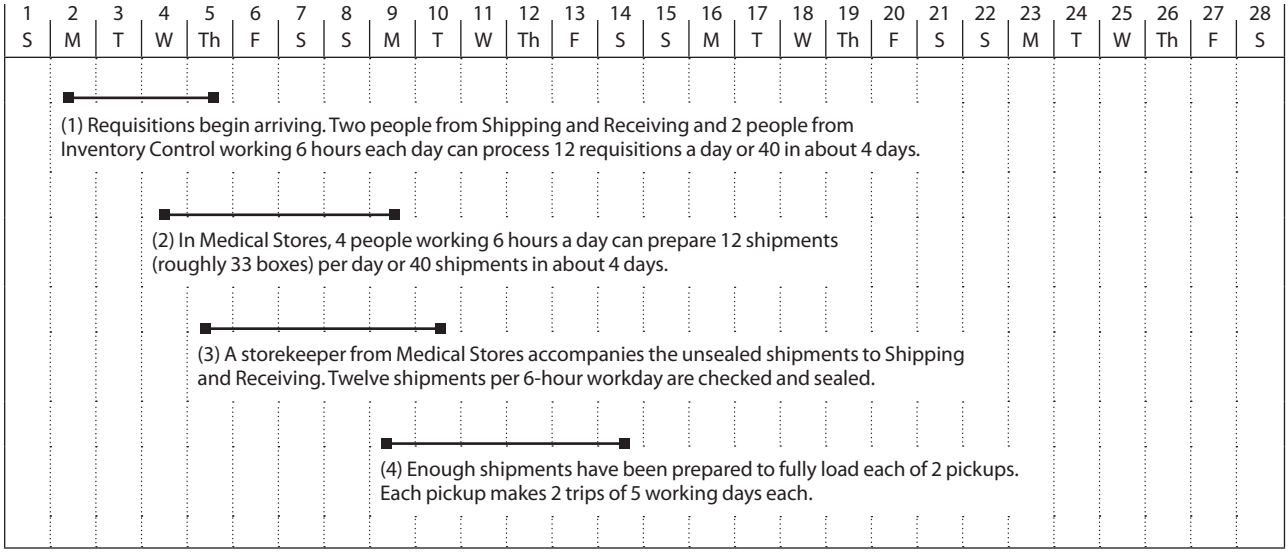
Climatic factors. Delivering to some facilities at certain times of the year may be impossible. Delivery frequency and volume must be scheduled to work around interruptions caused by rainy seasons or other recurring climatic constraints.

22.4 Resources for distribution management

Logistics managers

Under the traditional CMS supply paradigm, transport and warehouse managers and other officers with responsibility for logistics often had low professional status, and their skills and experience were frequently undervalued, if not

Figure 22-6 Planning for monthly requisitions and deliveries



ignored. However, as the importance of pharmaceutical supply management to health programs has become more apparent, many countries are undertaking serious reforms (for example, shifting toward more autonomous, commercially oriented systems) and are recognizing the need for experienced professionals. Therefore, logistics systems are now more often being run by well-trained, experienced professionals than previously.

Experienced professionals should be responsible for the operational planning, implementation, and monitoring of the tasks described in this chapter. In large countries, regional cadres may be more appropriate than a single group of national experts. Logistics managers must stress the importance of improving medicine availability and reducing distribution costs wherever possible. Major decision making may benefit from specialized providers of technical assistance.

To ensure efficient and effective management and planning, the logistics managers or planning team must be vested with sufficient status to resist political pressures; for example, to resist building a store in an area where one is not justified on operational grounds.

Staffing levels

The logistics managers must determine the staffing levels required to administer and operate the pharmaceutical distribution system effectively. Are sufficient staff members available? Are they appropriately trained? Are funds available to recruit and train additional personnel if necessary? The most well-designed distribution system will not work unless there are enough suitably qualified staff members to run it.

Information systems

Reliable management information is vital for coordinating the distribution network. Medicine consumption information flows up and down the network. The information system consists of forms and procedures to record inventory levels, cost and sale prices, and receipt and issue of medicines. The system may be manual, computerized, or both.

It is easy to visualize the one-way flow of medicines through the supply pipeline from CMS to regional or district stores and, finally, to hospitals, health centers, and community health workers. It is more difficult to understand and manage the complementary flow of forms and reports needed to coordinate pharmaceutical distribution.

Forms, records, and reports form the core of the supply information system. Forms are documents that move from one unit to another, carrying specific information about pharmaceutical needs, movements of medicines, and associated financial transactions. Copies of forms filed at various points in the distribution network comprise the audit trail to trace the flow of medicines and funds. Records may be maintained in computer databases, as card files, in ledgers, or in folders. Reports should be prepared regularly to summarize medicine consumption and expenditures. Individual health facilities report to district offices, which report to regional offices, which report to the central office. Such reports are used to project medicine needs, monitor trends in use, revise budgets, and assess medicine use.

The forms shown in Chapters 44 and 46 can be adapted by any supply system to suit its requirements. Some forms may be usable as is, some forms may need modification, and additional forms may be required to suit special information needs.

When a new pharmaceutical supply program is initiated or an existing one is adapted, a complete information system should be established as part of the basic planning process (see Chapter 49). All necessary forms should be available, and all staff members should be trained in the use of these forms before pharmaceuticals start moving through the system. Without this type of preparation, the process of recording medicine consumption and forecasting medicine needs quickly breaks down.

Communications

Good communications are essential to a pharmaceutical distribution system. Where reliable telecommunications networks and postal services do not exist, especially in rural areas, staff often must travel long distances to deliver or collect reports and requisitions. These journeys should be combined with supervisory activities if possible.

Good telecommunications reduce the need for travel, save staff time, increase security, and reduce wear and tear on vehicles. Maximum use should be made of the telecommunications resources available, and appropriate investments in communications technology should be made. Providing a facility with a radio transmitter or a fax machine may help avoid unnecessary travel costs. Increasingly, the Internet may be used for electronic communications, saving resources and improving information delivery times. Other technologies include VSAT (very small aperture terminal) satellite systems and mobile phone technology, which provides a cost-effective communication mechanism, even in remote areas. Mobile phones are being used in many places to report inventory data from the field.

Products with a high market value are at greater risk from diversion and theft than those with a lower market value. Antiretroviral products and artemisinin-based combination therapies, for example, may be at heightened risk; therefore, distribution security will be of increased concern. To track vehicles, onboard computers in delivery vehicles can communicate with a central location (such as the CMS) via GPS, global system for mobile communications (GSM), and short message service (SMS) without any input from the driver. Other wireless communications options to communicate with drivers, such as high-frequency radio and cellular telephones, are becoming more commonly used as a means of managing distribution and protecting pharmaceutical supply systems. Chapters 25 and 43, focusing on transport and security, respectively, cover these issues in more detail.

22.5 Cost analysis and performance monitoring

When designing or revising a distribution system, compiling and analyzing data on current operating costs are crucial, especially for modeling the potential cost impact of various alternatives. Total cost analysis, described in Chapter 40, is one method for analyzing costs and modeling alternatives in a supply system. This section gives an overview of the variable costs that apply to the distribution component of supply systems.

Cost analysis is not usually a continuous activity and should not be confused with performance monitoring (see Chapter 48), which should be carried out regularly using appropriate indicators to ensure that system performance is maintained.

Calculating costs

The first tasks in an evaluation of options are to calculate the *in-house costs* of the distribution system and then to estimate the costs of other alternatives for comparison. In-house costs include storage space, stores operation, equipment, staffing, holding and transport, administration and management, upgrading, and costs of contracting out (see Chapter 41).

Storage space includes the annual cost of rent paid to private warehouse owners and the annual amortized cost of warehouses owned by the health care service.

Operation costs include local building taxes and utility costs (electricity, gas, water, and insurance).

Equipment costs are annual amortized costs for equipment such as forklifts, for security equipment such as fire alarms and fire extinguishers, for specialized equipment such as cold rooms, for computer equipment used in stock control, and for other similar items. Costs should be amortized for items that are expected to have a useful life of more than one year.

Distribution staff costs include overhead and wages paid to storekeepers, drivers, mechanics, and laborers.

Holding stock (carrying cost) is the real cost associated with maintaining stock in inventory, as discussed in Chapter 23. Sufficient inventory must be kept to protect against stockouts and to take full advantage of bulk purchasing agreements. Holding too much stock increases storage costs and locks up funds; a good distribution system balances these two factors.

Transport includes all distribution charges not covered by the supplier's contract, which may end at the factory gate, at the dockside, or at the client's own warehouse (see Chapter 25). Transport costs may include—

- Air freight or shipping
- Insurance
- Demurrage
- Port clearing
- Transferring goods between forms of transport
- Distributing pharmaceuticals within the country
- Packing and unpacking

If government vehicles are used for medicines distribution, the costs include fuel, vehicle repair and maintenance, salaries and daily expenses for drivers, and vehicle amortization. Where financial management and accounting systems are not strong or are integrated into the general ministry of health accounting system, estimating the costs related to the in-house service may be difficult. When parastatal or private haulers are used, fixed and variable transport costs are more transparent.

In most cases, some costs (such as insurance and port-clearing fees) are outside the control of the pharmaceutical program. However, freight charges depend on the volume, value, and/or weight of the supplies ordered, as well as the fees charged by the shipping agent. Shipping costs are important considerations when evaluating pharmaceutical tenders. It is easiest to compare costs from competing suppliers when prices are CIF (cost, insurance, and freight) or CIP (carriage and insurance paid) (see Chapter 39).

Administrative overhead comprises all administrative costs incurred by, or allocated to, the distribution system.

Losses caused by poor management include the following direct costs—

- Damage from incorrect storage or transport conditions
- Theft of stock
- Misdirection of stock
- Unnecessary supplies in stock
- Supplies that expire before they can be used

Costs are also attributable to stock shortages. Extra costs are usually incurred when emergency purchases are made. When medicines are not available, it may be necessary to keep patients in the hospital for a longer period, thereby increasing nursing costs and making beds unavailable for other patients. When patients cannot be treated properly, they may infect others. These indirect losses are difficult to calculate, but they may be estimated using techniques of cost-effectiveness analysis (see Chapter 10).

Upgrading may require additional expenditures to bring an in-house distribution system to an acceptable level of efficiency. These costs must be compiled and included with other in-house costs for comparison with alternatives.

Contracting out incurs costs for private storage and distribution that should be estimated so that a comparison can be made with existing expenditures. These costs can be estimated by assessing private-sector capacity (see Chapter 36) and conducting a nonbinding tender to determine the costs of private-sector services (see Chapter 39).

Collecting and analyzing cost and performance data

In order to calculate costs accurately, collecting data from in-house accounting and reporting systems and from other sources is necessary. Data should be collected from natural cost centers; for example, if the system is organized on a regional basis, analysis of the costs by region will indicate how each region is performing.

Skilled staff or consultants are needed to design and carry out cost surveys, analyze data from survey questionnaires, and make useful inferences from imperfect data sets. The most informative survey collects field-based information from stock and vehicle maintenance records and from discussions with local staff. Chapter 36 discusses the management of an ad hoc assessment. Chapter 40 discusses data collection for total cost analysis. Chapter 48 addresses general principles of monitoring and evaluation, both valuable considerations when designing and implementing performance monitoring of the distribution system. In monitoring schemes, the same data should be collected from more than one source so that results can be cross-checked to assess the accuracy of existing record-keeping and reporting procedures.

22.6 The private-sector option

Pharmaceutical shortages are a common feature of government health services in many countries, even where such supplies are available through the formal and informal private sector. This situation is especially prevalent in major towns and cities. This private availability in the midst of public shortage suggests that, in these countries, the private sector is able to distribute pharmaceuticals more effectively than the public sector.

As discussed in Chapter 8, alternatives exist in many countries to a government-run storage and distribution system. With a well-developed private sector, contracting out both storage and distribution to a private company may be possible and appropriate. The first step should always be to identify local private-sector capacity. Determining the appropriate combination of private and public systems is then possible. A health service can contract all distribution services to the private sector, or may find that some combination of private and public systems is the most appropriate.

In many countries, the private sector can offer a comprehensive and effective distribution service only to the regional or district level. In small or low-income countries, very few private-sector distribution companies may be available, and when competition is limited, a contracted service may not be cheaper or better than the public sector (Bennett 1992).

Many formerly socialist economies have parastatal pharmaceutical distribution companies. Under the pressures of structural adjustment, these organizations are now forced to operate in the market economy. Parastatals can be well placed to provide distribution and transport services where a clear contractual (quasi–private sector) relationship

between the parties incorporates performance targets and penalties for noncompliance.

The decision to use contracted services must be carefully considered because properly managing a contractor's work requires considerable staff time and expertise. To decide whether private provision of distribution systems is truly cheaper, the cost of the existing transport and distribution system must be assessed. Comprehensive tender documents must be prepared, specifying contractual and performance requirements precisely and unambiguously. It is then necessary to assess the capabilities and financial stability of the tender participants. After the contract is signed, the performance of the contractor must be carefully monitored. Contracting is discussed in Chapter 39.

22.7 Considering improvement and replacement

Most health services already have a pharmaceutical distribution network, but needs and systems evolve. For instance, a program might begin by using medicine kits and then wish to move to a requisition-based system, which is more complex and usually increases the number of individual items handled (see Chapter 26).

A distribution system may be outdated; storage points chosen long ago may not suit the present situation, or record keeping may be inadequate. Data may be inaccurate, out-of-date, or not available in a clear, user-friendly form.

If the distribution system does not meet current needs, changes are necessary. The problems might be solved by improving the present system, but sometimes a complete and radical change is the best solution, although it may be difficult to carry out. Even a good system requires frequent minor adjustments to respond to changing needs.

The four examples that follow illustrate typical distribution problems and the types of action that may be appropriate to solve them.

Example 1. Poor administration

Problems in this system include failure to comply with standard operating procedures, inadequate reporting of shortages by peripheral health facilities, and excessive losses due to theft.

Action: Review and strengthen supervision, administrative procedures, and reporting standards. It may be necessary to change personnel, to provide incentives to improve performance, or both.

Example 2. Seasonal variations

Medicine shortages occur because roads are closed during periods of heavy rain or snow.

Action: Review delivery intervals and delivery quantities to take account of predictable weather hazards. Deliver more supplies when the weather is good. Check storage capacity.

Example 3. Major transport problems

Major transport problems, such as lack of fuel or lack of vehicles in working order, arise.

Action: Are the causes of these transport problems local or general? Local problems may be solved by providing more spare parts or installing a fuel depot. General, widespread problems may be a sign of structural weakness, necessitating more radical solutions. Contracts with private-sector or parastatal organizations may be a more cost-effective way to manage all or part of the transport system.

Example 4. Increased volume

New or expanding health programs may result in greatly increased distribution volumes.

Action: Evaluate existing storage and transport capacity and performance and determine how easy it would be to expand the existing in-house system. Existing systems may already be working close to capacity, and expansion might be constrained by limited human resources and management systems. Evaluate the capacity and interest of the private sector to provide a cost-effective service. Determine the optimum mix of public- and private-sector services. Contract accordingly.

Successfully implementing new distribution systems or modifying existing ones depends on many factors. Some of the most important factors include—

- Active commitment of management and staff
- Human resource readiness—having prepared staff members in all departments and at all levels
- Management's full understanding of its own organization
- Willingness at all levels to change and adapt—learn new skills, do new jobs, accept new responsibilities
- Openness to new ideas and creativity
- Continuous, institutionalized effort to improve ■

Glossary

Bin card: Card that records receipts, issues, and balances held in the stores. The bin card is kept in the warehouse with the physical stock.

Card file: A stock record based on the use of cards stored in a file box or a plastic, visible-edge record tray (Kardex).

Cold chain: A system of freezers, refrigerators, cold boxes, and other devices needed to maintain the proper temperature for vaccines (and other perishable supplies) from the point of manufacture to the point of administration.

Collection system: Pharmaceutical distribution system in which the health facilities are responsible for providing transport of supplies from the warehouse to the health facility. Compare *delivery system*.

Delivery system: Pharmaceutical distribution system in which the warehouse is responsible for providing transport of supplies from the warehouse to the health facilities. Compare *collection system*.

Demurrage: A charge assessed by shippers to purchasers that fail to unload and return containers. It can also apply when carriers are unable to off-load shipments because of delay through the fault of the purchaser.

Distribution system: A system of administrative procedures, transport facilities, storage facilities, and user facilities through which supplies move from a central point to the user facilities.

Double-shelf system: A system for stock control in which the stock of each item is physically separated onto two shelves. When the stock on one shelf is expended, the stock from the other shelf is used, and an order for replacement stock is placed.

First-expiry/first-out procedure (FEFO): A method of inventory management in which products with the earliest expiry date are the first products issued, regardless of the order in which they are received. This method is more demanding than *FIFO* but should be used for short-dated products such as vaccines.

First-in/first-out procedure (FIFO): A method of inventory management in which the first products received are the first products issued. This method generally minimizes the chance of drug expiration.

Holding costs: The costs of carrying inventory, usually expressed as a percentage of the average inventory. These costs include both the capital costs and the storage costs.

Imprest system: A form of periodic inventory control in which stocks are replenished up to a pre-established level. No running stock records are kept. The only stock control document is a preprinted sheet showing each item, its description, the unit of issue, and the imprest level. Generally used only at small facilities.

Indent system: A type of pull distribution system where facilities make direct requisitions for stock rather than receive pre-allotted quantities from a central facility.

Inventory: The total stock kept on hand at any storage point to protect against uncertainty, permit bulk purchasing, minimize waiting time, increase transportation efficiency, and buffer against seasonal fluctuations.

Inventory control: The function of supply management that aims to provide sufficient stocks of medicines at the lowest costs possible.

Inventory models: Systems of inventory control that determine how much stock is bought and how often it is bought. See Chapter 23 for a discussion.

Inventory taking: A periodic activity in which a physical count is made of the stock and compared with inventory control records. Also known as *physical stock count*.

Issue: To distribute a specific amount of an item to an intermediary stocking facility or a health facility.

Lead time: The time between the initiation of a purchase order and receipt at the warehouse from the supplier.

Lead-time demand: The number of units demanded and issued during the lead time.

Order picking: The systematic extraction of items from warehouse shelving to fill a client's order. Staff work from a picking list that defines the quantity and location of each item required.

Pallet: A transportable flat storage base, with or without sides, designed to hold goods and to permit handling by mechanical aids such as pallet trucks and forklifts.

Pipeline: The total storage capacity that must be filled in a pharmaceutical supply system, including the central medical stores, regional warehouses, district warehouses, and all regional facilities.

Pipeline analysis: The systematic diagramming of the supply system and calculation of the amount of stock held at each point in the system. The analysis determines the amount of stock actually needed and the amount of stock to be held at each storage point.

Prepacked kits: Also known as *ration kits* or *set packs*. An assortment of medicines and medical supplies to cover a set number of patient attendances, which are distributed unopened to health facilities.

Preventive maintenance: A series of maintenance and service activities performed regularly by a technician or operator and designed to prevent the breakdown of vehicles and other equipment. This form of maintenance is the least expensive.

Pull system: Pharmaceutical distribution system in which each peripheral facility determines the medicine quantities to be requisitioned from the procurement unit or warehouse. Compare *push system*.

Push system: Pharmaceutical distribution system in which the procurement unit or warehouse determines what medicine quantities are to be issued to the peripheral facilities. Compare *pull system*.

Receiving report: A document indicating when items were received, from whom, the total quantity in the shipment, the invoice price, and the amount of damaged or lost stock.

Routing: Determining the order in which facilities will receive their deliveries, based on the geographic location of facilities and an attempt to minimize delivery costs.

Safety stock: The buffer, cushion, or reserve stock kept on hand to protect against stockouts caused by delayed deliveries or markedly increased demand.

Service level: Most commonly defined as the percentage of items requested that are supplied, in the quantity requested, by a supplier or warehouse in one delivery. This term is sometimes used to describe the percentage of demand that is met from stock on hand.

Stock: Goods and materials stored for future use.

Stock count/physical inventory: The process of inventory taking, in which a physical count is made of all items in inventory and compared with the written record.

Stock numbers: Sequential numbers designating each item in inventory.

Stock position: All stock now available and soon to be available, including stock on hand and outstanding orders. This is sometimes called the *total inventory*.

Stock records: A generic term that applies to bin cards, Kardex records, stock ledgers, and computer files. These provide basic information for inventory management by recording all transactions for an item, including receipts, issues, orders placed, orders received, and stock losses.

ASSESSMENT GUIDE

Pharmaceutical distribution system

- Which levels of the supply system order pharmaceuticals from suppliers?
- Is distribution through a push or a pull system?
- Does the system include semi-autonomous vertical distribution components, such as EPI?
- How many levels are there in the distribution hierarchy? How many stores, clinical facilities, or pharmacies are at each level? How many levels of warehouses are needed (for example, central, provincial, district)?
- What are the catchment populations of warehouses, stores, clinical facilities, or pharmacies? Map the geographical distribution of each.
- Is the current distribution system based on collection or delivery?
- How many warehouses are needed? Where should they be? What geographic areas should they serve? What products should they store?
- What volume of medicines is distributed to each warehouse, store, clinical facility, and pharmacy per year? How often is each supplied? What is the physical capacity of each store? Is physical capacity ever exceeded? Map the current demand distribution.
- What criteria are used to calculate the resupply quantities at each level in the system?
- What changes in demand distribution are anticipated in the future?
- What mode of transport is used for each link in the distribution chain? What alternatives are available? What are the travel times for each link?

Supply sources

- What percentages in terms of bulk, value, and number of items do overseas and in-country suppliers contribute annually?
- Which ports of entry are used by each of the overseas suppliers? Which ports clear imports most efficiently and with the least loss?
- Where are the in-country pharmaceutical supply sources located?

Communications

- What methods of communication are available and actually used between each node in the distribution system (telephone, fax, radio link, physical visit)?

Performance indicators

- Cost of stock held as a percentage of stock turnover
- Percentage of health facilities submitting requisitions on time
- Frequency of delivery
- Number of emergency deliveries
- Number of items supplied out of total requested by clients (service level)
- Average stock position in months (quantity on hand and on order, divided by average monthly consumption)
- Stockout frequency for indicator medicines
- Percentage availability of indicator medicines at each level
- Quantity and value of expired items in stock
- Losses caused by damage and theft
- Distribution costs per ton per kilometer
- Vehicle availability and frequency of breakdowns
- Vehicle fuel availability in different parts of the country (a good indicator of the transport system's ability to make deliveries)
- Mechanical breakdown frequency for vital temperature control equipment such as cold rooms and air-conditioners
- Staff attendance rate and sick time used
- Variation between actual and recorded inventory level
- Currency of record maintenance
- Supplier and warehouse lead time

Monitoring and evaluation

- Are there effective systems for monitoring and evaluating distribution system costs and performance? If not, which elements are missing?
- How much can demand forecasts change without affecting the distribution system? For example, what would be the effect of a 50 percent increase in demand?
- What is the annual operating cost of the distribution system as a percentage of pharmaceuticals distributed? Are there significant regional variations?
- What are the costs of private-sector alternatives to in-house services?

Private-sector alternatives

- What private-sector pharmaceutical distribution systems exist? Identify the location of private-sector pharmacies within catchment areas of clinical facilities or pharmacies.
- Who are the private-sector storage and transport providers? Assess whether they are capable of handling medicines and delivering services to areas where they are needed.
- How would contracting out any services to the private sector affect customer service or costs?

Stocking cost: The cost of maintaining stock, including the capital and storage costs.

Stockout: Complete absence of an item that is normally expected to be on hand. In many cases, this indicator can be misleading, because a warehouse may always reserve a small stock—the warehouse is not literally out of stock, but a functional stockout exists because the warehouse will not issue the reserved stock.

Tachograph: A device that records comprehensive details of every journey and can provide a check on the accuracy of a driver's log.

Trans-shipment: Shipment of supplies to an intermediate location, from which they are forwarded by another means of transport to a facility.

Two-bin inventory control: Same as *double-shelf system,* except that two physically separate bins rather than shelves are used.

Unique identifiers: Techniques by which medicines can be identified as originating within the government supply system. Unique identifiers include labels with a program logo, reserved batch numbers, and imprinting of tablets and capsules.

Visual inventory system: A no-paper inventory control method in which the need to order is determined simply by looking at the inventory on the shelf. This system usually provides acceptable performance only in small facilities with a limited number of items in stock.

Working stock: That part of the inventory that is expected to be issued or consumed. It fluctuates between zero and the order quantity. The other component of inventory is the safety stock.

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