PUBLIC HEALTH SUPPLY CHAIN GUIDELINES

Disclaimer:

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The key challenge encountered by the public health supply chain is the uninterrupted and timely supply of health commodities at all levels of supply chain, most critically the last mile. Admittedly, the outcome of ensuring commodity security at the last mile could only be effectively accomplished through cascading of the fundamental supply chain functions at the provincial, district and sub-district levels.

We proudly put forward the completed version of the Public Health Supply Chain Management Guidelines, which was prepared after months of effort. The supply chain guidelines will help the government staff to ensure best supply chain practices at the provincial, district and below levels, contributing towards improved access of health commodities to the people of the province.

The Health Department, Government of Balochistan is committed to improve the health and quality of life for all, particularly women, children and marginalized communities, through access to essential quality health services which are accessible, equitable, culturally acceptable, affordable, and sustainable.

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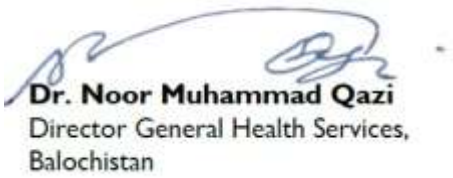

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Introduction to Supply Chain Management

1. Introduction to Supply Chain Management

1.1 Background

1.1.1 Local healthcare scenario:

In the Low and Middle-Income Countries (LMIC) like Pakistan, there is an ever-increasing demand for better healthcare services and requires considerable resource allocation and out of the box thinking to meet healthcare demands in effective manner. However, recurrent resource shortages, high expenditures and strained administrative procedures leave healthcare delivery systems in LMICs with relatively fewer options to deliver standard healthcare services to their populations. In addition, emergence of pandemics and or other unforeseen events such as natural disasters further widens the demand and resource gap in already strained economies.

Pakistan is a country of nearly 220 million people with approximately 27 million children of less than 5 years of age. With a challenging increase in the population having a growth rate of 1.8% up to 2030, the population demographics are changing rapidly thus posing multiple challenges to the healthcare delivery system of the country. For example, ever-increasing numbers of young children will substantially increase the burden on maternal and child health service delivery components across the country. Similarly, altering demographic milieu will have multifaceted impact on the communicable and non-communicable disease burdens and reciprocating healthcare service needs of the population.

The ultimate goal of the healthcare delivery systems is to improve the health indicators such as Infant Mortality Rate, Maternal Mortality Ratio, Mortality Rate in children less than 5 years of age and incidence of communicable and non-communicable diseases etc. Pakistan's IMR in the year 2018 was 57/1000 live births, with neonatal deaths constituting 62% of the total infant mortality indicating a high proportion of young infants dying early in life with underlying causes relating to maternal and early newborn health. The Under 5 mortality remains 69/1000 live births.

Infectious diseases present another challenge in the form of sporadic events, disease outbreaks at larger scales and even pandemic. Some of the infectious diseases have chronic progression element such as Hepatitis B (HBV), Hepatitis C (HCV), HIV/AIDS and Tuberculosis (TB) and are spreading in the population at increasing rates. Meanwhile, as per National TB Control Program Pakistan estimates, approximately 573000 people fell ill due to TB and Pakistan ranks 5th amongst the high burden countries for TB in the world. The prevalence, incidence and mortality per 100,000 population per year from TB in Pakistan are 348, 276 and 34 respectively[1]. Furthermore, very recently, a massive outbreak of HIV/AIDS was detected in Sindh province of Pakistan and the statistics are alarming pertaining to the no. of people infected and the service delivery infrastructure available to provide prevention and control services to the population against this fatal infectious disease.

Dealing with increasing incidence of non-communicable diseases (NCDs) such as diabetes, hypertension, myocardial infarction, stroke, chronic renal failure etc. is another major challenge for healthcare delivery system even in developed countries. Various factors contribute towards worsening NCDs situation including urbanization due to enormous increase in population, unhealthy life styles, environmental factors such as pollution, poor access to preventive and curative healthcare services and high cost associated with treatment of complicated cases of non-communicable diseases.

It is, therefore, evident that by altering only one of the health determinants i-e catchments population can drastically alter the demand of resources to cater for healthcare needs of our people. To deal with these challenges, pragmatic approaches and adequate resource allocations are required for health system strengthening.

1.1.2 Why Supply Chain Management in healthcare system:

The fate of any public health program either 'success' or 'failure' is highly dependent on availability of healthcare commodities (preventive / curative) to its end users when its required. The availability of supplies and commodities in a healthcare system is so essential that absence or shortage of commodities lead to even closure of the programs leave aside the success of the programmatic interventions. Therefore, it is regarded that if there are no commodities, there is no program.

One of the major functions of the program management / leadership is to ensure sustained availability of healthcare commodities to meet the needs of their clients in a timely manner. As healthcare systems require multitude of commodities in terms of medicines, equipment, consumables and specialized healthcare products such as vaccines, there is a need of systematic approach to ensure continuous availability of these commodities at all times. The function of ensuring commodities at the last mile of the healthcare delivery system comprises of multiple concerted and well-coordinated activities working in unison to accomplish this important task.

The public health programs are implemented and get benefitted through a well-functioning supply chain system in terms of improved health outcomes, enhanced impact of the healthcare programs and cost-effective value addition in the quality of care with enhanced client satisfaction and trust on the healthcare delivery program/system. Hence, efficient Supply Chain Management plays a pivotal role in ensuring the success of any program, project or an organization. Meanwhile, since these activities of the Supply Chain System are interconnected, therefore, compromising any one activity will have a direct impact on overall progress of the program/project. Ultimately, the rationale of a supply chain system in healthcare settings is to make sure that the products are available where these are required.

This chapter aims to provide a comprehensive introduction to the public health supply chain system with the notion that public health supply chain system ensures improved health outcomes in populations.

Objectives:

The specific objectives of this chapter are to:

1. Apprise the readers on basic concepts of supply chain management and its impact on healthcare outcomes
2. Enhance understanding of major components of a public health logistics system

1.2 Supply Chain Management

Operationally, Supply Chain is a system comprised of organizations, events, information, human resource and different resources involved in bringing a service or commodity from its manufacturer, producer or supplier to a consumer or end-user.

More specifically, supply chain is defined as an integrated system, coordinating range of interconnected processes based on the actual demand for the commodities and comprises of i) acquisition of raw materials ii) production of finished products iii) value addition of final products iv) storage and distribution of final products to the end-user/s and v) maintaining smooth sharing of

information with relevant stakeholders such as suppliers of raw material, manufacturers, third-party logistics providers, retailers, distributors and the program managers/decision makers.

It is worth noting that Supply chain management encompasses the planning and management of all activities involved in sourcing and procurement and all logistics management activities. Importantly, it also includes coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, supply chain management integrates supply and demand management within and across the program management or healthcare delivery system.

A functional supply chain system not only ensures commodity security but also brings significant value addition to various processes by enhancing value for money and ultimately reducing burden on the already strained healthcare delivery system in the context of low-to-middle income economies globally.

Supply chain management system can be useful in various ways. Some of the benefits of a functional supply chain system are enlisted and described below:

1) An efficient operational supply chain can contribute towards reducing the cost (cost-efficiency) in the program, and it can help in utilizing effectively the limited resources. The pay-off of a well-maintained supply chain is an investment that is reflected in:
   a) Reduction of losses owing to overstock, excess wastage, damage, expiry and pilferage
   b) Reduction in overall costs
   c) Indirectly protecting several investments in health care programs

   By these gains in a public health supply chain, commodity security is ensured with an improved program impact, enhancing the quality of care at an affordable cost by investing in supply chains. Moreover, a public healthcare program will be able to deliver comprehensive and high-quality services to the populations it intends to serve.

2) A reliable supply of commodities increases the confidence of clients/patients in using the health services offered by the healthcare delivery system. For example, the sustained availability of different contraceptive methods will lead to its increased use and therefore will lead to increase in the contraceptive prevalence rate (CPR) at the population level.

3) The programs with unstable supply of the relevant commodities will fail to provide quality services. For example, if the EPI program can ensure sustained availability of vaccines in required quantities to the trained vaccination staff based at a healthcare facility it will enhance the confidence of the community on the vaccination services and will ultimately increase the vaccination coverage in the populations.

In the following section logistic management system is described in detail.

1.2.1 Key Supply Chain Terms and Concepts

To avoid confusion and to familiarize mid-level managers of healthcare delivery system with the fundamental concepts of supply chain management, some key terminologies are introduced here.

1- ***Users***: In logistics terms, the user is often referred to as the patient, client or healthcare provider to whom the healthcare commodity is issued for treatment or diagnostic purposes. These terms are further explained below:
2- ***Clients:*** A person who receives service or treatment e.g. a patient receives a service of test for TB/HIV.

3- ***Patients:*** A person who visits the clinic to receive treatment for an illness such as an HIV patient enrolled in antiretroviral therapy (ART) program.

4- ***Customers:*** Patients, clients and users are termed as customers who are being served by the stakeholders of the health system including health centers, laboratories and service providers. The concept of customer services is also very important which can be applied between different tiers of the logistics system e.g., the regional warehouse is the customer of the central warehouse.

5- ***Consumption:*** Data related to the number of goods either given or utilized by the users.

6- ***Issues data:*** The information regarding the movement of products between any two storage facilities is known as issues data e.g. a public tertiary care hospital pharmacy provide supplies to the emergency ward, this is issues data.

7- ***Service Delivery Point (SDP):*** A facility that receives health-related supplies and issues to the users to provide healthcare services.

8- ***Pipeline:*** The pipeline is the whole chain of physical storage facilities and transportation links through which supplies move from the key stakeholders (i.e., manufacturer, port facilities, central warehouse, regional and district warehouses, entire SDPs, transport vehicles, community-based distribution networks) to the users. For example, a typical public sector domestic supply pipeline can be explained through a flow diagram as shown in Figure 1.

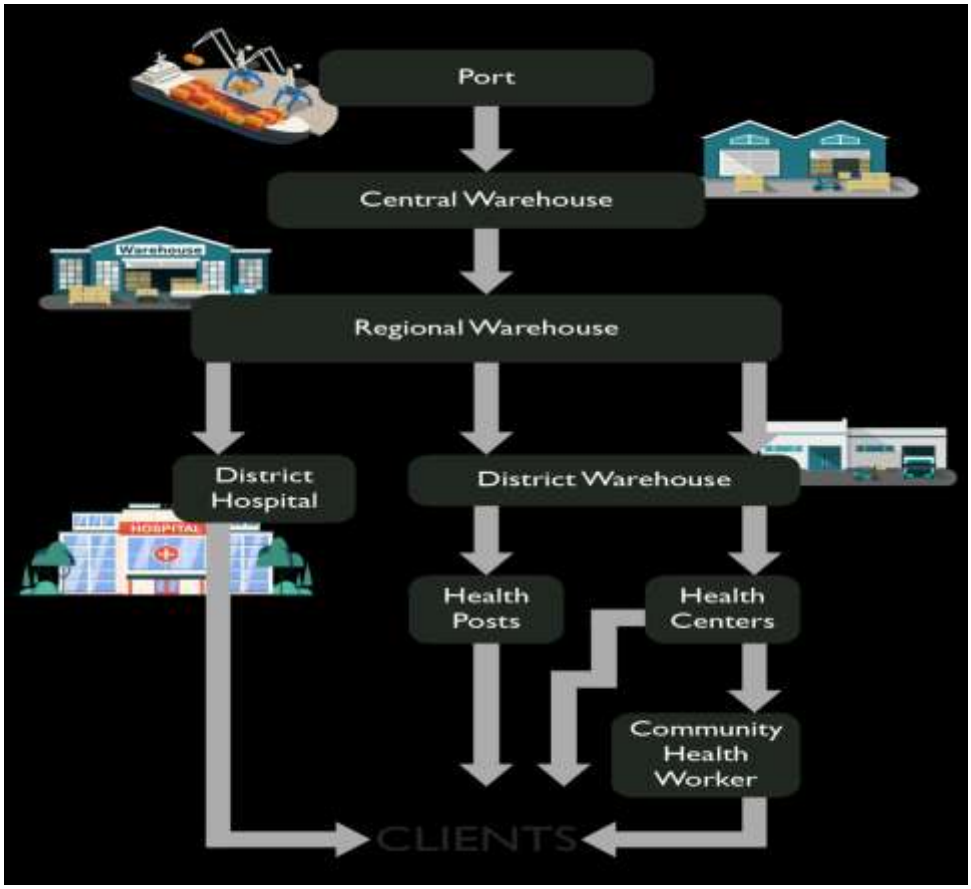


Figure 1: Domestic supply line in public sector supply chain management system

9- ***Lead time:*** This term refers to the time between when new stock is ordered and when it is received and available for use. The concept of 'available to use' is crucial because the stock that has been received, but not inspected, recorded, and put on the shelf, is not ready to be issued and ultimately cannot be used.

10- ***Value:*** **Value** is the price of goods or services along with the availability of customers who are willing to pay for what an organization provides them. Thus, is measured by total revenue, a reflection of the price an organization's product and service commands and the

units it can sell. Thus, the value added by the organization determines the level of the product's success because customer experience is directly related to the value of the product. So, the higher the value, the greater consumer satisfaction.

11- ***Push Strategy:*** This strategy refers to push products or services to the consumers/end-users such as patients through incentives or promotions. This strategy is built on the long-term forecast of anticipated demand as opposed to actual demand by the end-users. Therefore, the products are actually 'pushed' by the program management to the end users.

12- ***Pull Strategy:*** A strategy that accounts for actual customer demand for any product. The healthcare commodities are distributed to the SDPs as per the actual historical consumption data.

13- ***Integration:*** In the healthcare context, the WHO defined integration as *"the management and delivery of health services so that clients (patients) receive a continuum of preventive and curative services according to their needs over time and across different levels of the healthcare system."*

14- ***Product Integration:*** Combining the logistics management of some or all logistics functions for different commodity categories e.g., TB, malaria and contraceptives into a shared supply chain.

15- ***Supply chain integration:*** The supply chain integration refers to combined procurement, storage, transportation and distribution of different healthcare commodities by single unit of the healthcare system. For example, the provincial department of health may strategize the procurement of cold storage equipment for storage and transportation of vaccines, lab reagents and temperature sensitive products such as blood products instead of running separate procurements for different programs separately. This will enhance the performance of the supply chain system.

16- ***Coordination:*** Speaking of coordination from the supply chain perspective, there are three dimensions:

   a) *Intra-functional* coordination that administers the activities and processes *within* the particular function (e.g., coordinated inventory and transportation management within the logistics process) of an organization.
   b) *Inter-functional* coordination between logistics and purchasing, purchasing and production, and logistics and marketing *among* the functional areas of the organization.
   c) *Inter-organizational* coordination takes place *between* legally separated organizations.

17- ***Risk Elements:*** The multiple supply chain partners need to profile the potential risks involved in supply chain activities. The following list summarizes such profiles.

   a) ***Risk of healthcare quality failure***: In 2012, more than 100 cases of a rare form of meningitis in nine states in the United States had been traced to a tainted batch of steroids manufactured by the New England Compounding Center, Framingham, Massachusetts. As illustrated by the recall of these tainted steroids, the consequences of failing to assure quality at the upstream supply chain can be enormous. This is owing to the interdependence of supply chain partners. Likewise, in 2013, renowned pharmaceutical industries Glaxo Smith-Kline and Novartis experienced delivery delays of seasonal flu vaccines owing to manufacturing delays caused by their suppliers. Such delays created vaccine shortages for many regions of the United States and wreaked havoc in public healthcare when the flu epidemic started. Thus, these kinds of healthcare quality failures should be prevented at the furthest upstream supply chain.

   b) ***Risk of information failure*****:** The bullwhip effect is a noticeable consequence of information failure in the supply chain where production orders of medical supplies or drugs at the upstream supply chain members tend to exaggerate their true demand at the downstream supply chain. Since the bullwhip effect will create phantom demand and the subsequent overproduction and overstock of unnecessary medical supplies or pharmaceuticals, its risks should be assessed before the development of the healthcare

supply chain network. Such risks may be reduced by postponing the final purchasing as well as shipment of health commodities such as medical supplies or pharmaceuticals until they are needed.

1.3 Logistics Management in Public Health Supply Chain Systems

Activities related to logistics management are pivotal to any supply chain system. Various logistics related activities are organized in a manner that the supply chain system can fulfill the ultimate goal of commodity security.

A Supply Chain system is comprised of two major areas i-e:

i. *Operational: Logistics* related activities are the operational component of supply chains which include functions like product selection, quantification, procurement, inventory management, warehousing, transportation, fleet management, and data collection & reporting.

ii. Physical Infrastructure: Organizations are the structural part of the supply chain consisting of departments looking after procurement, planning, drug regulatory board, human resources, and health programs within a Ministry; central medical stores; non-governmental organizations (NGOs); donors; regions and districts; health facilities; community health workers; and private sector partners, such as drug manufacturers, distributors, third-party logistics providers and private service providers. All the actors within this system are part of the country's health system and the operational, legal and socio-economic environments.

The logistics system comprises of all activities that take place among multiple stakeholders including but not limited to the manufacturers, suppliers, customers and end-users. It brings a systems approach to understand and manage various activities crucial to organize the flow of goods and services from producer/supplier to consumer/end-user, eventually. The basic requirements of a community are, thus, responded to effectively by adopting the framework devised by this systems-approach especially in the case of health commodities.

Before explaining role and components a logistics management system in public health supply chain system, we need to understand the objective of logistics management. The objective of logistics management system can be described as ensuring availability of *right commodity, in right quantity, in right condition, at the right place, at the right time and at the right cos.* This is termed as "6 rights of the logistics system".

Figure 2: Six Rights of Logistics System

1.3.1 Components of Logistics management System

The major components of a logistics management system are enlisted below and described in the latter section:

1. Product Selection (Need-Based)
2. Forecasting and Supply Planning (FASP)
3. Procurement
4. Warehousing and Inventory Management
5. Distribution/Transportation
6. Data Reporting/Logistics Management Information System (LMIS)
7. Quality Assurance
8. Monitoring and Evaluation (M&E)

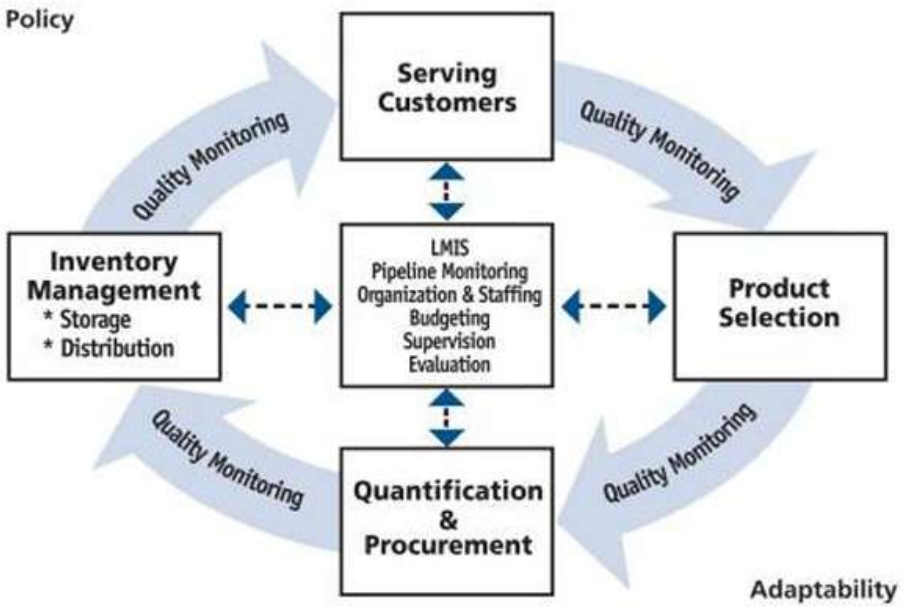


Figure 3: Logistic Cycle

1.3.1.1 Product Selection

A healthcare system requires range of commodities to fulfill the needs of the communities it intends to serve and also to achieve its programmatic targets. One of the major challenges for the health managers is to rationalize the selection of a healthcare product while taking account of various factors including but not limited to the manufacturers base capacity, cost of the product, available scientific evidence pertaining to the product safety and efficacy, legal and administrative environment and acceptance of the community for a selected healthcare product and the availability of the product in the market.

Product selection is the responsibility of technical experts who finalize the medicines/supplies required for different levels of Health Services delivery taking into account different considerations. These considerations include:

- Effectiveness (Vaccines availability and coherence with the Immunization Schedule of the Country)
- The convenience of the end-user
- Drug Sensitivity/Resistance Reports (Social behaviors and adverse effects notification)
- Side-effects (reports from health facilities and their confirmation)
- Cost-Benefit Analysis (safe and effective vaccines supplied at low cost)
- Scientific evidence from Local and International Experiences
- Availability of the product in the market

1.3.1.2 Forecasting and Supply Planning

While Product selection answers the question *'which product is required'* by the healthcare delivery system, Forecasting and Supply Planning (FASP) activity responds to the second most important question i-e ***'how much quantity of a product is required in a certain period of time at a certain place'.***

Careful forecasting and supply planning for the selected healthcare products helps to ensures credible service delivery, availability of adequate stocks (avoid product stock-outs and prevents excess stocks) and avoiding losses due to expiry or mismanagement of financial resources. Efficient procurement, inventory management, and distribution of products largely depend on realistic forecasting.

A dedicated team of professionals is required to conduct FASP activity while taking into accounts various factors and considerations such as:

i) Target population to be covered
ii) Epidemiological profile of the diseases
iii) Consumption trends of the product
iv) Adequate service delivery infrastructure availability (trained HR, SDPs etc.)
v) Financial resources available

1.3.1.3 Procurement

Procurement of the selected healthcare products requires various administrative procedures to work in unison with the national and regional rules and regulations. The procurement process covers procurement planning, preparation of bidding documents, advertising the tenders to invite bids, technical and financial evaluation of the bids, addressing the grievances of the bidding parties if any, awarding the contract to successful bidders and monitoring of the contract till the products are delivered by the contractors

Public procurement is a highly specialized field and requires involvement of a team of professionals including program managers, logisticians, legal and financial advisors and data managers.

The procurement process is usually governed and regulated by the existing regulations of a country/region. For example, in Punjab, there is procurement regulatory authority named 'Punjab Procurement Regulatory Authority' which monitors the procurement process to ensure that no rules and regulations have been violated while carrying out the procurement process by the procuring agency. Having established this authority, the Government of Punjab has developed and adopted a set of procurement rules. Punjab Procurement Rules are based on widely acknowledged principles of good public procurement practices. These apply to all procurements carried out with public funds. The authority covers the organization of public procurement, basic procurement rules and choice of procurement methods. Procurement detail is based on Open Competitive Bidding (Pakistan Public Procurement Rules 2014 and Pakistan Procurement Code 2004).

The success of public health programs depends on the successful and timely procurement of healthcare commodities. All the public sector healthcare institutions and programs require uninterrupted supplies of safe and effective products including medicines, vaccines, diagnostic supplies, equipment and other consumables. Programs that are unable to support regular supplies of healthcare commodities may not achieve their programmatic targets and fail to successfully complete the ultimate objective of providing healthcare services to its consumers and, therefore, go into disrepute and soon lose their credibility and ultimately their clients. The procurement process is based on the principles of Economy, Efficiency, Equality, Fairness, and Transparency.

1.3.1.4 Warehousing and Inventory management

Warehousing is an essential function of the logistics management to manage temporary storage of commodities before issuing to the service delivery points. The warehouse plays a significant role in Delivering the right product in the right quantity; Picking and dispatching products accurately; Delivering to the right customer at the right place; with the right labels; loading onto the right vehicle; using the adequate time to deliver the product on right time. Adequate warehousing resources ensure that the products are stored in right condition till it is available for consumption by the end user.

A warehouse is important in the process of delivering the perfect logistics – on time, in full, damage-free and with the correct book-keeping. In the past, warehouses were mainly used as stockholding places to match supply to demand and act as a buffer between raw material and component suppliers and the manufacturers and between the manufacturers and the wholesalers and retailers and/or consumers.

In the recent past, the information flow was slow and the stock visibility along the supply chains was limited which resulted in healthcare programs holding inadequate quantities of stocks (Over stocking or short of stocks).

Warehouses have expanded very efficiently the use of automation, creating efficient **inventories** using advanced software systems into warehouse operations. These steps exerted a significant effect on the operational side of logistics which have reduced human errors significantly thus helping in improving efficiency of the public health supply chain systems.

1.3.1.5 Transportation and Distribution

To ensure availability of healthcare commodities, the products need are transported from the central, regional or local warehouses to the service delivery points. Depending upon the geographical, road access and financial profiles of a country or province, different means of transportation are adopted such as air-transportation, rail and road transportation and transportation over water bodies. There are merits and demerits of each transportation system and

the concerned public healthcare program may adopt one or combination of different means of transportation to ensure sustained availability of healthcare commodities to its users. Airfreight is fast and reliable but expensive. The truck delivery may be fast but has to be reliable at a lower expense. Rail and shipping by sea is another means of transportation which are less expensive but take much longer time and there may be more uncertainty involved due to factors like geo-political situations and changes in the trade regulations etc. This uncertainty may result in stocking higher levels of inventory at the source point while creating shortage of commodities at the SDPs. Furthermore, there is certain healthcare commodities which require special transportation conditions such maintaining of temperatures during transportation of the commodities. When to use which mode of transportation has to be decided by the Organizations using the type of commodity based on the timeliness and the resources they have.

1.3.1.6 Logistics management Information System (LMIS)

Supply chain monitoring requires continuous availability of valid and accurate data related to product stocks consumption and availability at all levels of a supply chain management system. To address this important challenge, Logistics Management Information System is devised and implemented by the concerned healthcare service delivery programs. If the logistics data is accurate and timely, there will be better coordination leading to better decision making and planning related to commodity supply chain. Based on complete information, concerned people can make effective decisions about what and how much to produce, where to localize inventory and how best to transport it. In Punjab, an LMIS is in place since 2010 for contraceptives and vaccines supply chains. The LMIS in Punjab provides real-time Automation of Supply Chain System from central warehouses to the end users/Customers..

1.3.1.7 Quality Assurance

Quality assurance of the healthcare commodities is essential to ensure the availability of 'safe' and 'effective' products to be service end-users. The process of quality assurance starts from selection of the raw materials and spans the manufacturing process of healthcare commodity, its packaging, labeling, warehousing and transportation to the last mile. There are certain quality assurance standards put in place by the international organizations such as World Health organization which are required to be strictly followed by the manufacturers and supply chain managers. Therefore, before delivering certain healthcare commodities to the end users, it is responsibility of the product selection and procurement teams to assure that the product meets all the quality standards set by the world Health Organization standards for that particular commodity. In addition to WHO there are other international organizations and regional institutions which have devised certain standards for the quality of the equipment, consumables and even the service delivery systems. Various accreditations are available and the healthcare institutions are often required to get the periodic evaluations by concerned organizations (ISO, JCIA etc.) and get the certification of quality by these respected organizations. In the local context, minimum service delivery standards (MSDS) have been devised by the regional healthcare commissions and the healthcare institutions are bounded to get evaluated and accreditation for these commissions to ensure quality healthcare service delivery to its users.

1.3.1.8 Monitoring and Evaluation

Supply chain management has increasingly become an applied science that is complex enough but cannot be of any less value both locally and globally. An effective supply chain management process is essential to minimize supply chain risk and to protect the rights of the end-user.

For example, when considering immunization program, good monitoring systems are essential in saving lives, improving the immune status of the populations and hence bringing about effective control of vaccine-preventable diseases. Well established monitoring systems can inform on the

number of children that are vaccinated at a certain age, any adverse effects noted, any delays in immunizations due to any reason, refusals and other important public health measures that can be readily achieved. Thus, Monitoring systems provide information for an ongoing needs assessment as well. This information generated can improve the program approach, its management and supervision become more transparent in providing vaccination coverage to the susceptible populations.

Monitoring can be performed periodically (weekly basis) for implementing any activity which seeks to establish the process indicators of vaccinations, any adverse effects noted, any vaccine shortages, any refusals for vaccinations, inability to acquire and store the vaccines, deliveries, any reported diseases and their diagnostic procedures etc. so that timely action can be taken to correct deficiencies detected.

Evaluation is a process that determines, systematically and objectively, the relevance, effectiveness, efficiency and impact of activities based on the objectives to be achieved like reducing or eliminating vaccine-preventable diseases of childhood. It is, thus, a learning and action-oriented management tool and organizational process for improving current activities and helps in future planning and timely decision-making.

Supply chain monitoring and timely evaluation can involve thinking about how to make the most effective supply chain management process by:

i. ***Identifying the problem:*** the evaluation process improves the performance of a system in the supply chain. Periodic checking and using the process indicators can identify areas of weakness, the reasons for the weakness can be identified and timely interventions can be immediately imposed to improve the systems. Examining if the systems are falling short of performance targets or identifying any delays in the deliverance of the goods or services can help make immediate decisions so that they can be managed proactively (See VPD weekly surveillance reports).

ii. ***Keeping Comprehensive Data on immunization coverage and related activities:*** Ensure that the data is comprehensive, complete and up to date. If there is an effective data monitoring process, a successful supply chain management process will be well in place. This data should incorporate everything from performance figures to evaluation.

iii. ***Comparing with good practices:*** *An* effective data gathering and monitoring process when in place will enable one to review performance by segmenting the different areas of the supply chain and benchmarking them against best practices. Reviewing the key performance indicators like reporting and delays in immunizations, performance indicators, Vaccine-associated reactions, reporting by high performing or low performing districts or even smaller units can highlight the areas of strength and weakness. It can also indicate where the systems strengthening needs to be done (see VPD weekly surveillance reports).

iv. ***Creating a centralized system:*** *A* centralized data system will help the program succeed by periodically examining the trends across the supply chain. Over short periods, one can visualize the performance over time, over districts etc. This will provide the risk that the system may encounter. If the underperformance is over a 6-month or 12 months period, it may present with different levels of risk. If this can be done at an early stage, the damage to the end-user or the processes can be identified and intervened timely.

v. ***Applying a Supply chain management software:*** from monitoring your supply chain to managing your information, flagging potential issues, through the centralized system to communicate with other parties and share changes, concerns or updates to detailed analytics and alerts they can also ***improve transparency*** by developing an ***early warning system*** to prevent difficult situations and to better prepare the systems to rapidly respond to any untoward event with an informed and flexible approach.

Forecasting & Supply Planning Guidelines

2. Forecasting & Supply Planning Guidelines

2.1 Background

Pakistan is 6th most populous country in the world which is house to more than 220 million people. The country faces challenge of ever increasing population growth rate. According to the Census-2017 results, the population of Pakistan is recorded as 207.7 million as against 132.4 million in the previous Census of 1998, indicating an average annual growth rate of 2.4% during the period 1998-2017, being one of the highest in South Asia. The socio-demographic milieu of the country demands matching healthcare service delivery system to cope up with the health care needs of its population which is prone to double burden of diseases like all other low-to-middle income countries (LMICs). With such demographic challenges which are burgeoning at an exponential pace, it is but a sine-quo-non that a strong healthcare system is place which is underpinned by robust and uninterrupted supply of essential health commodities. We need to refer to the logistics cycle which explains that sustainability of any commodity supply chain relies on important actions such as product selection, forecasting and supply planning, quantification, procurement, storage and distribution of commodities. All these steps are required to be followed to ensure the availability of essential commodities at the service delivery points.

In a country like Pakistan, the healthcare delivery system is beset with overwhelming challenges of combating communicable and non-communicable diseases thus necessitating delivery of curative healthcare services as well as essential preventive services. In this context, multiple vertical programs have been designed to provide preventive services at a fast track. This arrangement requires multitude of commodities including essential medicines, medical and surgical equipment supplies, equipment, commodities for preventive services such as vaccines, contraceptives and other related products, diagnostic lab equipment and supplies etc. In addition, the healthcare system is also required to ensure its preparedness for any unforeseen even such as outbreaks, disasters like floods, earthquakes. The onset of COVID-19 pandemic has exposed the frailties of system and warrants immediate attention. Lastly, the healthcare system is operationally dependent on office supplies, transportation modalities and other logistical support mechanism to enable the healthcare providers and managers to implement the healthcare service delivery programs in true letter and spirit.

In the wake of the foregoing complex ecosystem, there is a need to pursue systematic approach for realistic estimation of resources and commodities/supplies for essential service delivery. In this backdrop, forecasting and quantification constitute the essential bedrock whereon the entire edifice of health supply chain hinges and the ultimate goal of provision of quality and affordable healthcare services to the communities in a timely manner can be achieved.

2.2 Importance of Forecasting & Supply Planning

Forecasting and supply planning (FASP) lie at the core of the operations of the supply chain in a healthcare delivery system. Forecasting and supply planning not only ensure realistic estimation of the commodities before going for actual procurement but also help in identifying various bottlenecks in the supply chain before incurring any expenses for commodity procurement. This important process enables health managers to ensure uninterrupted supply of commodities from the manufacturers to the end users i-e patients or clients. Moreover, if FASP is conducted in a systematic manner and by the field experts, health managers will clearly know the type and amount

of resources required at each step of the supply chain, thus, ensuring realistic resource planning. Lastly, FASP enables the managers to draw a realistic timeline required to achieve the programmatic goals and objectives.

Forecasting and Supply Planning (FASP) is an integrated process of estimating the required quantities of the health products for time and accurate procurement. It aims to assess the demand of a drug or other related supplies based on multiple sources of data. Health commodities include health products, health and medical supplies, and other items that may be needed for the provision of health services, including medicines, vaccines, medical supplies such as contraceptives dressings, needles and syringes, and laboratory/diagnostic consumable. The forecasting process is critical to substantially meeting the demands of health products, as the forecasting of health commodities is always a best estimate by remaining as closer to accuracy as is epidemiologically possible. The forecasting exercise provides important inputs for financial allocations and planning, and the regulatory bodies have started to recognize the significance of this exercise not only in health sector but other sectors as well, so that completely substantiated quantities and types of items surface for procurement process to uptake. Short- and long-term investments required to ensure commodity security cannot be achieved without an accurate forecast. Following are the key terms used in the forecasting process and their definitions:

1. ***Forecasting:*** As described above, it is the process of estimating the quantities of products needed to be dispensed to patients, consumers, or clients.
2. **Quantification:** This is the actual quantity of products to be procured for a specified period. Quantification includes the forecasted quantities adjusted according to the stock on hand and quantities filling the pipeline at lower levels.
3. **Supply Planning:** This is the process of managing supplies to maintain uninterrupted supplies to ensure stock sufficiency at each level of supply chain. Supply planning provides information on what quantities are required in various time intervals to maintain commodity security. The supply planning may include staggering shipments to ensure overstocks are avoided to prevent storage issues and understocks are averted to eliminate likely stockouts.

2.3 Forecasting Process

Following are the steps in forecasting

- Formation of forecasting/quantification team
- Notifying stock sufficiency levels at the facilities
- Organize and analyze data
- Select Forecasting Method (s)
- Build Forecasting Assumptions
- Calculate Forecasted consumption for each product

2.3.1 Formation of forecasting team

It is important to have specialized and dedicated team for forecasting and supply planning. Health departments will need to rely on trained officials for accurate forecasting and regular updating of forecasts and supply plans. The team will need to work closely with departments or sections involved in product selection. The teams' function are also linked with procurement and finance teams.

A quantification team must be composed of program mangers, procurement specialists, MIS specialists, warehouse managers, service providers, M&E officers, technical experts in quantification and donor agencies if applicable. Thus, a quantification team usually contains 7 to 15 members. Following are the competencies required in the team, one team member may have more than of these competencies

- Expertise in forecasting and quantification
- Expertise in pharmaceutical management
- Program experience relevant to the commodities under consideration
- Computer proficiency in terms of use of MS Excel spreadsheets or use of other programs to manage databases
- Engaged in monitoring and evaluation of the program, inclusive of supply chain monitoring
- Ability to analyze and present data

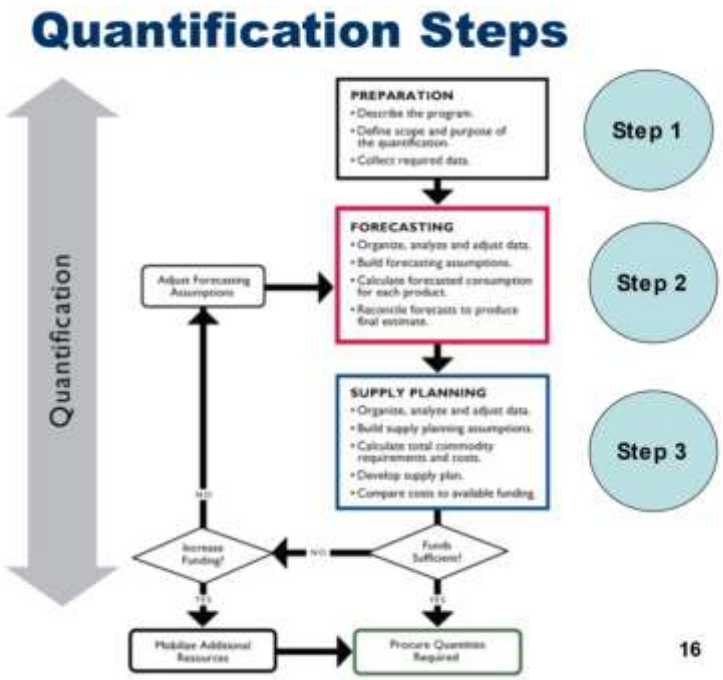


Figure 4: Quantification Process

2.3.2 Notifying Stock Sufficiency Levels at Facilities

After the decision has been made about which item will be procured and held in stock, the decision is warranted as to how much stock should be held at each level of the health system for several reasons i.e. to avoid shortage costs, to minimize ordering costs, to minimize transport costs and to allow for fluctuation in demand. Enhancing the confidence in the system and ensuring availability of the product are overriding considerations. Besides, minimum and maximum stock levels also need to be determined for provincial and district storage facilities plus the facility level as well.

2.3.3 Organizing and Analyzing Data

Multiple types and sources of data may have been collected, ranging from LMIS reports to number of patients treated or clients served, to incidence and prevalence rates of disease.

2.3.3.1 Types of Data required for Forecasting

For the purpose of forecasting different kinds of data is required. There are different merits and demerits of using any of these data sets for forecasting. Generally, these data sets can be divided into 4 categories:

1. Historical consumption patterns
2. Service statistics
3. Morbidity data
4. Demographic data
5. Program information

Historical Consumption Data: Recording the actual consumption of commodities is one the critical element of the logistics management information system. Consumption data includes dispensing to users or the information on commodities given to clients. Issue data is defined as the quantities of commodities issued to lower levels of supply chain up to the facility level. Issue data can also be used as a proxy to consumption, though it has some lack of accuracy. Consumption data has the strength of predicting the actual demand accurately if commodities are in full supply and stock outs have remained very low during the recent period.

However, utilization of historical stock consumption data for forecasting has its integral limitations. One of the limitations is it may not reflect actual need of the commodities and may develop complacency among the service providers hence demanding lesser and lesser quantities owing to low consumption of the commodities which may be due to poor performance of the service providers. Therefore, a detailed qualitative and staff performance reviews may be required to establish the actual need of the commodities. It is therefore recommended not to solely rely on the consumption data for realistic commodity forecasting.

Services Data: Services data is recorded at the health facility level on various aspects of services, e.g. number of clients served, number of services provided along with products used or dispended, disease episodes treated or patients on regular treatment for a specific period of time. Examples of services data include number of malaria cases treated at a facility, number of clients tested for COVID-19 or number of HIV patients receiving ARVs on regular basis from a treatment center.

Morbidity Data: One of the useful information on disease burden is emanated from various surveys conducted to estimate the incidence or prevalence of a disease or health condition within a defined population for a specific period of time. This data can be generalized to estimate the total demand of health commodities required to treat a condition within a population. The morbidity method uses morbidity, services, or demographic data to estimate the number of people or episodes of a disease that are expected to be treated, and then translates these into the number of products expected to be consumed. Morbidity data is useful in case of a launch of a new program or expansion of the current program, because it will estimate even those patients who may not be using the services and hence not captured through services data. However, overestimation from morbidity data will result if services are not able to reach each and every client. Thus, the data should be compared to services and logistics data. Morbidity data is not used to forecast preventative services e.g. vaccination programs and family planning services.

Demographic Data: For forecasting on preventative services, the demographic data is sometimes useful. The data is obtained from population census or demographic and health surveys. Population numbers by gender and age group and population growth trends are example of demographic data. It must be noted that only numbers of women of reproductive age may not help in forecasting for

contraceptives. Additional information on estimated number of married women of reproductive age (MWRA) and those who are currently using contraceptives would be required to forecast as per demand.

Programmatic Information: Information on current program performance, plans, strategies, and priorities, including specific program targets for each year of the quantification

The quantification team may be able to utilize target data. In some situations, program targets are also "political targets" that do not relate to the actual number of patients being served or who can be served by a program. Broad "political program targets" of this type are best used for advocacy and resource mobilization, and should not be used for quantification of products for procurement. Sources of program target data include program planning documents, national policy and strategy documents, and materials published for dissemination and advocacy.

Once the forecasting data have been collected, they should be organized by type of data, either consumption, services, morbidity, or demographic (see figure 2). Program targets for the two-year quantification period should also be included if available.

One of the most critical steps for the quantification team is to assess the quality of the data to determine if they can be used for the quantification. Some considerations for data quality include the following:

- What is the facility reporting rate? How many of the facilities that should be reporting consumption and/or services data have reported? Reported data must be adjusted to accommodate for non-reporting facilities. The lower the reporting rate, the lower the quality of the data. With very low reporting rates, it is not likely that data can be extrapolated to represent a national picture. Moreover, it is rare to have 100% reporting in consumption and services data. Less than optimal reporting affects the quality of data. For example, if only 80% of facilities have reported, the data has to be extrapolated for the remaining 20%. While this could be easy if we assume that non-reporting is not associated with any of the indicators, but in most of the scenarios this assumption will not be valid as mostly those facilities are unable to report who have number of challenges which may at the same time have affected the commodity security. The consideration of facility reporting rate becomes less sequential in case of outbreak or calamity situations as the spread of the outbreak/calamity may be limited to fewer areas but may require substantial amount of supplies. In such circumstances, the facility reporting rate in calamity/outbreak prone areas must be not be factored-in for extrapolation to national/regional commodity forecasting planning.
- For consumption data, did facilities experience stockouts at any time? If the program has experienced stockouts of products, past consumption data will underestimate what the consumption would have been if products had been continuously available at all facilities, and adjustments will be required to cover the stockout periods. Intermittent stockouts usually affect demand and divert the clients to other services, as people may lose trust and may not return to facilities to seek services even if products are made available after stockouts.
- How recent are the data? This is critical for all types of data, whether consumption, services, morbidity, or demographic data. The older the data, the lower the quality.
- Are historical data predictive of future need? Is current program performance an accurate reflection of the demand for services that will be provided or quantities of drugs that will be dispensed in the future?
- For new or expanding programs, the rate of increase in services to be provided or products to be dispensed should take into consideration past performance and historical growth rates.

- There is sometimes reliability issue with these data sets. Data obtained from different sources may show inconsistencies. Therefore, every effort must be made to validate data by comparing data sets from various sources.

It is helpful to organize the data that you have collected and analyzed into a table. Table 1 shows data that could be collected for conducting a quantification of HIV tests.

Table 1: Example Data for a Sample Quantification of oral nutrition commodities for children

Types of Data	Data	Quality of Data	Comments/Notes
Consumption Data	Central-level issues data Central-level stock on hand	Complete monthly issues data for the past 12 months	No stock on hand at facilities available Site-level consumption data not available.
Services Statistics	Number of children examined for malnutrition registered at Oral Therapeutic feeding Program (OTP) centers s, according to monthly/ annual DHIS reports and MOH monitoring and evaluation (M&E) reports. This includes children who lost to follow up during the treatment period.	75% reporting rate for the past 3 months	.
Morbidity Data	Malnutrition prevalence rate	1 year old	No prevalence rate available for neonates delivered in unattended pregnancies and children presented in private sector healthcare facilities for treatment of malnutrition
Demographics	Total population less than 5 years of age	3 years old	No population growth rate available

2.3.3.2 Adjustments/Estimations:

Data adjustments may be required to remove errors and deficiencies. All adjustments must be recorded for future analysis and use. One advantage of using consumption and services data is that it does not need to be converted. Although some conversion may be required in services data if only number of visits are recorded. In case of morbidity and demographic data, instances of disease episodes or a related health condition are recorded. Thus, person count (e.g., number of cases) will need to be converted into required number of commodities through usage of standard treatment protocols.

Adjustments are usually made for the following issues/purposes:

i. Incomplete reporting
ii. Aggregated data
iii. Stockouts

iv. Outdated data
v. Conversion

i. **Incomplete reporting:** It is indeed an ambitious aspiration to expect 100% reporting rate. In the majority of the cases, reports either contain inadequate or missing data. In view of the foregoing as well as owing to operational requirements, adjustment for such missing data is imperative. One should be mindful of the following considerations:

   a. Which facilities' or healthcare elements' reports are missing? Are these health facilities dissimilar in one way or another from those health facilities that have submitted reports?
   b. The forecasting team may assume that rate of utilization of products is similar among reporting and non-reporting health facilities, however, this assumption may lead to substantial errors e.g. in case the missing health facilities are located in a densely populated area, the consumption might be underestimated by adjusting their rate of utilization in line with the rate of utilization for those facilities which cater to less number of catchments population.
   c. In some instances, various reports are missing to make use of the utilization data despite having adjustments. If reporting rates are low on a regular basis, one should give serious consideration to use issuance data as a substitute, but one should bear in mind that use of a proxy for issuance data may still be pretentious to less ideal reporting, thus, if it is important to use the issuance data then facility reporting rates should be rigorously verified.

ii. **Reporting as aggregated data:** The consumption data may be grouped into annual quantities by using LMIS; hence, it would be difficult to break down them into smaller units of time for the aim of analysis. This sort of data contains two assumptions:

   a. The rate of consumption of products remains the same at all facilities.
   b. Consumption is equal for all the time intervals included (e.g., it is not possible to determine the decreasing or increasing trend).

   If we have the information regarding consumption of products along with different rates across the healthcare facilities, we can execute adjustments to correct for data aggregation. This may be a case that consumption of different commodities may be reported as an aggregated figure. One example could be that a healthcare facility may report utilization of combined oral contraceptive (COCs) pills and emergency contraceptive pills (ECPs) as one figure instead of segregating the utilization status for each contraceptive commodity. The sorting of health commodities by brands is essential to undertake forecasting and supply planning. The forecasting team may decide to fill the information gap by using statistics from some national or regional surveys about trend of utilization of each item to approximate the consumption data.

iii. **Rate of Stock-outs**: A rational estimate of actual demand must be the basis of forecasting health commodity requirements. It must be kept in mind that logistics records accurately reflecting true consumption may not reflect real demand. In the case of contraceptives, it may happen when a few contraceptives are out of stock for a longer period of time. This interval of stock-out can possibly mask the real demand for the health commodity because this demand is not met during the stockout period and so will not be reflected in the consumption data.

   If facilities reported that 932,000 tablets of medicine were dispensed last year, and it is known they were stocked out, on average, 20% of the time, then— Consumption adjusted for 20% stockout rate = 932,000 tablets ⁄ 0.80 = 1,165,000 tablets dispensed if the stockout had not occurred.

The aforesaid calculations afford us the understanding that every facility was stocked out whereas that might not have been the case. It is also very probable that facilities are effectively stocked out even if inventory records of the facilities do not indicate zero stock balances. For emergency use or some other reason, it is a common practice of the staff to hoard quantities, especially if a stockout is imminent. If consumption of a contraceptive method suddenly stops or drops off significantly, you may suspect hoarding or rationing. Because of hoarding or rationing, you may need to further adjust your data to account for a period when consumption was below normal.

This formula may also misrepresent true demand if consumption trends varies from a steady, straight-line increase. If consumption was rapidly rising until the stockout, the formula assumes the same rate of increase as the period when stocks were available.

iv. **Outdated data:** Adjusting for outdated data is often necessary when one use demographic data to forecast, especially to obtain current population estimates. One may need to make assumptions about trends in many variables, not just population growth. Generally, a single demographic data source doesn't contain all data points required; multiple data sources contribute to compiling the demographic data that represent different points in time, wholly or partly among which may be required adjustment enabling them to reflect the same period. It is highly probable to encounter significant errors in the forecast owing to these additional assumptions. To reduce the number of adjustments, for the base or starting year of the forecast, select the date of the survey that you used as the major data source for the projection.

v. **Conversion:** The forecasting data is collected from five distinct sources, as listed in the data section, each having different units of measurement; like for instance the services data is collected in the estimated number of visits of users; demographic data is measured in the estimated number of users; while morbidity data are counted in the number of patients, the number of episodes of diseases or health condition, and the number of lab tests. As for forecasting the commodities, the unit employed is the quantities of product, therefore all the other units should be converted into it.

The conversion of units of measurement is performed by multiplying the unit to be converted with the relevant commodity to get a conversion factor that will give us the commodity estimation in terms of quantities of product.

2.3.3.3 Build and obtain consensus on assumptions

Usually, two kinds of assumptions need to be made during the forecasting step:

1. Assumptions on adjustments made to historical program data, when data are missing, unreliable, outdated, or incomplete
2. Assumptions on future program performance, based on factors influencing demand for services and commodities

Most often, complete data are not available for a particular quantification. The most critical point in making assumptions is to document clearly and specifically which assumptions were made, and on what basis. If there are few or no data, the forecast will rely heavily on assumptions. Assumptions may include issues such as a change in Standard Treatment Guidelines (STGs), products, program strategies, priorities, expansion plans, or service capacity (infrastructure, human resources availability, and capacity), client awareness of and access to services, timing and amount of funding commitments for procurement, seasonality, or geographical differences in disease incidence and prevalence.

It is critical for the forecasting and quantification team to reach consensus on the forecasting assumptions. A quantification workshop is often an effective forum to achieve consensus, and

should include dedicated time for clarifying, agreeing upon, and documenting assumptions. This should be a consultative process with a wide range of program implementers (program planners, procurement specialists, clinical experts, pharmacists, warehouse managers). It is important to document the sources of information and input from key informants used in making the forecasting assumptions. The quantification should be revised if any of the forecasting assumptions change. Data may be available to aid formulating assumptions in some cases. Even in case of availability of data, a larger consensus should be built among managers, policy makers and other relevant stakeholders.

2.3.4 Calculating forecasted consumption for each product

Calculating forecast is a scientific process which entails using historical data to predict future demand of the health product in question. Following is an overview of methodology of forecast for the types of data sets described in earlier section.

2.3.4.1 Assumptions related to Consumption Data

The historical consumption data is first cleaned and validated as described earlier. Historical trends in consumption are then observed, e.g., per month or per quarter increase or decrease in consumption are noted. The proportionate change in consumption will indicate the future trend as well. Graphical representation makes it easy to identify outliers and/or spikes or high or low consumption. Sudden changes are mostly due to issues related to commodity availability. The forecasting team may decide to exclude these time periods from analysis. For each of the products, following steps will be implemented to estimate the forecast

1. Based on the historical trend, the total volume of products required for the next twelve months is estimated
2. Month to month or quarter to quarter changes in consumptions are observed. A growth pattern is then selected to ensure future consumption growth patterns are covered adequately. The growth pattern is applied to adjust consumption for first and following years.
3. Any further adjustment is done for potential wastages

2.3.4.2 Assumptions related to Services Data

The historical services data is reviewed and cleaned based on similar lines as consumption data. Outliers and sudden changes in services data are identified and based on the underlying reasons (e.g., closure of service or other factor leading to lack or absence of services provision) the forecasting team may decide to exclude facilities or specific time periods from the analysis. The growth patterns in services is then estimated based on new facilities being established or expansion of existing services. Similar to the steps carried out for consumption data, the basic estimate for the first year is adjusted as per recent growth patterns. The services data, given in terms of treatments provided or clients treated, is then converted into number of products required.

2.3.4.3 Assumptions related to Morbidity Data

The disease burden or morbidity data is usually reported through surveys. The surveys or studies used must be generalizable to the target population for which program is aiming to forecast. However, large scale studies are usually not available for each and every condition, especially in a developing country like Pakistan. Data extrapolated from smaller studies is prone to errors. The forecasting team should carefully review the available evidence and choose the appropriate data in the local context. Morbidity data provided population-based estimates, and these numbers may be quite high compared to those actually seeking healthcare. For example, all children less than 15 suffering from diarrhea may not visit health facilities due to variety of reasons, e.g., severity of illness, use of traditional medicine or home-

based remedies, distance from health facility etc. Thus, a careful estimate of those who are likely to visit the facility will help in preventing overestimates.

The disease burden data is used to estimate the number of patients in the population under consideration for the time period aligned with forecasting duration. This number is adjusted by multiplying it with the proportion of those who will be seeking healthcare. The number of patients or health conditions needed to be treated at health facilities are achieved through this process and will need to be converted to number of products required by using standard treatment guidelines.

2.3.4.4 Assumptions related to Demographic Data

Census-related data may be required in some conditions which cannot be classified as diseases e.g. contraception use and vaccinations. Similarly, programs aimed at the prevention of diseases may target a certain age group or segment of the population, e.g. breast cancer awareness programs or programs aimed to do breast cancer screening in women aged 40 years and above. In all these scenarios, population numbers with certain characteristics will be required. Such data is usually available from the census and will need to be adjusted to the current time frame by applying the population growth factor. Other adjustments may also be needed if changes in characteristics are expected with reference to past surveys. The numbers obtained in the end are converted to required commodities by estimating the need for a single individual e.g., x-ray films for the number of screening cases, and combined oral contraceptives required by a woman for one year of protection from pregnancy.

Table 2: Comparison of different data sets for estimation of Forecasted Consumption
(Ref: JSI Supply Chain Handbook)

Type of Data	Conversion Factor			Forecasted Consumption	
Consumption	The estimated quantity of product to be dispensed/used	X		=	– Quantities of Product –
Services (family planning)	Estimated number of visits or users	X	Dispensing protocol (contraceptives)	=	
Services (HIV and AIDS, TB, malaria, essential medicines, labs)	Estimated number of patients, number of episodes of disease or health condition, number of lab tests	X	STGs, testing algorithm, lab procedure	=	
Demographic (family planning)	Estimated number of users	X	A couple of years of protection factor	=	
Demographic/ morbidity	Estimated number of patients, number of episodes of disease or health condition, number of lab tests	X	STGs, testing algorithm, lab procedure	=	
Program targets	The targeted number of users, number of patients, number of episodes of disease or health condition, number of lab tests	X	A couple of years of protection factors, STGs, testing algorithm, lab procedure	=	

2.3.5 Using the prediction models

The data obtained from the listed sources are employed in the estimation models developed for forecasting the demand of the commodities. Estimation is a technical process that requires expertise in inferential statistical and econometrics to build models to predict future demands of health commodities. The quality of data and its accuracy are two critical elements that determine the accuracy of estimation and therefore the emphasis at the time of data acquisition is to ensure that the data is obtained from a reliable source. However, it is a challenging proposition to obtain accurate data especially in the context of developing or underdeveloped countries due to untrained staff working as a key source of ensuring data quality at the ground level who are neither motivated nor act in a responsible way. This leads to the occurrence of various systematic and unsystematic errors while recording data that may vary from mild to severe errors such as recording of incomplete data, outdated or wrong data, over and or under-reported data, missing data, fabricated data later of occurrence of event or incidence.

Such concerns demand collaborative efforts of the supply chain management team to cope with such issues and to mitigate the effects of the error-prone data. This can enable the management to identify reliable sources to ensure the quality of data. Besides, various methods can be used to triangulate the data authenticity from multiple sources. Meanwhile, proxies can be identified for consumption data in case of missing or incomplete data. Data can also be adjusted especially when there is a discrepancy in the recorded and actual data. It has been also recommended to make adjustments when the inventory is either issued or received from the same level of supply chain management hierarchy. However, the methodology of adjustments should be discussed with supervisors and field staff for a better understanding of reported and recorded data. The adopted methodology for adjustments must be explicitly defined by recording whether the adjustments are for stock-outs, for facilities or outdated data. The recording of the methodology is useful for future monitoring and validation needs and use.

Therefore, an appropriate prediction model must be used to forecast accurately. These prediction models are applied where historical data in case of consumption and services is available. A time series approach is most suited to predict future consumption. The quantification team must decide whether to use more recent data points (last six months or last year) or less recent data (e.g. two to five years ago). In case of a product having a seasonal variation, a complete set of 12 months should be used whether using recent or old data. The choice of which data are most suited are based on factors like consumption variations, stock availability or quality of data. For example, the quantification team may be more inclined to use recent data is data quality has improved due to use of electronic LMIS. Conversely, older data may be more relevant if the product was stocked out in the past year or so.

2.3.5.1 Trend Projection

Data is plotted on graphs to observe historical trends. Excel can be used as a good tool for this purpose. Monthly, quarterly, bi-annual, or annual values are visualized on bar or line graphs. The growth trend functionality in MS Excel can point towards the forecast. The historical trend will not account for any program expansion or increased uptake due to other factors. The quantification team must account for these variations manually through adjustment of the growth factor. Figure 2 explains how the trends of usage of contraceptives can be presented in the form of a bar chart.

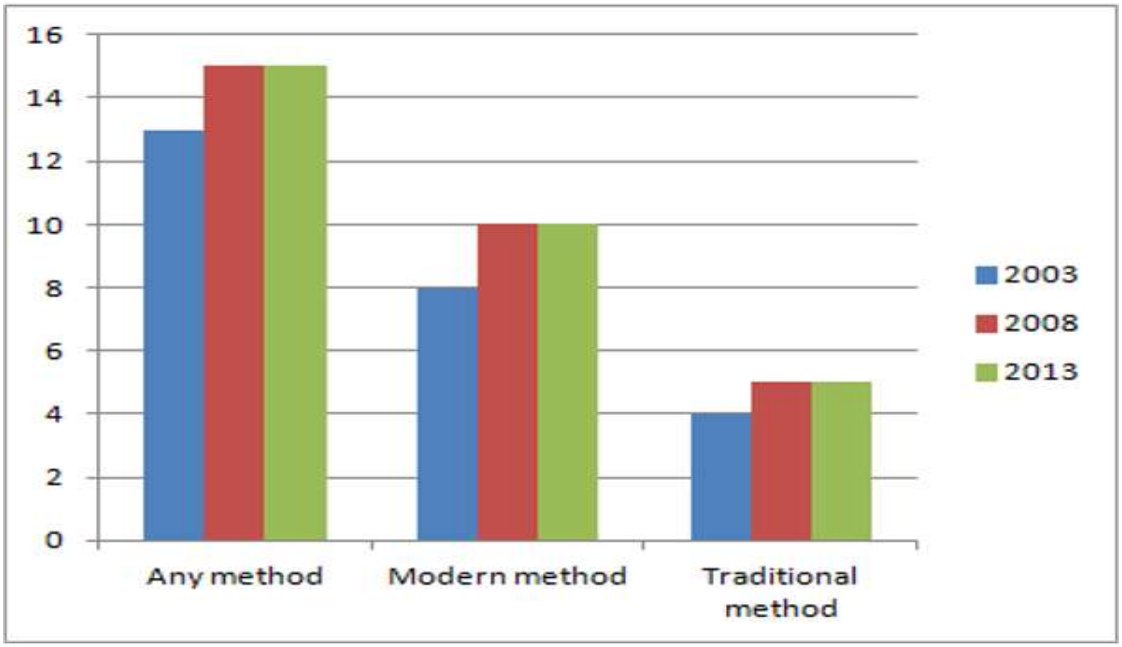


Figure 5: Trends in Contraceptive Use

2.3.5.2 Regression methods

These more complex methods are used to include multiple factors in prediction models. Unlike trend projection, factor like program expansion can be adjusted directly in the model. MS Excel or more advanced statistical packaged like SPSS can be used for building such models.

2.3.5.3 Moving average

It is a series of averages of historical data to forecast for next month, quarter or year. It is used when demand is almost constant. The moving average eliminates the effect of random variations in data.

Exponential smoothing and weighted moving average are also other methods which can be used for forecasting. The weighted moving average gives weights to certain portions of data based on its accuracy. Exponential smoothing can be applied through software, it provides flexibility of building the potential forecasting error in the model.

2.3.5.4 Wastage

A certain amount of wastage occurs to the quantities of medicines in the entire supply chain because of spillage, contamination, or damage. Wastage may also include quantities of defective/counterfeit commodities that are discarded. While it may be difficult to collect data on actual quantities discarded/wasted, consultation and discussion with relevant officials in the supply chain, from store keepers, logisticians and distributors will lead to consensus on a reasonable wastage rate to apply. Factoring in the wastage consideration is integral to realistic forecasting exercise.

2.3.5.5 Selecting a forecast

While multiple methods of forecast make the estimate robust, but also pose a challenge on selecting the appropriate forecast. Selecting appropriate forecast entails comparison of both forecast inputs and outputs. Among inputs, data quality and assumptions are compared. Outputs are compared to see how much difference of quantities emerges from various approaches. After careful considerations, the quantification team must agree on one approach, i.e. either of consumption, services, demographic and morbidity data based forecasts. The team may decide to take an average of the two or three most suitable approaches.

2.4 Quantification & Supply Planning

Typically, national quantification exercises include a commodity forecast for a two-year period in order to identify funding sources and mobilize additional resources to meet funding gaps if needed. Although the forecast should be done for two years, an actual procurement plan should be done for one year, where orders have been placed with suppliers and shipment dates negotiated. Developing the supply plan entails coordinating the timing of funding disbursements from multiple funding sources with procurement lead times and supplier delivery schedules to ensure a continuous supply of products and to maintain stock levels between the established maximum and minimum levels.

As for forecasting, supply planning must be done in a systematic manner and the process can be broken down in to different steps.

The steps of supply planning can be described as:

1- Organize and analyze data for forecasting
2- Build supply planning assumptions
3- Estimate total quantities and costs
4- Develop Supply plan
5- Compare funding available to total commodity cost

2.4.1 Organize and Analyze the Data for forecasting

Once the forecasting and quantification team has calculated the monthly forecasted consumption for each product, the team must now determine the total quantities to be procured actually. For this purpose, different kind of data would be required. These data, which should now be organized and analyzed, include:

- National/program-level stock on hand (physical inventory) of each product to be quantified
- Expiration dates of products in stock, to ensure they will be used before expiration
- Quantity on order: any shipment quantities of product(s) already on order, not yet received
- Established program-level maximum and minimum stock levels
- Procurement lead time(s)

Supplier information

- Supplier prices
- Supplier packaging information
- Supplier lead times
- Shipping and handling costs

Funding information

- Identify all funding sources for procurement of commodities.
- Verify amount and timing of funding commitments by funder.
- Confirm funding disbursement schedules to determine when funding will be available for procurement from each source.

Procurement information

- Identify all procurement mechanisms (e.g., government or international bidding/tendering, donor procurement, or local procurement) for all products to be quantified.
- Verify procurement lead time for each procurement mechanism.

Distribution information

- In-country storage and distribution costs (if applicable)
- In-country sampling/quality testing costs
- Customs clearance fees

2.4.2 Build the Supply Planning Assumptions

As previously mentioned, the most critical point in the assumptions building process is to document clearly and specifically the sources of information and the key informant inputs on the assumptions. And as in the forecasting step, consensus must be reached among the quantification team on the supply planning assumptions. For the supply planning step, assumptions may need to be reached on the timing of available funds, lead times for each supplier, exact amounts of funding available, and estimates on arrival dates of supplies.

The quantification team will also need to make assumptions about national and facility stock levels, if the data are not available.

If a maximum-minimum inventory control system is not formally established, the quantification team will need procurement in next quarter. to make assumptions about the minimum and maximum stock levels at each level of the logistics system (facility and central levels, for example).

2.4.3 Estimate the Total Commodity Requirements and Costs

Estimating the total commodity requirements consists of determining the quantity of each product needed to meet the forecasted consumption and ensure that the in-country supply pipeline has adequate stock levels to maintain continuous supply to service delivery points.

Total Commodity Required = Quantity required to cover the procurement and leadtime +
Quantity required to maintain buffer stocks – (stock on hand +
Quantity ordered and in the pipeline +
Stock to be expired before receiving the stock to be ordered)

2.4.4 Develop the Supply Plan

The ultimate output of quantification is a supply plan which details the exact quantities required staggered over a period of time to maintain the stock levels. For each of the product, minimum and maximum stock levels are usually defined. The overall procurement objective is to keep the stock levels between minimum and maximum. A supply plan will consist of quantities, the expected arrival time at the central/provincial or district store as the case may be, and their packaging information.

The next step will be to estimate the cost of the total commodity requirements.

Updated sources of information on drug prices and supplier rates are needed to estimate the cost of the quantities of drugs to be ordered. However, to accommodate for differences in pricing methods adopted by different manufacturers/suppliers, previous year's rates plus 10-15% annual inflation cost may be considered for estimation of procurement quantity. In addition, information on the cost of insurance and freight, customs clearance and duties, and in-country storage and distribution costs may need to be added to the cost of the quantities of drugs to be procured if not included in supplier rates or budgeted for through other mechanisms or waiver agreements.

If price data have already been entered into Pipeline, the costs associated with a shipment will automatically be calculated. Flexible procurement contracts with suppliers are recommended so that shipment quantities can be adjusted to respond to uptake in services, fluctuations in patient demand, existing stock levels, and rates of consumption of drugs. Agreements with suppliers may also need to include flexibility in delaying shipments into the year following the year of the forecast if uptake of services does not meet expected demand.

2.4.5 Compare Funding Available to Total Commodity Costs

The final decision on the quantities to procure will be determined by the amount of funding available for procurement of products. Where sufficient funding is available, the final quantity to procure of each drug will be the same as the quantity to order as a result of the quantification. If funding is insufficient, the quantification team will need to determine whether additional resources can be mobilized. An effective venue for this can be through the presentation of the quantification results, illustrating what the funding gap is in order to ensure timely procurement and delivery of the required quantities of commodities. After adjusting the forecasting assumptions, the quantification team will need to repeat the steps in the quantification process, through the calculation of the forecasted monthly consumption of each product to the final calculation of the actual quantities of each product to procure, to reconcile the results of the quantification with the funding constraints.

A supply plan needs to be monitored continuously to ensure stock sufficiency at each level of supply chain. Various off-the-shelf applications are available to create and monitor supply plan. If feasible, the supply plan, LMIS and Warehouse Management System should be integrated digitally to allow for real-time exchange of information. This will allow the supply plans to be adjusted as per actual issuances from the warehouse. It also provides an added advantage of volumetric analysis by allowing mangers to see the future storage requirements and take measures in case incoming volumes are beyond the storage capacity of warehouse.

2.5 Managing Forecasting & Supply Planning

It is imperative to have a strong organizational set up for forecasting and supply planning. The institutional responsible must look after all the interconnected processes from product selection to supply plan monitoring. A technical working group (TWG) is usually constituted at the level designated for procurement, which in case of Pakistan is provinces. Following could be some key functions of a TWG

- Product selection
- Capture, store, clean and analyze data for forecasting
- Build mechanism for long term data storage and management
- Develop forecasting assumptions in consultation with other relevant departments
- Develop and implement a mechanism for pipeline monitoring
- Feed relevant and timely information to procurement team and warehouses to ensure smooth flow of products down the supply chain

Quantification does not end when the final quantities and costs have been determined; it is an ongoing process of monitoring, reviewing, and updating the forecasting data and assumptions, which in turn may require a recalculation of the total commodity requirements and costs. For the quantification exercise to be useful and effective, the forecasting assumptions and the supply plan should be reviewed and updated at least every six months, and more frequently for rapidly growing or changing programs. Ongoing monitoring and updating of the quantification is critical to keeping program managers, donors, and other stakeholders informed on the availability of drugs and is a vital precondition for timely decision making on product selection, financing, and delivery of commodities.

Reviewing and updating the quantification involves the following activities:

- Reviewing and updating the forecasting data and assumptions

- Calculating or recalculating the forecasted consumption (using Excel spreadsheets, or other software)
- Updating the stock on hand for each product
- Assessing national stock status for each product (based on product consumption and stock levels)
- Reviewing and updating shipment delivery schedules to ensure continuous supply and maintain desired stock levels
- Updating the amounts and timing of funding commitments
- Recalculating the commodity requirements and costs over time
- Estimating and updating funding needs and gaps for procurement

2.5.1 Knowledge and Skills Required

Ideally, the same core team of people who conducted the initial quantification should conduct routine updates. The knowledge and skills required to complete a quantification for health commodities include the following:

- For each commodity category, expertise in the specific program area and knowledge about the commodities and how they are used
- Computer literacy and proficiency in the use of Microsoft Excel spreadsheets or software programs to create and manage databases
- Commitment to conduct ongoing monitoring, data collection, and updating of the forecasting data and assumptions and supply planning data to update the Pipeline database
- Preparation and presentation of quantification data and methodology and final quantification results to key stakeholders and implementers

Procurement in Public Healthcare Supply Chain Settings

3. Procurement in Public Healthcare Supply Chain Settings

3.1 Introduction

Procurement is one of the key thematic areas of supply chain management of healthcare commodities and invariably supply chain management of healthcare commodities revolves around this thematic area. In comparison to other elements of supply chain management, procurement process is adapted as per the legal and financial environment around the procuring body; volume of procurement, types of commodities being procured, availability of the commodities and institutional capacity responsible for running the procurements.

The extensive healthcare delivery system in Pakistan is mandated to provide healthcare services to its population through a coordinated network of academic institutions, primary, secondary and tertiary care level facilities, para-statal hospitals and vertical programs for prevention and control of communicable and non-communicable diseases. Also, a widespread, thriving and robust private sector is also in place for catering the healthcare needs of the country population. Moreover, private sector is engaged not only for manufacturing drugs, equipment and other healthcare commodities but also holds the charge of importing the commodities to fulfill the needs of the healthcare system. Such a diverse healthcare delivery system in the country requires a good level of regulation hence various government institutional bodies and authorities are established to provide coordination, regulatory and monitoring support to the healthcare delivery system of the country. Pakistan Medical Commission (PMC), Provincial Healthcare Commissions (PHCs), pharmacy and nursing councils, Drug Regulatory Authorities (DRAs), Public Procurement Regulatory Authorities (PPRA) are some of such institutions. In addition, national and international stakeholders such as UN agencies (WHO, UNICEF), Global Fund for TB, Malaria and HIV/AIDS, Global Alliance for vaccines and immunizations (GAVI), United States Agency for International Development (USAID), Pakistan Pharmaceutical Manufacturers' Association (PPMA) and local trade coalitions also hold a significant position in the national healthcare delivery system.

The massive healthcare delivery system is continuously in need of financial resources, goods and services to ensure smooth healthcare delivery to its people. Keeping in view the vast scale and diversified healthcare services being provided by the public and private health sectors, procurement of the healthcare commodities is a bit challenging task. It requires a systematic approach which is scientifically valid, competitive, transparent, promotes efficiency & cost effectiveness and is able to ensure uninterrupted supply of the essential goods and services such as drugs, equipment, technology and other consumables across the healthcare service delivery network.

Over the period of time, the process of procurement has become highly specialized field in the advent of modern technology and is strongly influenced by radical concepts of supply chain management. Moreover, advancements in the fields of industrial development and information technology and its increasing utilization in supply chain management has resulted in increased production of the goods and service at ever accentuated rates, globalization, augmented market size with intricate market forces at play and escalated competition among the manufacturers and suppliers for reaching the maximum clients. Hence, the field of procurement has evolved from a simple process of purchasing goods from local markets to a strategic operation requiring modern technique, astute management skills and knowledge about procurement process and methods.

It is, therefore, vital for the decision makers and health managers to understand basic concepts, processes, legal and operational paraphernalia; and best practices and challenges involved in carrying out public healthcare procurements. This chapter aims to provide the sound technical knowledge pertaining to different components, operations and pertinent considerations for developing the procurement plans and strategy for healthcare procurements.

Objectives:

By the end of the chapter, the reader will be able to:

1. Learn key legal definitions and technical terms related to healthcare procurements
2. Recognize and relate the diversity of product portfolios pertaining to healthcare procurements
3. Understand the roles of different stakeholders participating in the healthcare procurements
4. Develop sound understanding of different legal entities and regulations in place to regulate the healthcare procurement process
5. Understand different models employed in the healthcare procurement and process of public procurement
6. Understand key challenges faced in carrying out healthcare procurements

3.1.1 Key terms pertaining to procurement management

Drug: Any substance or mixture of substances that interacts and alters human body systems, when manufactured or prepared under prescribed conditions by the drug law; used internally or applied externally in a specified amount to prevent disease, relieve symptoms, restore health and used to treat any disease.

Adulterated Drugs: The adulterated drug can be defined as:

i. A drug that is contaminated intentionally or unintentionally with other substances affects its quality and safety.
ii. A drug that is packed in such containers leach its chemicals into the drugs and makes it injurious to health.
iii. A drug that contains any foreign material for example dirt, filth, insects or rodent.
iv. A drug that contains any ingredient which is not prescribed by the drug law.

Counterfeit Drug:

A drug having a label or outer packing an imitation or close resemblance with the label or outer packing of a drug by another manufacture.

Misbranded Drug:

The misbranded drug can be defined as:

i. A drug that is not labelled properly as per the drug law.
ii. A drug that is labelled in such a manner that it does not contains necessary information or the information is not prominently placed on the label or it does not contain warning and cautions or missing direction of use or the label boasts about its effectiveness.

A drug with its label not mentioning the specifications of the manufacturing document.

Spurious Drug: The spurious drug can be defined as:

i. A product that purports to be a drug but does not contain the active ingredient of that drug.
ii. A product that purports to be the product of a manufacturer, place or country of whom or of which it is not truly a product.
iii. A product which is imported or exported or sold or offered or exposed for sale under a particular name while actually, it is “another drug”
iv. The label of any drug bears the name of an individual or company purporting to be its manufacturer or producer which individual or company is fictitious or does not exist.

Sub-Standard Drug: According to the drug act 1976 of Pakistan, a drug which does not meet the specifications as detailed by its manufacturer.

Specifications

i. Specifications are the directions of manufacturing, and they are prescribed by the drug law.

ii. Specifications in the following mentioned publications are also acceptable when the law does not contain a specification for some drugs

a) the Pakistan Pharmacopoeia
b) the International Pharmacopoeia
c) the European Pharmacopoeia
d) the United States Pharmacopoeia
e) the British Pharmacopoeia
f) the British Pharmaceutical Codex
g) the United States National Formulary

Medical Device: instruments, medical equipment, implants, disposables and software, used mainly for the purpose of diagnosis, monitoring and treatment of disease or any other item which the Federal Government may, by notification in the official Gazette, declare as medical device

Tender: A tender is an offer disclosed publicly in black and white by the buyer or government to invite sellers or service providers for the provision of desired commodities and services.

Bid**:** It is an offer for service and goods against a price, which is submitted by a supplier to the purchasing organization against the desired specification described in the tender by the purchaser. Bids are submitted by the organizations that intend to sell their goods and services to the purchaser when offers are invited by the purchaser.

Bill of lading: Bill of lading is an official and legal document that is generated by the shipping company. It contains all the details about the cargo being carried from one port to another port. This document serves as a shipment receipt for the transfer of goods from the seller to the buyer.

Cost, Insurance & Freight: Cost, Insurance and Freight means that the seller is liable and accountable for the cost and liabilities of transportations of commodities until the buyer receives his shipment.

Free on Board: Free on Board (FOB) is a legal term which in simple terms denotes that the buyer is responsible for the cost and liabilities of transportation once commodities are shipped from the purchaser to his warehouse.

Free of Charge: Free of Charge (FOC) is a term commonly used in the services and hospitality industry and refers to services for which no additional charges are required to pay by the buyer to the seller.
The Incoterms are a set of commercial/trade rules established by the International Chamber of Commerce (ICC) that are used in international sale contracts. The Incoterms are not mandatory rules for them to receive legal effect, but they must be explicitly incorporated by the contracting parties into their contracts.

The incoterms are updated and grouped into two categories reflecting modes of transport. Of the 11 rules, 7 are for 'ANY' mode/s of transport four for the Sea, Land or inland waterway transport.
The most commonly used incoterms are given below:

EXW - Ex Works (insert place of delivery)
FCA - Free Carrier (Insert named place of delivery)
CPT - Carriage Paid to (insert place of destination)

CIP - Carriage and Insurance Paid To (insert place of destination)
DAP - Delivered at Place (insert named place of destination)
DPU - Delivered at Place Unloaded (insert of place of destination)
DDP - Delivered Duty Paid (Insert place of destination).
FAS - Free Alongside Ship (insert name of port of loading)
FOB - Free on Board (insert named port of loading)
CFR - Cost and Freight (insert named port of destination)
CIF - Cost Insurance and Freight (insert named port of destination)

Contract: A contract is pact in black and white between two people or organizations for the performance of certain desired activities or operations, for example, provision of services, sales and purchases etc. The contract may contain certain terms and conditions with the mutual discussion of the parties for the implementation of the desired operations stated in the contract. Contracts have specific life which is either stated in the document or is automatically considered null and void after completion of the operation if no specific conditions stated in the document are applicable.

Agreement: An agreement in the context of contract law, refers to a meeting of the minds of two or more parties and at which point a contract is formed. A contract becomes the legally enforceable agreement between the two or more parties with enforceable obligations and promises.

Good Manufacturing Practices: Good manufacturing practices (GMPs) is a concept of quality management that applies to the manufacturing industries of a wide range including, food, beverages, cosmetics, pesticides, pharmaceuticals, medical devices and equipment manufacturing units. GMPs includes set of quality manufacturing principles or guideline for every industry laid by the international organizations; laws and rules made by the country or state as well as industry internal standard operating procedures for the assurance of safety and standard of quality. It is important to state that GMPs prescribed by the international organizations may not be binding for the manufacturing units but, the manufacturing units are bound to follow GMPs prescribed by the legislature of the country or state no matter either they belong to the public or private sector.

Pre-Qualification: In association with procurement, the term prequalification is referred to as the detailed assessment of suppliers and vendors to evaluate their capacity, capability, reliability, quality, market goodwill and experience of business. This procedure acts as a system of filtrations to shortlist suppliers and vendors who can fulfill the purchase demands of an organization or enterprise. Prequalification shortens the time of the procurement process because only prequalified and listed suppliers and vendors can apply for tender to the organization.
Manufacturer: A manufacturer is a person or company that produces finished goods from raw materials by using various tools, equipment, and processes, and then sells the goods to consumers

Supplier: A supplier can be defined as a firm, organization or enterprise that sells its goods or services to another organization or enterprise against a certain amount of money to meet the buyer's needs and demands.

3.2 Procurement: Concepts and Importance

There exists no single definition which can incorporate all of the ingredients of procurement because the process of procurement may vary from discipline to discipline.

Procurement is the act of obtaining goods or services, typically for business purposes.

In case of public sector procurement, this act is carried out to obtain commodities or services for providing services to the communities.

Procurement may be referred to as the flow of essential commodities from one point to another point (e-g manufacturer to the central/provincial warehouse) in the exchange of money or services.

But it is easy to understand procurement in relation to its various attributes. Technically procurement is described through its attributes including:

1. The process of procurement covers acquisition of the right commodity of right quality in the right quantity against the correct price and delivered to the intended place at the right time.
2. It is also considered as business management function that guarantees identification, sourcing, access and management of the external resources that an organization needs or may need to fulfill its strategic objectives.
3. It is essential to explore supply market opportunities while implying resourcing strategies to ensure best possible supply outcome for the concerned organization, stakeholders and the clients.
4. Process of procurement leverages the available technology and skilled human resource to make this process cost efficient.
5. Strong procurement management ensures mitigating the risks posed to the supply chain by implying effective negotiation of contracts, cost and price models and quality assurance measures.
6. Ultimately, robust procurement management ensures the organization to achieve its strategic targets and goals within stipulated time period

It must be understood that procurement is a critical component of the supply chain management framework (see figure 1) and without appropriate procurement management, no program/project can achieve its core objectives and targets.

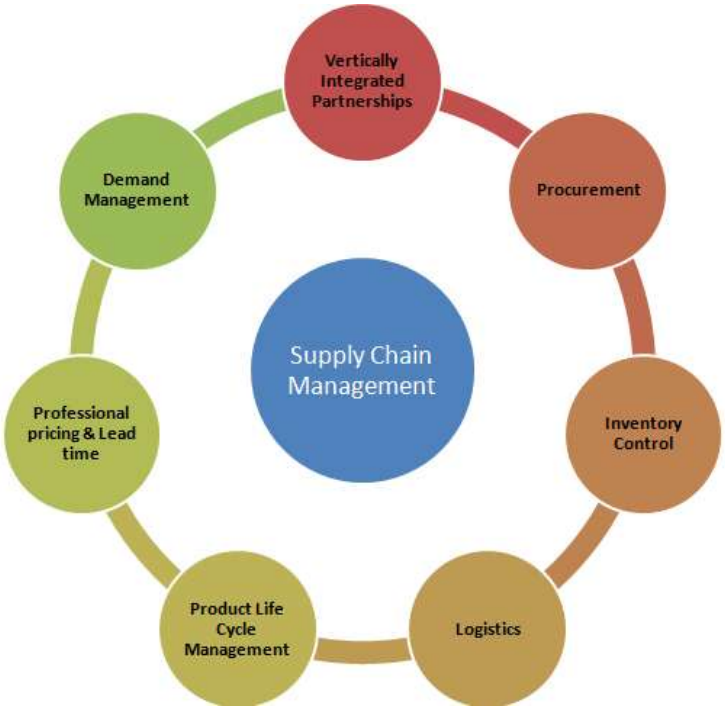


Figure 6: Procurement within the Supply Chain management framework

In conclusion the procurement management is a core function of the program management which requires execution of technically correct processes in a well-coordinated manner and is a crucial element for developing linkages among other components of supply chain in a healthcare delivery system.

An efficient procurement management system ensures that standards are maintained at all levels of procurement process. The standard attributes of an efficient procurement management system in a healthcare system are summarized in the table 1 given below.

Table 3: Determinants of Procurement management in a healthcare system

Factors	Description
Quality	Recognized and approved standards from a reliable source.
Quantity	Will be based on forecasting and needs assessment of the organization.
Time	Will be procured and delivered according to the established timeline.
Place	Will be delivered at a specified location designated by the program.
Price	Best value for money is achieved in terms of quality, volume of procurement, timeliness, reliability, after-sales service, upgradeability, price, source, and a combination of whole–life cost and quality to meet the procuring agency's specifications.

3.2.1 Key Stakeholders in procurement Process

A stakeholder may be a person, a group or organization which is influenced, directly or indirectly, by the operations and outputs of the key activities administered by a public or private sector enterprise/program. As a matter of fact, the healthcare systems embark upon vast levels of operations and activities with an extensive product portfolio thus demand for the commodity support is huge at any given time to meet the targets of the healthcare delivery system. Therefore, the healthcare system has a wide range of stakeholders. For the ease of understanding these stakeholders may be divided in two broad categories i-e ***Internal and External Stakeholders*** especially when it comes to programmatic procurement management function**.**

3.2.1.1 Internal Stakeholders

Internal stakeholders include:

i. **Healthcare and Allied Health Professionals** are important stakeholders in a procurement process as they act as they work close to the end of a supply chain pipeline. They actually 'use' or 'consume' the healthcare products and therefore are able to provide exact consumption rates of any product. Furthermore, their feedback about functionality of any equipment is also primary for ensuring that the equipment and technology procured meets the specifications and quality standards (***user feedback***).

ii. **Institutional Committees/bodies:** Departments of Health have multiple committees notified by the competent authorities for the diversified nature of operations to be carried out for procurement management. Examples of such committees related to procurement process include technical committee for finalizing bidding documents, grievances committee, physical inspection committee, technical and financial evaluation committee etc. These committees not only facilitate and execute their role in developing specifications for the health products to be procured but also ensure that rules and regulations are followed at each step of the procurement process to enhance transparency and accountability of the procurement process.

iii. **Vertical and Horizontal Healthcare Programs:** Different vertical programs working within the healthcare system are also important stakeholders of procurement management system as they are the procurement bodies. These programs play vital role in product selection,

forecasting planning, initiating the requisition for procurement and sometime s also are required to undertake the procurement process on their own.

iv. **Accounts and Finance Departments/sections:** Finance departments/units play a critical role in the procurement process. These units determine and release the funds for procurement, storage and distribution of healthcare commodities. Also these departments are mandated to ensure financial accountability and transparency in any procurement process.

3.2.1.2 External Stakeholders

i. **International Organization and Alliances:** National and International organizations and alliances are key partners of the government, particularly in the health sector. They support the national healthcare systems in terms of monetary assistance, capacity building of the systems and workforce, technical assistance for coordination and developing standards for quality of care services (such as standard treatment guidelines) and generating relevant data to determine exact disease epidemiology. Examples include UN agencies (WHO, UNICEF, UNFPA etc.), United States Agency for International Development (USAID), Global Alliance for Vaccines and Immunizations (GAVI), Bill & Malinda Gates Foundation (BMGF), Global Fund for control of TB, Malaria and HIV/AIDS. In addition, some of these organizations support the government in connecting with the manufacturers in case of commodities requiring import from global resources. There are examples when some of the partner organizations actually carrying out the procurement process on behalf of the governments such as USAID has been procuring contraceptives for the government of Pakistan and UNICEF actually procured vaccines for the government of Pakistan.

ii. **Manufacturers and Suppliers:** Considering the broad product portfolio of a healthcare system, there is a need of matching number of manufacturers inside and outside the country. Manufacturers and suppliers impact the procurement process by their manufacturing capacities, import quotas, export volumes, trade alliances, internal competition and marketing strategies. These stakeholders have direct impact on the commodity price, schedule of procurement and delivery plans and auxiliary service. Taking account of their vital role in completing the procurement process manufacturers and suppliers may be engaged in planning phase of procurement process to avoid any delays or bottle necks in the supply chain.

iii. **Regulatory Bodies:** Different regulatory bodies are in place within the country to provide legal, financial and administrative frameworks for the procuring agencies thus ensuring that all the procurements are carried out in the best interest of the public while meeting the standards. Examples may include Public Procurement Regulatory Authorities (PPRAs), Drug Regulatory Authority of Pakistan (DRAP) and some law enforcing agencies. These regulatory bodies have authority to halt the procurement process at any stage in case of any violation to the legal, administrative and financial rules and regulations pertaining to procurement process.

iv. **Professional Associations and Trade Unions:** Professional associations and trade unions are also an important player in the procurement process especially when it is carried out at a massive scale. The aim of such associations and unions is mainly to safeguard the rights of their members. These bodies act like a pressure group for the government to promote their business and to achieve their motives for the policies that influence them negatively. PPMA is a registered representative body of all pharmaceutical manufacturing units in Pakistan. The association came into existence in the year 1961 and it has more than three hundred members. PPMA emerged as one of the strong lobbies of the people who control the market and have an impact on the business statistics of the country.

3.2.2 Models and Approaches for Public Procurement

Public procurement in a healthcare system usually implies three procurement models for commodities like medicines/drugs, vaccines, consumables, diagnostic supplies and equipment.

1. Direct Procurement
2. Indirect Procurement
3. Pooled procurement

This is important to understand that at a given time, the procuring agency may opt for any of the three models or any combination of the models to complete the procurement process. All these models have their own pros and cons and decision to opt any of these models depends upon the volume of procurement, capacity of the procuring agency (financial, technical, legal) to run the procurement, type/s of commodity being procured, market situations and legal and administrative environment at the time of procurement.

3.2.2.1 Direct procurement Model

In this model procuring agency directly approaches the manufacturers, suppliers or their authorized representatives for procurement of healthcare commodities. Quotations or bids are obtained from the market and contracts are awarded to the sellers who are qualifying the criteria and compete for the market as well. Direct procurement is a cost-effective mechanism, but it is a resource-intensive and time-consuming process. This type of model is opted by organizations which have a continuous requirement of multiple commodities; to address their needs, these organizations have established a procurement unit. This type of procurement model is followed by the majority of public sector health organizations including pharmaceutical manufacturing units, hospitals, diagnostic laboratories and research institutes.

3.2.2.2 Indirect Procurement model

In this model, the procuring agency approaches another firm/organization for carrying out the procurement on behalf of the procuring agency. The intermediate party is mainly responsible for running the procurement process and charge the administrative cost to running the procurement while the procuring agency usually provides the financial inputs along with legal and administrative framework for this purpose. The products, which have manufacturing base outside the country and international trade and transport rules and regulations bar the procuring agency to run the procurement, can be procured through this process. Additionally, limited institutional capacity of procuring agency may also be a reason opting for this type of procurement model.

International supply services and international procurement agencies are organizations that purchase health products in bulk and resell to non-profit health care organizations in developing countries. They maintain catalogues of products and sell to donor organizations and governments at-cost plus fees. An international procurement agency procures specific items requested on behalf of the procurement unit, not necessarily items kept in stock; they often require cash in advance for these procurement services.

In Pakistan there are various examples of indirect procurement such as procurement of contraceptives for DoHs and Population Welfare Departments.

3.2.2.3 Pooled Procurement Model

Pooled procurement model involves a combination of the individual organization to form a larger group or an alliance with a common interest of procurement of similar nature commodities for the joint union. This increases the volume of commodities to be procured and at the time it also impacts the diversity and nature of the commodities. This in turn helps the purchasing group to make effective negotiations with the seller over price, quality and auxiliary services. GAVI is a union to

ensure the availability of vaccines and adherence to the immunization process in developing countries to achieve Sustainable Developmental Goals (SDGs). It works with the partnership of the WHO, UNICEF, the World Bank, Bill and Melinda Gates Foundation, governments of donor countries, government of the implementing countries, civil society organizations, non-governmental organizations, research agencies and vaccine manufacturers. In Pakistan, the vaccine is procured through GAVI for the public sector, particularly for the EPI of the country. The vaccine is delivered to the federal government of the country and it is then the responsibility of the country to distribute the vaccine nationwide. Vaccination schedules and implementation is monitored by UNICEF.

Chain pharmacies and chain laboratories in the private sector also have a central purchase unit and warehouse. All of the required commodities are procured by the chain at one point and then distributed to individual units according to their needs. This makes the procurement process highly challenging but has a huge impact on the price and cost of the commodities.

3.2.2.4 Competitive and Non-competitive Procurement:

Another categorization of procurement methods can be described as i) procurement through a competitive process and ii) procurement through a non-competitive process.

The competitive procurement method requires following a step wise approach as detailed in public procurement rules. In this method, it is ensured that an open competitive process be adopted to promote a healthy competition among the manufacturers and suppliers. Competitive procurement approach is mostly adopted and promoted for public health procurements. This approach ensures transparency and accountability of the procurement process and also helps in buying the best products with best value for money from the open market. Open tendering, restricted tendering or request for quotations are issued by the procuring agencies to call for bids from the open market.

But there are scenarios where the procuring agency may opt for a non-competitive procurement method and existing procurement rules and regulations of the country do allow to complete the procurement through this method *(Clause 42 – Alternative methods of Procurement - S.R.O. 432(I)/2004.- In exercise of the powers conferred by section 26 of the Public Procurement Regulatory Authority Ordinance, 2002 (XXII of 2002)*. This type of procurement is applicable in two scenarios

a) Procurement for petty purchases (value of procurement less than 50,000 PKR)
b) As mentioned earlier section referring to direct procurement methods, single source procurements for any financial value may be carried out through non-competitive procurement process with appropriate . In this scenario the procurement agency has to satisfy the competent authority that the product being procured through non-competitive process is of critical value and there is one sole manufacturer, patent rights holder or supplier holding the product. Additionally, this method is also considered as method of choice when the quality is the only concern of the procuring agency or there is national emergency requiring the particular commodity for response. In some instances, the procuring agency may need a monopoly product to run their operations.

N.B. Non-competitive approach is not method of choice for routine procurements and must be reserved for extra-ordinary circumstances.

3.2.3 Procurement Process

Procurement is the decision making process followed when products or services are purchased. Because the process of procurement involves transfer of funds, frequently substantial amounts of money, most of the procurement process focuses on making it as fair and competitive as possible. Therefore, good public sector procurement relies on thorough documentation and transparency

throughout the process to ensure that no party can claim that one group was unfairly favored over another. This means that each step must be standardized and regulated according to public laws and regulations. However, this can also make the procurement process time consuming. It is important for supply managers, program managers, procurement units, and other stakeholders interested in supply chain management to understand how long the procurement process usually takes; to ensure continuous availability, they must be able to plan procurement schedules and order quantities in a reasonable time.

In a systematic approach, process of procurement is completed in 3 phases and each phase has its indigenous elements. Table 2 given below provides an insight into the phases and there elements.

Table 4: Procurement Supply Process (Path 2009)

3 Phases	10 Elements
Procurement Planning	Defining healthcare commodity supply chain needs (e-g reproductive healthcare commodities, vaccines, antimicrobials, services etc.)
	Specifications
	Assessment of procurement options
	Budget, Funding and procurement requisition
Critical link: Funded Procurement requisition	
Procurement process	Procurement planning
	Developing Bidding Documents & Inviting offers
	Selecting Suppliers
	Contract Awarding
Critical Link: Signed contract and Payment Guarantee	
Contract Performance	Contract performance and monitoring
	Delivery of Goods/Services
Critical Conclusion: Delivery and acceptance of high quality products	

As we know that procurement of healthcare commodities is a regular feature and requires repeating of the process periodically to ensure availability of the commodities thus supporting the programs to achieve the targets. In this scenario, procurement process is often referred to as the procurement cycle comprising of specific steps. Figure 2 given below describes a procurement cycle and its steps.

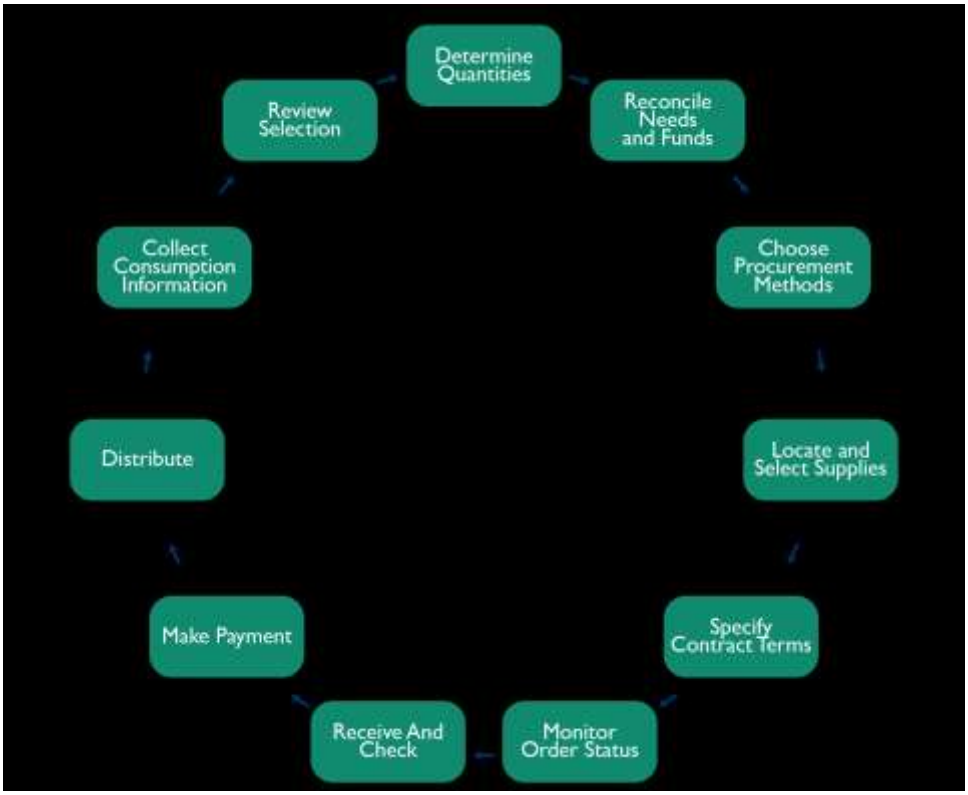


Figure 7: Procurement Cycle

A prerequisite for sound procurement is to have a clear idea of what needs to be procured. The selection and quantification of the health commodities to be procured should be based on factors including demand and disease burden. The following are some essential activities of the procurement process:

3.2.3.1 Step 1: Defining the Health Supply

To ensure smooth operations of any healthcare program and reduced or zero stock outs, every program requires a certain set of information about the volume and types of goods or services required for this purpose. As a regular practice, the procuring agencies in healthcare system lists all the commodities to be procured on yearly basis and define clearly the timeline when these quantities are required at the service delivery points (health facilities/outreach healthcare points). Based on the requirements, the procuring agency completes the forecasting and quantification of the commodities to be procured in coming year. The process of forecasting is crucial to the procurement process and is detailed in respective chapters of this guideline.

3.2.3.2 Step 2: Setting the Specifications

Based on the forecasting and quantification of the products listed for procurement, the procuring agency decides about the specifications of the products to be procured. Setting the specifications is a crucial step as this would be the prime consideration of the suppliers/manufacturers while entering the bidding process. This is very important that the specifications are set in a way that maximum supplier/manufacturer base in the market can be approached and the process of procurement remains transparent thus promoting a healthy competition in the market. Secondly, setting up the product specifications also ensures that no one supplier or manufacturer is favored in the procurement process. Thirdly, the specifications set by the procuring agency will act as the bench mark for the suppliers/vendors and will be used for validation of the delivered goods at the end of the procurement process.

The specifications may include:

- Generic name of the drug
- Formulation strength
- Dosage form
- Packing requirements
- Labeling instructions
- Any additional material/s if required.

The specification should be developed by keeping in view regulatory requirements by the DRAP and the Drug Act 1976 of Pakistan. The public sector procurement unit is also liable to ensure quality standards of the commodity on the developed specification and their compliance by the supplier.

Technical specifications also constitute the laboratory analysis of the commodities for quality assurance as well as specifications related to packaging and transportation purposes. Specifications are the principal approach that most of the countries employ for the protection of their people from acquiring substandard and counterfeit commodities. Specifications also assist in assuring that the commodities are appropriately labeled and sufficiently protected from sunlight, moisture, pressure, radiations and extreme temperatures during transportation and shipping. As an element of the bid, quality assurance and quality control related specifications should be undoubtedly mentioned, determining all necessary documentation that the procuring agency shall require from the supplier such as specific data related to manufacturing operations, the certificate of chemical analysis, and mandatory accreditations and licenses from the appropriate regulatory authorities. These specifications must comprehensively mention details regarding the procuring agency's inspection process and procedures related to commodity sampling.

3.2.3.3 Step 3: Evaluation of Procurement Choices

It is important to assess and select the most suitable method for the execution of the procurement process. The choice for the most favorable procurement method is made upon the volume of commodities to be procured, the timeline for procurement, nature of the market, procurement lead time, the scale of the organization and the type of commodity to be procured. In public sector organizations, competitive bidding is considered as the ideal process for procurement of pharmaceuticals and vaccines for hospitals and vertical programs. The government of the country also opts for pooled procurement to purchase vaccines for the EPI as Pakistan is one of the countries supported by GAVI and UNICEF. Private sector organization uses multiple methods for procurement depending upon the nature and volume of commodities they want to inject in their system.

Commonly employed methods of procurement by using direct, indirect or pooled procurement model in the healthcare industry are as follow:

1. Open Tendering
2. Restricted Tendering
3. Request for Quotations
4. Single Source Procurement
5. Petty Purchases

3.2.3.4 Step 4: Budget, Funding, and Procurement Requisition

Money is the key ingredient that fuels the process of procurement and it is the only critical factor that impacts the output of the whole process and impacts the functionality of the healthcare system. It is of crucial importance for the procurement unit to know the amount of money required to purchase the quantified commodities. Estimate the total cost of the operation can be made depending upon the previous offers received from the sellers. To have a more concise and accurate figure, the time value of money, rate of inflation, price of dollar and gold can also be taken into account. This estimate is then referred to as the budget for the procurement and once it is finalized after review by the competent authority, the procurement process has to be conducted keeping in

mind the budget window. Centralized procurement in the public sector is funded by either provincial or federal government; funded by international funding agencies; or sponsored by any international healthcare NGO. It is therefore essential for the public sector procurement unit to have clear information about the sources of funding and time of the available budget. For this purpose, it is the liability of the procurement unit to make effective communications and coordinate with other stakeholders, chiefly the concerned state-federal ministries and concerned provincial departments as well as international partnering institutions for the acquisition of information about the availability of funds and to establish their release mechanisms. While the purchase is made from the international market, it is also important to consider the cost of shipping, insurance, storage and cost incurred at the port during the release from the customs.

As compared to the public sector, the private sector organizations have a clear estimate about the money required, sources and availability of funds. Along with that, the private sector organizations have faster and more effective coordination with associated departments. The private sector organizations are also not bound by the public procurement regulatory authority and minimal approvals are required for procurement in private sectors. Combining all of the factors, the procurement operation in the private sector is relatively faster and easier as compared to the public sector.

3.2.3.5 Step 5: Planning of Procurement

As stated earlier, procurement (given the sensitivities involved) can be a lengthy and time-consuming process; because it consists of financial transactions, it is required to be planned with extreme caution and usually well in time before the unfolding of actual procurement operations and activities. A procurement plan is more closely related to a supply plan, as detailed in Forecasting and supply planning chapter of these guidelines, but it involves more information from multiple players. The supply plan functions as a basic document for purchase processes and highlights vital inputs and contributions to the procurement plan.

The information gathered from the supply plan, which will turn out to be the component of the procurement plan, involves the needed consignment quantities, with a detailed schedule of desired delivery date for each commodity. In addition to that, the procurement plan also incorporates:

i. the recognition of the procurement methodologies to be employed; enlistment of the critical and vital stages of the procurement process,
ii. as well as a timeframe with projected dates for the successful completion of every stage of the process, and
iii. contains the names of the accountable stakeholders.

Similar to the supply plan, the procurement plan must be commenced 24 to 36 months in advance, and it is ought to be revised on regular basis (for example, a rolling procurement plan). The rolling segment symbolizes the cyclical nature of healthcare commodity procurement. This procedure also guarantees that all steps of the process and timelines are accounted for to ensure that the correct commodities, in the correct amounts; received at the correct time, in the correct form, at the correct amount, and the correct location.

The procurement agency or unit normally keeps this plan and it may also provide to the related stakeholders as per their requirement. All the sections of the plan should undoubtedly jot down timeframes, tentative dates, and liabilities designated for each action and operation. Days and dates for completion should be predetermined for all actions and activities; but they must be pragmatic and realistic in approach, keeping into consideration the previous experience and existing capacity. All dates should be incorporated, starting from the basic activities to commodity delivery and the schedule of payments, to guarantee ongoing planning for procurement planning (to ascertain uninterrupted availability of the products). Information regarding the arrival of the new stock will help the procurement professionals to determine when the next order should be placed.

3.2.3.6 Step 6: Creating Bidding Documents and Invite Offers

To ensure efficient and effective competitive procurement, it is crucial to generate and issue comprehensive bidding documents which will be mandatory for the suppliers to evaluate their capacity and interest to offer their goods and services. Bidding documents should explain in detail the following items:

i. Quantities along with specifications for each commodity
ii. Quality control and quality assurance obligations of the desired commodities
iii. Dates of supply and specified destination of the consignments
iv. Time frame, processes and regulations to respond to the proposals
v. Assessment criteria employed suppliers' selection.
vi. Payment modalities

Keeping in view the regional context, it can be mandatory to acquire approval for tender documents from the federal or provincial official institutions or the donor organizations before making them publicly available. As well as a thorough review of all documents is also essential before they are being finalized by any authority, to make sure that there is no ambiguity, contradiction or non-synchronization in the document.

After approvals and reviews, the procurement documents are ready to solicit tenders. The overall goal of this activity is to attract a wide range of relevant and concerned suppliers to make sure that the process of selection is as fair and competitive as feasible. The tender should be advertised to the public, keeping in view the provision of the regulatory body and the donor organization, normally in the national newspapers, journals, bulletins and websites of most relevant institutions. Furthermore, the procurement office may directly send the proposal to the most relevant and concerned suppliers that would more likely be interested in bidding against a tender. Keeping into consideration the regulations of the public procurement regulatory authority the public sector organizations must advertise in one English and one Urdu newspaper of the national level.

3.2.3.7 Step 7: Selection of Suppliers

The success of the procurement process depends on selecting suppliers (in terms of prequalification) who will have the capacity to provide commodities of better quality, at a reasonable price and at the expected time. Consequently, after the proposals are received, the procurement unit must be sure that the assessment method, procedures and protocols are fairly structured and designed to yield impartial and transparent execution of the process. It is commonly observed in the public sector that a committee is constituted for the assessment and evaluation of the proposal submitted by the supplier. Such committees compare the proposal amongst each other mainly for their cost, technicalities, reliability and additional services and recommend submissions to the contracting board.

As the first stage of the supplier assessment and evaluation process, the basic and essential obligations, demands and specifications stated in the bidding documents and examined. This comprises of the assurance that the submitted proposals by the suppliers are in the accurate format; include all the needed information; fulfil all the mandatory terms and conditions; are overall complete.

Following guidelines to assess submitted proposals meeting the minimum requirements can be employed for the examination of the suppliers:

i. Assess all the submitted proposals by the same standards for assurance of neutrality and transparency.
ii. The submitted proposal must be in line with the needs mentioned in the bid document publicized.
iii. The proposal which does not comply with the basic criteria should be rejected.
iv. Assess all eligible proposals keeping in view the minimum stated cost in general or pre-established standards for pricing.

v. If the policy is to be inclined to the national organization, unambiguously mention the nature and extent of the inclination in the initial invitation to tender or call for proposals.

Supplementary benchmarks for the selection of an appropriate supplier include:

i. The applicant must contain adequate financial resources to meet any monetary security and operational requirements linked with the contract.
ii. The applicant possess the essential organizational capability to adhere to the terms and conditions as well as holds the operational capacity to complete it in the specified period.
iii. The applicant must provide references, or another indication, that it has previously satisfactorily completed projects of similar nature under similar contract terms.
iv. Manufacturers comply with the GMP criteria and appropriate ISO standards, as demanded by the government or funding agency.

All the submitted proposals that comply with the stated essential, technical and commercial demands are afterwards examined and assessed based on the financial comparison of total price (including conversion of currency, if mandatory and if required) and are graded according to the best-stated price or technical considerations otherwise deemed fit for assessment. The bid assessment committee then drafts a report of the assessment procedures observed for evaluation and performance of the bidders, consisting of recommendations to award the contract.

This recommendation report should incorporate information of all applicants and received a proposal; should state the reasons for recommending the identified suitable supplier to award contract. The report is then signed by all of the committee members and they also certify that process of selection was fair and impartial. It is important to state that it is important to keep all of the information, of the applicants and the submitted proposals, confidential as per the PPRA rules and also from the point of view of ethical practices.

3.2.3.8 Step 8: Award Contract

The contract is the output of the bidding process; it is the document that will lawfully bind the purchaser and supplier to an agreed-upon set of commodity specifications, delivery requirements, performance and payment obligations of both the parties and legal recourse in the case of non-adherence to the terms and conditions by both of the signing parties. Several types of contracts are frequently used, but regional procurement regulations policies determine the one to be used by the purchaser, or the ones which are permitted by the federal or provincial government of the country.

Determination of the mode of payment is a critical component of the awarding contract process. To prevent interruptions in obtaining supplies, the procurement unit is required to conclude payment arrangements as soon as possible, when the award of the contract is decided and confirmed by the authorities. Particularly, in the case of international orders of bulk volume, suppliers will not commence production or commodity delivery without confirmation of payment. The most frequently used mode of payment in this regard is a letter of credit or a down payment whereas, it is not unusual, in indirect payment for international suppliers, to ask for complete payment in advance on behalf of the purchaser.

The last stage of this process is to acquire any essential approval by the concerned commissioning authority or the donor agency if needed; the procurement unit must make sure that all documents are authorized by competent bodies and properly signed by the appropriate parties.

3.2.3.9 Step 9: Contract Performance

The subsequent stage after the contract is being decided and awarded is to assure that the formulated contract complies with the terms and conditions, as well as the consignments are received as planned. This implies that the procurement unit must contain predefined standards and protocols to supervise and monitor the performance of the supplier. Contract supervision and monitoring standards and protocols assertions that the essential requirements and technical

specifications stated in the contract have complied with the stated required standards. It also empowers the purchaser to identify any potential issues and assesses the supplier in light of consideration for future contracts.

The fundamental components of this type of system are:

i. Procurement documents and major indicators of performance
ii. Techniques for tackling disputes or issues
iii. Pre-shipment adherence plan
iv. Protocols to supervise consignments movements

Formulation of supervision and monitoring system for contract performance and its execution in the early phases of the contract execution helps to highlight problems and devise ways to solve them on the spot before they transcend to be more complex. One mechanism to monitor adherence of suppliers with the standards is to conduct pre-shipment sampling of the commodities, on-site inspection, and laboratory analysis. This may be a prerequisite of the federal or provincial government or concerned regulatory authority or funding agency, but this is usually deemed a good opportunity to assure product adherence to quality standards and documented specifications in the bid before the product is shipped by the supplier.

The three basic levels of pre-shipment compliance to monitor quality standards includes:

i. Review of documents before commodities are shipped,
ii. On-site visual inspection of the commodities, under processing or finished goods
iii. Chemical analysis by a laboratory or physical testing of the commodities.

The opted measure to check pre-shipment compliance to monitor quality may vary by nature of the commodity or by the type of supplier. If the supplier has a good reputation related to the delivery of quality products, the levels of determination of pre-shipment compliance to standards are reduced. Nevertheless, to assure consistency in quality over time, the procurement unit should keep random checks at different levels and different intervals of the process. Once commodities leave the warehouse of the supplier, it is also vital to supervise the quality of transportation and delivery arrangements of shipments made by the supplier to guarantee that they arrive on time and in good condition. The key areas to supervise and monitor in this regard are proper packaging; adherence to the shipping instructions; adherence to the delivery schedule; and adherence to the temperature, or other special shipping considerations mentioned in the contract.

3.2.3.10 Step 10: Delivery of Shipment

The final stage in the procurement process is to make sure that the delivery and receipt of the products are at the required destination. For international shipments, this involved the shipment of commodities from the warehouse of the supplier, through the port of entry, clearance through customs, receipt and inspection at the designated place of delivery, and resolution of any insurance or damage claims. While shipping terms and responsibilities may vary, it is the liability of both the purchaser and supplier to backup and supports the customs clearance process by making sure that they have all the necessary desired paperwork to facilitate clearance. Inadequate or incorrect documentation can cause unnecessary delays in clearance, which frequently leads to charges that the purchaser or seller (depending upon the set incoterm per contract) is responsible to pay. Customs demands should be clarified with the national agency and shared with the supplier before the shipment is sent so that all documentation can be provided to the purchaser in a reasonable time.

When the shipment is delivered to the destination, the warehouse must officially receive the consignment by confirming receipt of the correct documentation; including the commercial invoice, packing list, and any other required documentation. At this point, the warehouse staff should inspect the shipment to assure that the consignment consists of the right commodities, in the right quantities, in the right condition (with no damage), in the right packaging and labeling. Commodities

must also comply with any particular packing or expiry date demands mentioned in the contract; involve a complete packing slip and the manufacturers' certification of the product.

After inspection of the consignment, if no problems are identified, commodities can be accepted into the warehouse and added to the usable inventory. Warehouse records should be updated to incorporate the new consignments and all the paperwork related to the new consignment should be shared with the procurement manager to show proof of delivery and to authorize them to process payment to the supplier. If the contract has been fulfilled and payment made, one can consider it closed.

3.2.4 Applicable Laws

The procurement of medicines and diagnostics is governed by the following legislations:

- Public Procurement Rules, 2004
- Punjab Public Procurement Act 2009
- Punjab Public Procurement Rules 2014
- Sindh Public Procurement Rules 2010
- KP Public Procurement Act 2012
- KP Public Procurement Rules 2014
- Balochistan Public Procurement Rules 2014
- The Drug Act 1976 and the rules framed thereunder
- WHO Essential Drug List
- Government procedures to perform current good manufacturing practices (cGMP)
- Parameters for quality assurance
- ISO documents

The procurement process at DOH is decentralized and broadly comprises of:

- The establishment of annual rates lists for medicines and medical supplies by the centralized body.
- Devolved procurement carried out by tertiary hospitals, vertical programs, and partially devolved procurement by district health offices, primary and secondary healthcare facilities including Basic Health Units (BHUs), Rural Health Centers (RHCs), Tehsil Headquarter (THQs) and District Headquarters (DHQs).
- The raising of purchase orders for items in the rates lists - mandatory for district health offices and voluntary for tertiary hospitals and vertical programs

3.2.5 Standardization of procurement List and Rate Contracting

Since product selection and standardization lies at the heart of supply chain function, the centralized body (i.e. Procurement unit) undertakes national competitive bidding for selection and rate contracting of drugs, medicines, surgical disposals, and non-drug items (hospital supplies) at the provincial level. In Pakistan some provinces e-g Punjab, have adopted central contract strategy such as in Punjab. In this strategy, the provincial government contracts out the unit rates of the selected pharmaceutical products for the pre-qualified and best evaluated responsive pharmaceutical firms. The bulk of these needed products are then purchased by the districts for their respective facilities. Use of these rates lists is understood to be compulsory for districts. Since the centralized body rate lists are very extensive, it caters to a wide range of medicine classifications required for various specialties and sub-specialties in a health system. As such, there

is a need to identify a priority list of medicines which may be termed as District Priority Formulary of Medicines. This list is from within the same centralized list that should be available in full supply at the district health facilities catering to basic health services.

The following steps are followed by Centralized procurement body before the approved list of medicines and rates are circulated to all the stakeholders in Punjab, Sindh, KPK etc. The end users from the different public institutions are involved in gathering the specifications of pharmaceuticals. These specifications are then summarized by the Technical and Evaluation (T&E) Committee and receive approval from the Selection and Rate Contract Committee (S&RCC) before advertisement.

- As per PPRA rule, Open Competitive Bidding procedures are followed with nation-wide advertisement.
- Firms, manufacturers, and importers can participate in the tender.
- Technical evaluation of the application is made by the T&E Committee based on technical documents and subsequent visits to the manufacturer and importer facilities.
- Bid evaluation report by T&E Committee is submitted to Selection and Rate Contracting Committee (S&RCC).
- Technically evaluated firms are declared as responsive firms and their financial bids are opened.
- The financial evaluation involves making a comparative statement in correlation with technical marks.
- The highest scoring bid and rate is approved by the S&RCC of the centralized procurement unit headed by Director General Health Services (DGHS).
- The rates approved are for all public sector hospitals and DHOs for the whole year within the province.
- The procuring entity of the public sector institutions then places orders from this approved list which has its own terms and conditions mentioned in the contract agreement established with the firm.

3.2.6 Procurement by District Health offices

- The district health administration will call a joint annual meeting of all relevant experts, including senior doctors, Medical Superintendent (MS) of Tehsil/Talluka level Hospital, heads of regional health centers, and representation from some doctors of the Basic Health Units and civil dispensaries. The meeting focuses on identifying medicines in line with the disease trends reported in the DHIS report and should be in accordance with the requirements of their health facilities and per the approved list of medicines.
- The required annual demand of medicines will be analyzed and finalized by the concerned DHO and aligned with District Priority Formulary of Medicines.
- The districts will establish their annual demands (distributed on quarterly basis) on a prescribed template to be provided by DHO office.
- The DHO office will consolidate the facility-wise demand of medicine and supplies and will prepare an indicative costed plan for placement of supply orders with the approved suppliers prequalified by Centralized Procurement Unit.
- The DHO office will place supply orders with staggered and quarterly delivery options, keeping respective facility officials informed of the supply scheduled.

- An option of pre-shipment inspection should be considered to avoid duplication of efforts and wastage of resources.
- Inspection and physical verification of medicines supplied is done by a committee which must include the drug inspector of the relevant district as well as a hospital pharmacist nominated by the DHO (if available). Once complete, medicines will be distributed to the relevant health facility.
- The turnaround time for Drug Testing Lab (DTL) will be reduced to the bare minimum of 15 days, with efforts to electronically integrate with the District Supply Chain Management Information System.
- The payment will be made by the DHO office from their own budget upon production of the invoice along with any additional documentation needed. Penalty imposition or any other punitive action, as described in the bidding documents, will be the responsibility of the concerned DHO office.
- DHO will introduce a functional responsibility to undertake supplier research and supplier performance monitoring. This function could also include maintenance of the database for items procured, including the assignment of unique numbering, producing yearly statistics on quantities of the same item procured by all entities, unit prices paid, and suppliers who supplied to different entities. This information could be obtained by including a condition in the rates agreement template that successful bidders will be required to submit on a yearly basis.
- Procurement centralized body at the provincial level will arrange familiarization and capacity building sessions for district staff responsible for procurement based on provincial rules.
- There should be an element of flexibility for the entities to procure items that are not included in the approved rates lists and any specialized items through a process of collective cooperation, collaboration, and coordination.
- There should also be flexibility to procure emergency supplies up to a pre-determined amount. Each procuring entity generally is allocated special funds under the heading “Pro Poor Special Initiative Program and Emergency Relief Package” to all public sector hospitals. From this funding, emergency drugs for different disasters and day to day emergencies can be procured separately.

3.3 Challenges in the procurement process

Acquisition of resources as a key input for the system may seem to be a simple task but from the above-mentioned complex process of procurement, particularly in the public sector, it is clear that it is a hectic procedure to perform with a lot of responsibility on the procurement team. Though procurement process is a matter of routine for the procurement units operating in the public and private sector, but every time it unfolds with challenges that test capabilities, skills, professionalism, ethical values and pressure management of the procurement team. Key challenges faced by the procurement units are listed below:

1. The complexity of the procurement process, especially in the public sector organization, itself is a challenge for the procurement team to complete. It requires efficient and effective coordination with different teams, units and departments as well as excellent synchronization of the healthcare facilities, to yield positive outputs. Extensive documentation and record-keeping in soft and hard formed with limited human resource makes the produce more hectic.
2. The process of procurement is highly regulated by the public procurement regulatory authorities at the federal and provincial levels through the well-written legislature. Along with that the healthcare commodities themselves, including pharmaceuticals and vaccines are also monitored

and regulated by the federal government through different institutions and multiple federal laws, bye-laws and rules. This makes procurement a technical process to acquire the desired product by ensuring compliance with all of the applicable rules and regulations and adherence to all of the monitoring parameters of the regulatory institutions.

3. The process of procurement, either conducted by public or private sector organizations needs to be initiated and completed in the desired timeframe. If the process is initiated late or is delayed due to any reason, it will lead to stock-outs that will have a huge impact on healthcare delivery services. It can affect the vaccination schedule and may lead to failure in achieving the target set by the government and international healthcare agencies for the eradication of vaccine-preventable diseases. Therefore, time management is one of the critical aspects of the procurement procedure and it is important that every activity, task and operation should be initiated and complete well in time.
4. Communication and coordination with the beneficiaries and healthcare facilities to fetch their demands and to address their concerns, keep in view the chain of hierarchy and mode of communications opted by the public sector organizations in the contemporary practiced mechanism of manual working in government offices makes communication difficult and imparts a serious challenge for the procurement team to meet the deadlines in the desired timeframe.
5. The amalgamation of international partner organizations and alliances with the healthcare delivery system as the key stakeholder further complicates the procurement process. Every international partner has different areas of work and different nature of objectives to achieve. For example, one organization focused on Tuberculosis, Malaria & HIV/ AIDS control (Global Fund) while others are directed to fight childhood vaccine-preventable diseases (GAVI and UNICEF), whereas another group is offering financial and technical support (the World Bank and USAID), therefore, to address the concerns and fulfil requirements of every international partner with different objectives adds a challenge to the procurement process in the public sector.
6. Another challenge faced by public and private procurement units is the accuracy of the forecasting data which acts as a key input for the procurement team. If the data received by the procurement units are not accurate it may result in too low or too high estimates of the commodities to be procured. This will in turn result in stock-outs or wastage of financial resources respectively. Making a precise and accurate estimate of the commodities to be procured for a specific timeframe is a challenge faced by the procurement units in both the public and private sectors.
7. In Pakistan, the budget for healthcare is allocated by the federal government and it is released by the ministry of finance through proper channels for different operations. Making approvals and release of the budget by the government for the procurement process is a time-consuming procedure. The international financial support partners of the country have a different set of procedures for the release of financial resources. Cash cycles of the government and the international sponsors are mostly not in line and this results in delays to pay the suppliers. The suppliers in return hold delivery of commodities which results in stock-outs and systematic failure to achieve desired healthcare targets.
8. Quality assurance is the responsibility of the procurement unit until the commodity is received by the central warehouse. To purchase the same commodity as described in the specification by the procurement unit during the procurement process and to avoid the purchase of any counterfeit, adulterated, substandard or spurious drug or vaccine, the procurement unit has to strictly monitor the production and storage of healthcare commodities. For this purpose, the procurement unit sets parameters keeping in view the drug laws and GMPs and make sure that the supplier delivers the same product with the same ingredients and of the same quality as

mentioned in the specifications. If the quality control units find any deviation in the specification or quality of the products, the procurement officer can be held accountable for it.

9. Establishing transparency; fairness throughout the procurement process; the influence of the suppliers on the procurement team; maintenance of ethical practices and avoiding conflict of interests is a serious challenge incurred by the procurement professionals. A small manipulation at any step or stage of the procurement process can have a huge impact on the output because the commodity volume being procured is very large and a huge amount of money is involved in the process. Therefore, the elimination of corruption and promotion of transparency throughout the process is very important and one of the major challenges of the procurement process.
10. Competition among the suppliers and the market players is a natural phenomenon and it can be useful for the procurement unit to make effective negotiations with the manufacturers or suppliers to buy auxiliary or value-added services. This business competition may also attain a form of worst rivalry among the manufacturers and suppliers which may lead one of the parties to engage in unnecessary litigation against the procurement unit. This issue often arises in the purchase of pharmaceuticals and major consumables for the hospitals and vertical programs by the public procurement unit. Such happenings result in the delay of procurement execution, which adds time pressure as well as results in the wastage of resources.

Storage & Transportation

4. Storage & Transportation

4.1 Background

In the continuum of supply chain, storage of products and their distribution to the service delivery points is of prime importance. In a healthcare supply chain system, availability of a network of warehouses spanning all levels of administration from national to the health facility level become even more important owing to the vitality of any healthcare service delivery program to serve the communities. The healthcare service delivery programs are expected to provide essential medicines, vaccines, equipment and other consumables to not only the healthcare providers but also to the communities to provide quality healthcare services. Over the period of time, we have learnt that stocking of essential supplies near to the end-mile is a best practice to ensure quick provision of supplies to run the day-to-day business of any healthcare facility. Moreover, this practice has also proven its efficacy in avoiding and dealing with large scale humanitarian emergencies.

Refer to the logistics cycle explained in the earlier chapters of these guidelines *(Figure 1).* It is evident that the storage and distribution of commodities along with the complementing inventory management system is mandatory to complete the logistics cycle.

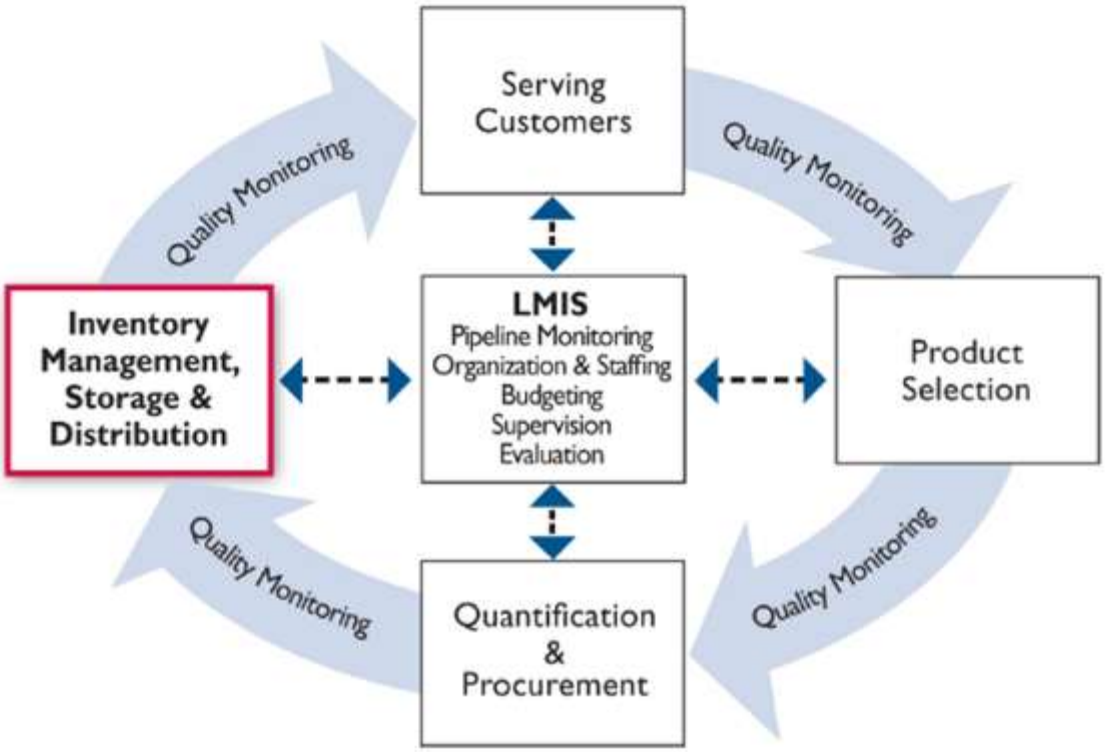


Figure 8: Logistics Cycle

Concept of warehousing is not new and multiple historical accounts prove that humans learned to store the food items to avoid famines and food shortage crises. Over the period of time, warehousing became broader, complex, and diverse owing to the diversity in the tradeable commodities. Moreover, there is growing need to store commodities for longer periods of time considering the geographical distances between the manufacturing countries and consumer

countries. Warehousing has evolved from conventional storerooms to the state-of-the-art storage facilities for manufactured goods in shipping, trading, and production.

The warehouse is a crucial component of the modern supply chain, especially for health commodities. They act as a safeguard against uncertainties within the supply chain which stands true for developing countries like Pakistan.

> **"The process of laying out a warehouse is a lot like putting a puzzle together. Like a puzzle, it is difficult to complete until all the pieces have been defined and assembled."**
>
> Edward H. Frazelle

The corporate sector has taken a systematic approach to warehousing; realizing its value to consumer satisfaction, reducing overall cost, and improving business performance. In the developing world, stakeholders involved in the public health sector have also started to focus on commodity warehousing, realizing its role as a vital resource for improving health care service delivery systems.

The systematic approach is directly related to the challenges faced by public health warehousing in developing countries. Challenges, such as demand for reduced turnaround time; use of technologies, and the increase in the range of essential medicines and health products in the public health system which can be addressed by improving stock management. The increasing demand for supplies and improved access to the information pertaining to various solutions for any healthcare problem requires enhanced focus on supply chain management and human resource capacity building within the warehouse. A broader information system can also be implemented including a warehouse management system that may link information to other points in the supply chain.

The management of public health warehouse requires a comprehensive plan for professional, appropriate commodity handling, and storage. There is a need to take a holistic view of available facilities, incorporating technologies where needed, and when appropriate while keeping the local settings in perspective.

This chapter is focused on sharing the standard protocols and best practices related to storage and distribution of public health commodities and to enable public health managers, logistics advisors, warehousing professionals, and supply chain managers to improve and increase efficiency in health commodity warehousing and distribution.

4.2 Objectives:

By the end of the chapter, the reader will be able to:

1. Define the essential elements and operations of a standard storage facility
2. Understand the network optimization for warehousing
3. Learn the best practices for commodity storage, transportation and distribution
4. Waste management protocols

4.3 Warehousing / Storage Facility

4.3.1 Warehouse

A warehouse is a place to temporarily store commodities and provide a buffer in supply chains.

Mainly, a warehouse is a trans-shipment point where all commodities are received, inspected, inventoried and dispatched to various destinations. The warehouse does not keep goods ad infinitum. Modern warehouses are key to ensure that consumer expectations are met in the form of damage-free, in-full, and on-time deliveries. This expectation driven transition has attracted various corporations to invest in introducing technology and automation in the field of warehousing.

Furthermore, concept of establishing a network of warehouses has emerged so that warehouses are built in a systematic manner to address the needs of all levels of administration especially in a public health care system.

As a process, the warehouse **receives commodities**, **proceed with the orders, restock**, **make necessary value-addition (if required**) then **ship orders**. Advances in warehousing tend to relate to the effective management of resources, accuracy, speed, improved performance measurement, and use of technology.

4.3.2 Rationale for warehousing

The demand drivers of the market remain volatile which discourages the best notion of holding minimum stock within its pipeline. Thus, we need to hold stock at different stages within the supply chain.

Various reasons for holding stock are as follows:

1. *Erratic demand patterns:* Supply of various commodities such as umbrellas, mosquito nets and air conditioners etc. are more likely to experience uncertain demand patterns depending upon the weather variations. The effect of major events and the launch of a new product may also trigger uncertain demands e.g., flag scarves during Cricket World Cup matches and Samsung Galaxy handsets, respectively.
2. *The trade-off between shipping costs and transport:* The capacity to move commodities in bulk tends to reduce cost per unit. Here, the trade-off means two inter-related choices i.e. the cost of storing surplus stock compared with the transport cost incur for the smaller, groupage sort of deliveries. The nominal transport cost can be availed subject to the availability of additional storage capacity.
3. *Discounts via bulk buying:* The buyers usually receive reduce cost per unit through buying in greater quantities. Before making a bulk purchase, it is important to calculate the whole-life cost of the commodities so that warehouse may be able to clear the stock before goods expire. The determinants of such cost may include working capital interest, damage, possible discounted sales, disposal costs, additional storage, and handling costs. A trade-off exists between lower unit purchase costs and increased storage costs per unit.
4. *Price fluctuation of raw materials and finished goods:* Certain products fluctuate in price significantly and can also be affected by weather conditions. Companies may, therefore, buy significant quantities when the price is profitable or when weather conditions dictate. This will necessitate additional storage capacity.
5. *Lead time in a supply chain:* In a supply chain, the lead time is the timeframe from the initiation to the completion of a process. The lead time of product delivery from the warehouse to the end-user may take up to eight weeks depending upon the location of the warehouse. In this scenario, there is a trade-off between the increased transport and inventory holding costs and costly local producers and suppliers.
6. *A coping strategy to mitigate the effect of production shutdowns:* There is a specific time when the production companies and sectors continue to shut down their operations for stock counts, machine maintenance, and vacations. To mitigate the effect of such a shutdown, this is essential for the warehouses to build up stock before the shortfall to ensure the smooth functioning of a supply chain.
7. *High seasonality*: Seasonality means time such as spring and autumn or any specific day around the year such as New Year, Independence Day, or Eid, etc. Manufacturers buildup inventory for high seasonality periods.

8. *Maturation and ripening*: Some products require longer-term storage to improve the quality or the maturity of the product such as mangoes and apples etc.
9. *Consignment stock*: There are examples where manufacturers will utilize their customers' warehouses to store their goods. This is called consignment stock where the customer only pays for the stock once it has been used or consumed. This takes the pressure off the supplier to hold more stock and ensure delivery on time whilst the customer has available stock within the warehouse but has yet to pay for it, thus increasing flexibility and improving cash flow.

The prerequisites for operating the smooth supply chains through warehouses include adequate shipping/receiving ports, storage in appropriate conditions for the commodities, and enough workspace to access and compile onward shipments for products going to regional or district warehouses or SDPs.

4.3.3 Elements of a warehouse

Following are the major elements as pre-requisite for setting up a warehouse:

1- Lay-out and operations capacity
2- Building Infrastructure
3- Warehouse equipment
4- Special storage facility
5- Safety & Security equipment and protocols
6- Human Resource
7- Inventory management

In a country wide healthcare system, the healthcare commodities are received from the suppliers/manufacturers directly at a central warehouse and then transported through a network of regional/provincial warehouses for further distribution to the service delivery points where the commodities are finally issued to the end-users i-e patients or clients in this case. For example, there is a central warehouse facility for EPI in Islamabad where all the vaccines are received from the suppliers/manufacturers and then shipped to the provincial EPI stores. The provincial EPI stores in turn issue the vaccine stocks to the regional and district level EPI stores for stock keeping and further distribution to the sub-district level stores and ultimately to the health facilities. This organized network of warehouses ensures continued and seamless distribution of vaccines through out the country without any delays. Although, in the post devolution scenario, some the roles of the central warehouse have been taken over by the provincial warehouses and the suppliers/manufacturers are shipping the vaccines directly to the provincial warehouses. But the over all mechanism of vaccine stock receiving, storage, inventory management and transportation/distribution remains essentially same.

Similarly, there is at least one provincial level central repository in every province which is responsible for receiving, temporarily storing and issuance of essential medicines, equipment and other supplies to the district level stores. These provincial level storage facilities are usually referred to as Medical Store Depots (MSDs).

Concurrently, there is at least one district warehouse/store room for managing supplies at every district headquarter. These district level store rooms are entrusted to receive supplies from the provincial stores and then rationalize and distribute the received stocks to the subdistrict level stores (tehsil/Taluka stores) and sometimes directly to the health facilities. As per the protocol, every

health facility, irrespective of the level of healthcare (i-e Primary, secondary, tertiary level) has its own store room.

Figure 9:Healthcare Supply chain visualization (Source: PwC)

This concerted network of warehouses requires a well-coordinated and systematic approach to run the operations harmoniously while sticking to the standard protocols for storage, record keeping, transportation and waste management. Figure 2 demonstrates various elements of a healthcare supply and role of central coordination mechanism to ensure smooth supply of commodities from the suppliers/manufacturers to the patients/end-users.

4.3.4 Network optimization for warehousing:

While setting up a new warehouse site or selecting the existing buildings for this purpose multiple considerations need to be addressed before finalizing this important decision. Ideally, the warehouse site must be accessible to all units and health facilities it intends to serve. To ensure security measures and avoid automobile and human congestion, a separate plot of land is a suitable location for the medical depot along with easy access of large vehicles to the warehouse.

Be Aware!

- **Warehouse should not be located on congested roads.**
- **The location of the warehouse should be on higher ground that is not on the verge of flooding site or has drainage problems.**
- **Trees should be regularly checked for the weakness to prevent them from falling on the depot during extreme weather and trim others to avoid falling branches. Tree roots should also be checked if they are not affecting the building's foundation.**

Drainage: The warehouse is usually built on a raised foundation to allow rainwater to drain away from the store at the time of any unforeseen situation.

Trees: The internal temperature of the warehouse also depends upon the tree plantation on the site.

Strategically, the selection of a cost-effective geographic location for the warehouse is one of the important decisions that require the assessment of various quantitative as well as qualitative measures. The accessibility to the appropriate road network is essential so that the warehouse can be reached without any unnecessary hassle and the lead time can be minimized.

4.4 Operations at warehouse

As we understand that a warehouse/store room is established to temporarily hold the supplies received from the suppliers/manufacturers which are intended to be provided to the end-users, there are various operations which are being performed at every warehouse. The understanding of these functions by the program managers and warehouse staff is essential. Major operations being carried out at any warehouse are enlisted below:

1- Receiving of commodities
2- Put-Away
3- Stock Placement
4- Record Keeping
5- Stock management
6- Waste/Expiry management
7- Transportation

In the sections given below, each function/operation of the warehouse is explained along with the best practices for each section.

4.4.1 RECEIVING AND INCOMING

a) When unloading vehicles, the cartons and packages are visually inspected to avoid the likelihood of damage during transportation (leakage, breakage, intact cold chain… etc.). The quantities of the products, Vaccine Vial Monitor (VVM), and temperature data loggers are also verified and recorded (invoice, voucher, packing lists).

b) The responsible official must report any discrepancy in the physical count or any damaged / cold chain broken items spotted during the visual inspection.

c) Visual inspection is the process of examining products and their packaging to look for any obvious problems with the product quality.

d) Immediate shifting of cold chain items to the cold rooms/ ILRs accordingly

e) The products received at the store can potentially undergo two types of damages; mechanical (physical) damage and chemical damage.

i. Mechanical damage is caused by physical stress, such as crushing or tearing when the product is loaded, off-loaded, or stacked. This kind of damage is usually limited to crushed or torn parts. Generally, mechanically damaged items are removed from stock and the remainder of the box, or carton, is redistributed.

ii. Chemical damage is more difficult to detect and is usually not obvious during a visual inspection. Laboratory testing is typically required. Some indications of chemical damage include changes in the VVM, color, flavor, fragrance, or consistency of the product. Chemically damaged items are removed from inventory, quarantined, and destroyed per disposal procedure. Any broken Cold chains should also be reported to the vertical programs sending those cold chain items.

Table 5: Indicators of Product Quality Problem

All products	Liquids	Light-sensitive products (such as x-ray film)	Latex products
• **Broken or ripped packaging (vials, bottles, boxes, etc.)** • **Missing, incomplete, or unreadable label(s)**	• Discoloration (color change) • Cloudiness • Sediment • Broken seal on bottle • Cracks in ampoule, bottle, or vial • Dampness or moisture in the packaging	• Torn or ripped packaging	• Dry • Brittle or hard • Cracked
Lubricated latex products	Pills (tablets)	Injectables	Sterile products (including IUDs)
• **Sticky packaging** • **Discolored product or lubricant** • **Stained packaging** • **Leakage of the lubricant (moist or damp packaging)**	• Discoloration • Crumbled pills • Missing pills (from blister pack) • Stickiness (especially coated tablets) • Unusual smell	• Liquid does not return to suspension after shaking	• Torn or ripped packaging • Missing parts • Broken or bent parts • Moisture inside the packaging • Stained packaging
Capsules	Tubes	Foil packs	Cold Chain Items
• **Discoloration** • **Stickiness** • **Crushed capsules**	• Sticky tube(s) • Leaking contents • Perforations or holes in the tube	• Perforation(s) in packaging	• Vaccine Vial Monitor (VVM) color change • Data logger recording out of range (2-8 Celsius)

4.4.2 PUT AWAY

a) Cold chain items should move immediately to the cold rooms/ ILRs after physical inspection of VVM.
b) After unloading and unpacking the containers, the goods should be stored in their designated area (rack, shelf or floor) and recorded in the stock ledger.
c) The best approach is to store and record the commodities the day they are received.
d) Commodities must be stored based on FEFO (First Expiry First Out) principle, ensuring that patients receive them in good condition and on time, well before their expiration dates.

4.4.3 STOCK PLACEMENT

4.4.3.1 Store Products Using FEFO Principle

i. In addition to having visible expiration and manufacture dates, products must be stored such that those that expire first are easiest to reach. This will ensure that the first product to expire is the first out. Managing by expiration date ensures that the oldest products, having less shelf lives as compared to the fresh stocks, leave the store first. The storekeeper should confirm that FEFO is being followed every time they take a physical inventory.
ii. At the service delivery point, old stock should be moved or rotated to the front of the shelf, with new stock placed at the back of the shelf. By rotating stock, staff can ensure that the first stock issued is the first stock to expire.

iii. The goal is to get the product to the patient, not to have it expire on the shelves.

4.4.3.2 VVM Consideration in Cold Chain Products

i. In case of cold chain products, VVM is the first criteria need to be considered.

ii. Stages 1 and 2 are acceptable while 3 and 4 need to be destroyed. The general standard inner circle color should be lighter than the outer circle color at the time of use.

iii. If there are vaccines with VVM on stage 2 with a longer expiry and stage 1 with a shorter expiry, the 1st one should be given preference and should be stored in front.

4.4.3.3 Storage Conditions for Laboratory / Diagnostic Items

i. Laboratory and Diagnostic items include chemicals, reagents, equipment, serums, antibiotics, standards and diagnostic kits etc.

ii. Different kind of storage requirements needed for different category of items.

- Chemicals and reagents need to be stored as per requirement mentioned on them e.g. Inflammable products i.e. alcohol, nitrogen etc. need to store in inflammable portion away from main store. Corrosive items need to be stored in lower shelves to avoid splash and use protective equipment i.e. gloves, goggles and coverall at the time of handling.
- Equipment i.e. microscopes, GeneXpert, Micro lab etc. required cool temperature at the time of operations, while glass items need to be placed in lower shelves during storage to minimize breakage
- Diagnostic kits, GeneXpert kits, antibiotics, antimicrobial, serums etc. need to be refrigerated to maintain their efficacy

4.4.3.4 Store supplies in a dry, well-lit, well-ventilated storeroom, out of direct sunlight

i. The ideal light for warehousing is natural light (indirect sunlight) during daytime by reducing the use of either incandescent or florescent bulb lighting which emits heat and ultraviolet rays, respectively. Exposure to such light may harm certain products. At the same time, it is essential to keep products out of the reach of direct sunlight.

ii. One key consideration is to minimize the exposure to heat and direct sunlight as they can be detrimental to shelf life and the composition of products.

iii. To avoid such damage, it is recommended to store products in their original cartons and shade the interior of the storeroom from direct sunlight at lower levels, store products in the inner boxes (i.e., those that came inside the cartons), and leave medicines in their dark-colored/opaque bottles.

4.4.3.5 Clean and disinfect storeroom regularly

Rodents and insects (e.g., termites and cockroaches) eat tablets and their packaging. Keep the storeroom clean and disinfected at all times as it protects from pests. Do not eat or drink

there and if possible, regularly schedule exterminations to eliminate pests. If rodents are a serious problem, cats may be an inexpensive, nontoxic alternative to traps or poisons.

4.4.3.6 Secure storeroom from water penetration

Water has an equally destructive impact on medicines and its packaging. Even if there is no damage to the product, damaged packaging makes the product unappealing to the patient.

The best way to prevent water damage is to repair leaky roofs and windows. It is recommended to stack supplies off the floor on pallets at least 10 centimeters (4 inch) off the ground and 30 centimeters (1 foot) away from walls to avoid water damage from moisture.

4.4.3.7 Fire Safety Precaution

Stopping a fire before it spreads can save thousands of dollars' worth of supplies and the storage space itself. The right equipment must be available throughout the storage facility, especially fully functioning fire extinguishers (clearly indicating expiry date) near the exits. If extinguishers are not available, use buckets of sand. Fire safety training is imperative for the staff managing the store.

4.4.3.8 Store latex products away from electric motors and fluorescent lights

Latex products, such as condoms and gloves, can be damaged if they are directly exposed to fluorescent lights and electric motors. Condoms and gloves stored in their proper packaging (i.e., boxes and cartons) will not be affected by limited exposure. Whenever possible, keep latex products in their paper boxes and cartons. If not, keep them away from lights and motors.

4.4.3.9 Maintain cold storage, including a cold chain, for commodities that necessitate it

Cold storage, including the cold chain, is essential for maintaining the shelf life of drugs and vaccines that necessitate it. These items are irreparably damaged if the cold chain is broken. If the electricity is unreliable, the alternative option is bottled gas or kerosene-powered refrigeration. During immunization campaigns, cold boxes or insulated coolers may be used for rapid transport.

It is important to follow the manufacturer's recommended storage conditions for all products. To remain compliant with the storage conditions, keep thermometers in various places within the storeroom and record temperatures twice a day (9:00 am and 4:00 pm). The following terms relate to temperature and medical supplies:

i. **Store frozen:**

Some products need to be transported within a cold chain and stored at –20°C (4°F) (e.g. BCG and Measles vaccine stored in the freezer room). Frozen storage is normally for longer-term storage at higher-level facilities.

ii. **Store at 2°– 8°C (36°– 46°F):**

Some products are very heat sensitive but must not be frozen. These are usually kept in the first and second part of the refrigerator (never the freezer). This temperature is appropriate for storing vaccines for a short period of time as well as medicines like oxytocin.

iii. **Keep cool:**

Store between 8°– 15°C (45°–59°F). Contraceptives like DMPA are stored at this temperature

iv. **Store at room temperature:**

Store at 15°– 25°C (59°–77°F). Medicines like paracetamol are held at this temperature.

v. Store at ambient temperature:

Store at the surrounding temperature. This term is not widely used due to significant variation in ambient temperatures. It means "room temperature" or normal storage conditions, which means storing in a dry, clean, well ventilated area at room temperature between 15° to 30°C (59°–86°) depending on climatic conditions.

4.4.3.10 Flammable products safety

Store these highly flammable products near a fire extinguisher and away from other products, such as phenobarbital sodium (elixir).

4.4.3.11 Stacking of Cartons

Pallets keep products off the floor, so that they are less susceptible to pest, water, and dirt damage. By keeping pallets 30 cm (1 ft) away from the walls and from each other, air circulation is promoted and it is easier to move, clean, and inspect stock. If storekeepers can walk around the stacks, they are more likely to be able to follow other good storage practices (sweeping, reading labels, and FEFO).

Cartons should not be stacked higher than 2.5 m (8 ft), whether on pallets or not. This is the highest that products can be stacked without crushing the cartons at the bottom. Stacking products at a stable height of less than 2.5 m also reduces the possibility of injury to warehouse personnel. When a storeroom has a reliable metal racking system, the cartons should be stacked in the racks accordingly.

Where pallets are inappropriate, shelving is an excellent way to store products. Metal shelving is preferred because wood shelving may attract termites.

4.4.3.12 Arranging Cartons

It is essential that medicines that are the first to expire are also the first products issued, regardless of when they arrived at the storage facility. If shipping cartons do not show the manufacture or expiration dates, or if this information is difficult to read, use a marker to rewrite the dates on the cartons in large, easy-to-read letters and numbers.

Items should always be stored according to the manufacturer's instructions on the carton. This includes the direction of the arrows on the boxes, as storing cartons upside down can affect the usability of certain medicines.

4.4.3.13 Arranging Products

The district store should have a system for classifying and organizing medicines, which all relevant staff should be oriented on.

i. **Alphabetical order by generic name:** Often seen in both large and small facilities. When using this system, the labeling must be changed when the Essential Medicines List is revised or updated.
ii. **Therapeutic or pharmacologic category:** Most useful in stores where the store staff are very knowledgeable about pharmacology.
iii. **Dosage form:** Medicines come in different forms, such as tablets, syrups, injectables, and external use products such as ointments and creams. In this system, medicines are categorized according to their dosage form. Using the other methods of categorization can be used to organize the items more precisely.
iv. **System level:** Items for different levels of the health care system are kept together. This works well in stores at a higher level when storing kits is required.

v. **Frequency of use:** Frequently used products that move quickly through the store should be placed at the front of the room or closest. This system should be used in combination with another system.

vi. **Random bin:** Identifies a specific storage space with a code that corresponds to its aisle, shelf, and position on the shelf. This system requires computer automation.

4.4.3.14 Electricity Backup/Generator

I. An electricity backup /Generator is required at district store level to ensure the ambient temperature for the infectious diseases drugs and to ensure the intact cold chain for vaccines and other temperature sensitive items.

II. Frozen icepacks are also needed to maintain and ensure cold chain in emergency situations

III. Pitchers are also utilized by Malaria Control Program to ensure the temperature remains within the ideal range in a few areas of KPK and Baluchistan

4.4.4 RECORD KEEPING

a) Every district store has a stock register. The stock will be entered by store staff on the stock register and all details will be recorded including brand name, generic name, strengths, dosage forms, quantity, batch, lot number, expiry and receiving date. VVM is also recorded in the case of vaccines. Each entry should list the initials of the staff member that completed the intake.

The minimal information that should be collected on stock records for medicines and other health products includes:

- Product name and description, including the dosage form (capsule, tablet, liquid suspension, etc.) and strength
- Stock on hand or opening balance
- Receipts
- Issuance
- Losses and adjustments
- Closing or ending balance
- Transaction reference (such as issue voucher number or name of recipient)

Depending on the system, stock records might also include additional product information such as:

- Special storage conditions (e.g., Temperature 2°– 8°C)
- Vaccine Vial Monitor (VVM) stage
- Unit prices
- Batch & Lot numbers or bin locations
- Item codes
- Expiry dates

b) Stock records might also include certain calculated data items. These are determined by mathematical formulas that depend on system design parameters, such as how often orders are placed. Calculated data items include:

- Consumption data, such as average monthly consumption (AMC)

- Lead times[1] for ordering or requisition
- Maximum and minimum stock levels
- Emergency order points

c) A storage and distribution system may not necessarily use all these forms but it will need forms to record stock data and product transactions. Standard forms used for inventory control include:
   - Stock register: Provides an up to date record of all transactions for medicines received, issued, and discarded
   - Bin cards: An updated balance of an item available in stock. The bin card will be placed and maintained on every item stack for immediate stock monitoring. A separate bin card will be maintained for every drug. Drugs with different dosage forms and strengths of same generic name will be treated as separate drugs and separate bin cards will be used for each of these items.
   - Requisition or issue vouchers: Used for supplies issued or received at one time by the store.
   - Receiving forms (packing slip, freight bill etc.): Used for supplies issued or received at one time by the store.
   - Delivery or issue vouchers: Used for recording the stock issued at one time
   - Temperature monitoring chart both for store and cold chain i.e. cold room, ILR etc.
   - Expired stock disposal forms: Used to keep record of the expired stock disposals
   - Physical inventory forms: The physical stock counts will be conducted at the end of every quarter and records will be maintained after signatures of the relevant authorities to ensure transparency in procedures.
   - List of approved medicines and prices.

d) The store staff will ensure the presentation of monthly, quarterly, and annual stock reports to the authorities.

[1] The time between placement of supply order and delivery of the medicines

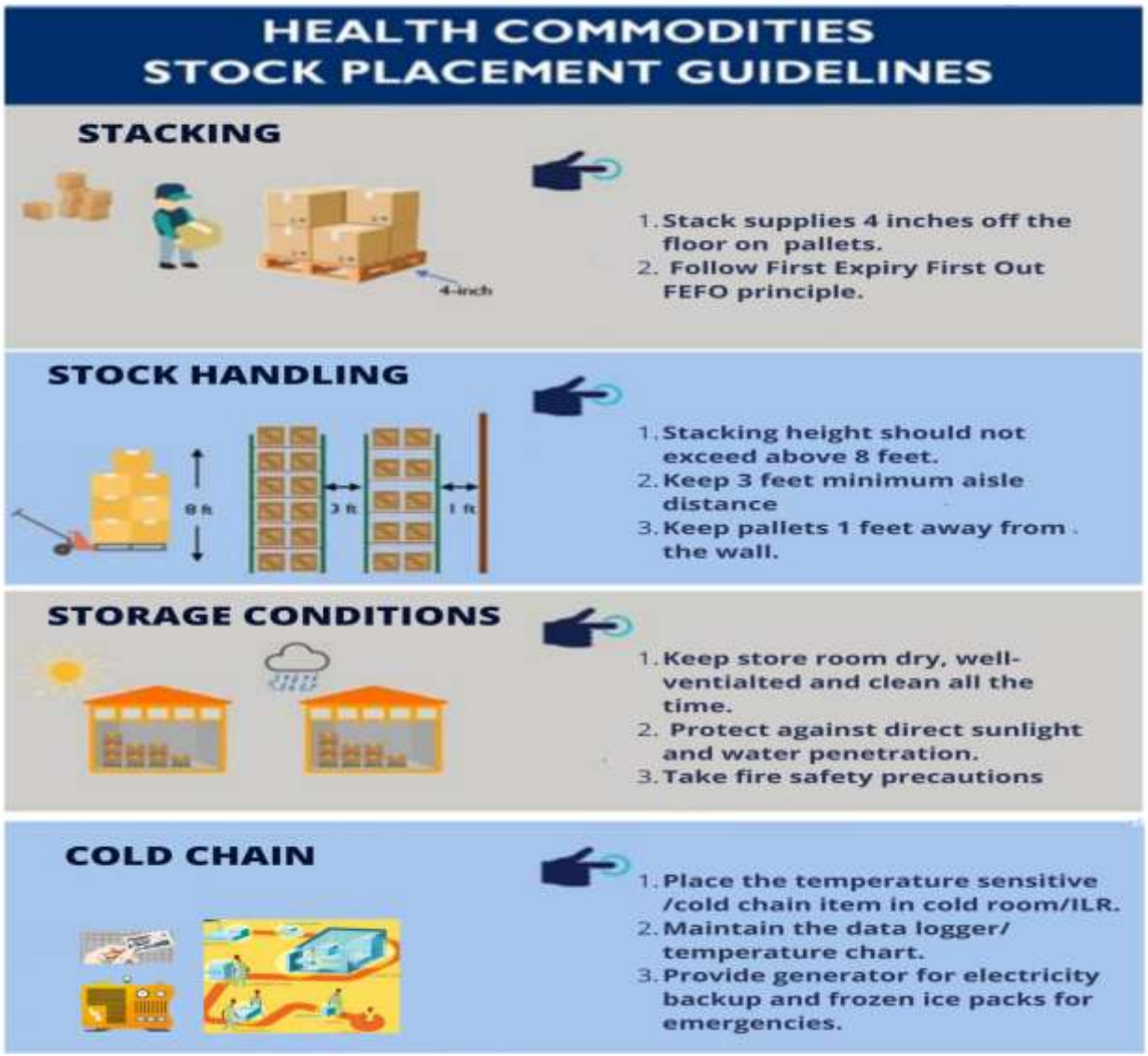


Figure 10:Snapshot of Stock Placement Guidelines

4.4.5 STOCK MANAGEMENT

4.4.5.1 STORAGE SPACE CALCULATION

For district stores, shelves and racks are sparingly used and the following parameters are considered:

- Total product volume, by commodity, based on a peak month
- Required space for receiving, picking and packing, and shipping
- Organization and labeling of cartons to ensure accessibility and FEFO
- Required operation aisle distances (at least 3 feet)

Proper storage includes the effective use of storage space. If too much space is unused, a storeroom is underused and money is wasted. If products are crammed into too small a space, they may be damaged or inaccessible. Thus, store staff must learn how to calculate the space needed to store incoming shipments, how to calculate overall storage requirements for the store, and identify an ideal layout for storage.

To develop a workable layout and calculate storage requirements at a large warehouse, which may serve multiple purposes, it is important to identify the various warehouse activities that would influence layout planning. The space requirements and ideal layout for each activity must be determined to mitigate on constraints.

To determine space requirements, the following must be considered:

- Total stored pallet equivalents, by commodity, based on a peak month
- Stored pallet orientation
- Required space for receiving, inspection, and quarantine (away from other medicines)
- Required space for picking, packing, and shipping
- Type of storage media per commodity (i.e., pallet rack, gravity flow rack, shelving)
- Required operation aisle distances
- Type of material handling equipment required

Some issues to consider before purchasing racking or shelving include:

- Product volume (size and weight of loads)
- Pallets and containers (type, condition, dimensions, and weight)
- Equipment clearance (standard height of equipment and equipment extensions, such as forklifts and load heights)
- Building dimensions
- Warehouse floors (stress and strength requirements)

For smaller storerooms, pallets might not be used as they take up too much space. Shelves may be used instead of racks. Other factors to consider are:

- Total product volume, by commodity, based on a peak month
- Required space for receiving, picking and packing, and shipping
- Organization and labeling of cartons to ensure accessibility and FEFO
- Required operation aisle distances

Space calculations begin with the total number of units of the product needed to be stored. If calculating space for a single shipment, use the number of units in that shipment. If calculating space requirements for the entire quantity of a product that you need to be able to keep in store, use the maximum quantity, as per formula of max stock level × AMC. In addition to knowing the total number of units stored, the store staff needs to know:

- Number of units in a carton (exterior packaging)
- Size of the cartons

If the carton size is not previously determined, ask the relevant supplier, donor (in case of donation), central or provincial warehouse staff.

To calculate the amount of floor space needed to store any product, follow the steps below (also see table 2).
For example, to store 100,000 of syringes—

1. Divide by 100 syringes per carton, which equals 1,000 cartons of syringes.
2. Multiply by 0.004307 m_3 per carton of injections, which equals 4.307 m_3 of the total volume.
3. Divide by 2.5 m the maximum carton stack height, which equals 1.723 sq. m of floor space.
4. Multiply by 2 to allow 100 percent for handling space, which equals 3.446 sq. m of total floor space. The square root of 3.446 sq. m is 1.86 m.

Table 6: How to calculate floor space

Step	What This Tells
1. Begin with the number of units expected in a single shipment. **OR** **Begin with the maximum quantity of a product you expect to store if calculating overall storage requirements for the warehouse.**	Most shipments are expressed in units. One needs the number of units expected to tell the total amount one should place in a stack.
2. Divide the number of units to be stored **by the number of units in a carton.**	This tells the number of cartons. Sometimes, the shipping documents list the number of cartons in the shipment. In such cases, just skip this step.
3. Multiply the number of cartons by the volume of a carton.	Know the volume per carton. Obtain this information from the supplier, donor, or central or provincial warehouse. The answer is the total volume of space needed to store the product, but it does not tell the amount of floor space needed.
4. Divide the total volume by 2.5 m or 8 ft.	Whatever the volume of the cartons, you do not want to stack them higher than 2.5 m or 8 ft high. Divide the volume by the maximum height to determine the floor space needed to store the product.
5. Multiply the floor space needed to store the product by two.	Double the amount of floor space to allow for handling space, aisles, and other variables. This is the total amount of floor space needed. Multiply by a number larger than 2 to allow more space in which to create a handling area for new or outgoing shipments. In very small facilities where smaller quantities of product are kept, as much handling space may not be required, so one would multiply by a number smaller than 2.
6. Calculate the square root to get the dimensions of the total amount of floor space needed. You can also estimate the dimensions using your knowledge of mathematics.	The answer is the dimensions of the needed space, assuming the space is square. Of course, may storerooms are not square. For example, 36 sq. m is a square of 6 m x 6 m. It could also be an area of 9 m x 4 m.
7. Repeat these calculations for all products to determine the total amount of storage space you will need.	Calculate steps 1–6 for each product separately to estimate the floor space needed for each product separately. If total space requirements For the store are to be known, follow steps 1–3 above for each product, then total all the volume requirements and perform steps 4–6 on this total.

By calculating space requirements for future shipments, the storekeeper can determine whether they have adequate space to receive the shipment. If sufficient space is not available, the storekeeper should ask to receive the order in several small and staggered shipments, instead of one large one. However, large shipments are usually less expensive. Alternatives could also be considered, such as renting additional space when space is not available.

When procurement contracts are set, it would be advisable to set a fixed size of allowable shipments and include a shipping schedule in the contract. Knowing how to calculate storage space before shipments arrive can save a program time and money.

The formula to calculate space needed in an entire warehouse begins with the maximum quantity of product that can be stored rather than the number of expected units. The store staff will usually want to add extra room for loading and unloading docks, quality inspection and quarantine, packing and preparing shipments, and offices for administrative staff.

4.4.5.2 PHYSICAL INVENTORY COUNT

Stock-on-hand information is recorded but how is the accuracy of the information recorded on the stock card corroborated? The only way to be certain is to conduct a physical inventory count.

While conducting the physical inventory count, it is essential to compare the quantities on hand with the quantities that have been entered in records (for example, inventory control cards). A physical inventory count enables the storekeeper to confirm how much stock is at hand and whether forms are being completed correctly.

For quality assurance, a physical inventory count is also an opportunity to inspect products visually, as described earlier. The frequency of inventory counts depends on various factors, however the district storekeeper and/or District Health Officer (DHO) may advise a physical inventory count on quarterly, biannually, or yearly basis. If the storekeeper finds that the records do not match the actual stock, then there is need to conduct a physical inventory count more often and steps must be taken to improve recordkeeping.

When conducting a physical inventory count, it is important that the rules of proper storage are followed. Boxes are to remain sealed and only one box or carton is opened at a time. A physical inventory count, therefore, can be a quick routine exercise, especially if good storage practices are followed.

One factor that may deter storekeepers from conducting a physical inventory count is the large number of products in a storeroom that must be counted. Some options for conducting inventory counts in this situation include:

a. Complete physical inventory:

All products are counted at the same time. A complete inventory should be taken at least once a year. More frequent inventory (quarterly or monthly) is recommended.

b. Cycle counting:

The storekeeper conducts a physical inventory count for a fraction of items each month. By the end of the year, all items have been counted. When the next year starts, they begin the process again. Regular cycle counting can keep physical inventory up-to-date without disrupting store operations.

Selected products are counted and checked against the records on a rotating or regular basis throughout the year. This process is also called cycle counting.

c. Vital, essential, or nonessential (VEN) analysis:

This involves counting the most essential, or most expensive items, more often. This analysis categorizes products as vital, essential, or nonessential, enabling the storekeeper to assess stocks of vital items more frequently than nonessential items.

d. ABC analysis:

In this process, the products are divided into three categories, based on monetary value. ABC analysis is not based on cost but rather how often a receipt or issue is made. Antibiotics can be issued more often from the store than any slow-moving stock like IUCD. In this situation, it is advised to count and assess antibiotic supplies more often.

As with assessing stock status, having many items to count does not need to be a barrier to conducting regular physical inventory counts or regular assessments of stock status.

4.4.6 WASTE/EXPIRY MANAGEMENT

4.4.6.1 EXPIRED/DAMAGED MEDICINE

Signs of Damaged or Expired Product

1) Discoloration
2) Crumbled pills
3) Missing pills (from blister pack)
4) Stickiness (especially coated tablets)
5) Unusual smell

Causes of Expired or Damaged Product

You might have expired or damaged products in your treatment center because:

1) Your system for storage and product movement does not facilitate following the FEFO method
2) Expiration dates were not being double checked during stock checks
3) Poor handling during delivery
4) Poor storage practices (e.g. exposure to light, water damage, haphazard stacking, etc.)
5) Overestimating drug requirements

As mentioned before, immediate removal of all expired and damaged medicine from the area where useable stock is held is important to avoid giving patients ineffective or harmful medicine. After removing the stock, you should:

1) Place the goods in a separate area clearly marked for that purpose. BE CAREFUL that you do not place unusable product where it can be accessed by non-store staff (e.g. patients at the clinic).
2) Create a record of all stock that has expired or is damaged.
3) If nearing stock out, order more stock.
4) For clinics, if you are unable to dispose of goods per national guidelines, it is recommended that you transport expired and damaged stock to the district Store for disposal. Make plans accordingly.

In Pakistan, the central, provincial, and district level stores must each have a ***Destruction Committee*** in place, which meets periodically as per the need arises. They are responsible for determining the best way to dispose products following the National Guidelines. The safe disposal method of various infectious diseases medicine and diagnostic products is provided in ***Annexure A*** given at the end of this document.

4.4.6.2 MICROBIOLOGY LAB SAFETY AND WASTE MANAGEMENT

Microbiology lab safety and waste management is an important area to cover in reference to lab reagents and equipment. Details can be found on this subject under ***Annexure A***.

4.5 Transportation/Distribution of the healthcare commodities

All the diversified healthcare commodities need to be moved from one point to another point through an appropriate carrier so that the needs of the community can be served adequately. Transportation is therefore an important component of the supply chain management which keeps the whole chain operational to yield fruitful results. It would not be incorrect to state that transportation is the backbone of the supply chain management because it can impact the supply

chain policies, quality of services, customer satisfaction, quality of products, delivery schedules, cost of commodity, lead time, shelf life, potency and efficacy of the commodities. Another important aspect of the same is the efficient and effective distribution of healthcare and the models, modes and mechanisms adopted to disperse the commodities to every healthcare facility within the network of distribution. Distribution may sound like an easy task to perform but when the time of delivery and cost of shipment attributed to it and the number of healthcare facilities in the coverage network increases, it becomes a complex and challenging task to accomplish. Multiple factors (revolving around the concepts of distribution and transportation) interplay, to make the commodity reach the desired destination well in time, keeping in view the quality of services and quality of the commodity. A very good supply chain strategy may fail because of poor distribution and transportation protocols as well as a poor supply chain strategy may yield customer satisfaction if distributed and transported by good means.

Staff responsible for managing the warehousing and transportation of commodities in a healthcare supply chain system must be able to:

i. Ascertain the resources required to efficiently transport and distribute healthcare commodities from the main storage area to the attached healthcare units.
ii. Determine parameters involved in the optimization of the transport for the specified healthcare commodities.
iii. Understand different types of systems commonly used in the practice to acquire healthcare commodities.
iv. Establish the utilization of different models of distribution employed to disperse healthcare commodities from the main store to the healthcare facilities within the network.
v. Understand the basics of cold chain management and transportation of the laboratory samples from one place to another.

4.5.1 General considerations pertaining to transportation:

There are two general principles laid down for distribution at the district level:

1. The personnel involved in the distribution of health commodities have a responsibility to ensure that the quality of health commodities and the integrity of the distribution chain is maintained throughout the distribution process from the central warehouse to the district stores and to the health facilities.
2. The principles of good distribution practices should be followed at central and district level stores following minimum standards.

4.5.2 Transportation/Distribution Planning

4.5.2.1 Determine Transportation Needs and resources

Distribution planning and transportation needs should be re-configured and implemented to complement the adopted storage model. District stores will develop efficient and robust district-specific distribution and transportation plans down to the facility level.

Some vital questions need to be addressed when designing a new network for transportation and distribution, or redesigning an existing one.

i. What is the ideal distribution network given current resources?
ii. Will it provide a satisfactory service level, without stockouts, at dispensing facilities?
iii. What would be the ideal distribution network if more resources were available?
iv. What would be the economic impact of transportation type and route used for distribution?
v. What would be the impact of a transportation route on the delivery time?

The points listed below are essential for any design, regardless of size or complexity. By analyzing this information, officials in charge will be able to determine suitable transportation and distribution methods for delivery sequence and frequency to each facility. They can then use this information to identify the efforts and resources to build an ideal distribution system.

These points include:

i. Monthly demand for products supplied to each health facility (total quantity, weight, and packaged volume).
ii. Location and distance of facilities from their supplying facilities, with information projected on maps for easier viewing (hard copy or in electronic form).
iii. Fleet details including a list of vehicles in use, their type, load capacity, fuel capacity, and length of time (in days) the vehicles are available for health product delivery. In some cases, vehicles may not be solely for delivering health products [such as vehicles assigned to Lady Health Supervisors (LHS) of Lady Health Worker (LHW) Program)].
iv. Staff trained in activities relating to transportation, including proper equipment operation, safety, delivery schedule planning and execution, material handling, and reporting.
v. Transportation policy promulgated by the management of the organization.

4.5.2.2 Distribution planning includes:

i. Arranging a cutoff date (such as the 1st of every month) for receipt of requisitions and demands from health facilities.
ii. Introducing the requisitioning system covering lead time, safety stock and review period (i.e., the time between the current stock analysis and the previous one to determine whether to reorder) to ensure stock availability and avoid any under or overstocking.
iii. Chalking out the distribution plan for all health facilities. Considerations should be given to the capacity of vehicles used, distance from distribution store, and vicinity of another recipient facilities.

4.5.2.3 Transportation optimization

Transportation optimization enables public health supply chain systems to improve routine transportation in the most cost-efficient manner by consolidating their monthly deliveries to different health facilities by volume, weight, quantity and carton. This is achieved by converting the quantities for different health facilities into one complete shipment within a district to adopt the most cost-effective and appropriate mode of transport per shipment volume.

a. Key Features of Transportation Optimization:

Key features of transportation optimization are:

i. ***Shipment conversion by volume:*** This tool provides complete information for a single or multiple health facilities' deliveries into shipment volume. It provides the most cost-effective mode of transport per the planned deliveries volume for single or multiple health facilities.
ii. ***Shipment conversion by carton:*** This tool converts the products' quantities into several cartons.
iii. ***Shipment conversion by weight:*** This tool demonstrates the complete weight of shipments for the planned deliveries of particular district health facilities.
iv. ***Shipment conversation by pallet:*** This tool will convert planned quantities of a single or multiple health facilities' deliveries of districts into pallets.

b. Benefits of transportation optimization:

The following benefits can be obtained through transportation optimization:

i. Shipment information by cost for kg per carton, appropriate vehicle, or truck volume/
ii. Cost-effective transport planning of routes.
iii. Integration and optimization of resources (vehicles and human resources).

Based on the deduction that unstructured sub-district level distribution mechanisms are responsible for low or no stock availability at the last mile, the proposed model eliminates district stores altogether and necessitates direct delivery from the manufacturer, provincial repository/ warehouse, to the health facilities in the district. The stocks to be delivered are determined based on supply orders placed by the health officer of the district. These supply orders are based on the Medicines Coordination Cell (MCC) list received and on contraceptives, average monthly consumption, coverage area, and program targets.

4.5.3 Modes of commodity distribution: Push & Pull Modes

There are two types of systems being followed globally as basis for distribution of commodities i-e ***Push & Pull system***. The nomenclature is derived from the notion that the warehouse staff needs to determine when and how much supplies are needed to be transported to the sub-level stores or SDPs.

In a ***pull system***, the quantity to be transported is determined by demand-based catering to consumption trends at the SDPs. In a **push system**, product selection and quantities are determined by allocations from a higher level within the supply chain management system.

Based on different characteristics of the supply chain, the managers can decide about the kind of commodity distribution mode best suitable for respective settings. Some of the important considerations in this regard are enlisted below.

a. Capacity of the central/provincial/district warehouses for stock keeping
b. Type of commodity to be distributed. For example, if the program has decided to upgrade existing laboratory equipment at all the secondary level healthcare systems, then the mode of distribution best suited for the distribution of upgraded laboratory equipment will be push system. Similarly, some of the supplies which have been procured to enable the SDPs for disaster/outbreak preparedness can be provided through push mode of distribution.
c. Rate of consumption of medicines/supplies at the SDPs. The SDPs where rate of consumption for some particular medicine such as antibiotics is higher as compared to other SDPs would tend to 'pull' the supplies.
d. Availability of adequate means of transportation such as vehicles, POL, situation of road access etc.
e. Availability of funds required for transportation
f. Availability of inventory management system for stock management and replenishment
g. Availability of trained HR for warehousing, inventory management and distribution

Both push and pull approaches can be used for managing healthcare supply chain system but it is usually inefficient to combine the two systems between facilities at the same level. A pull system can be used from the provincial level to the district level, but a push system can be used from the district store to the facility level. It can be cumbersome for store staff if some facilities are pulling health commodities while other facilities want the health commodities to be pushed towards them. Proper quantities must be ordered and dispatched in the shortest possible time and deploying two systems at one level adds to confusion and delays.

4.5.4 Health commodities transportation and distribution models

Health commodities transportation and distribution models include the following approaches:

1. Facility managed distribution through cluster approach
2. Outsourcing transportation
3. Framework contracts – system driven replenishments (topping up approach)

a. Facility Managed distribution through cluster approach

Facility managed distribution is the most common distribution model, whereby the facilities clustering approach is adopted. In this model, the facilities are mapped based on their geography and distances. The type of vehicle is arranged according to geographical location and distance of the health facility from the district store. This enables optimal utilization of vehicles for the distribution of health commodities, contributing to cost savings and timely distribution. As explained in Figure 4, the geographical proximity of certain facilities has enabled clustering which allows the contracting of the most appropriate vehicle to deliver all the commodities needed for these clustered facilities in one shipment. At the district store, they are accounted for separately.

Figure 11: Self-managed distribution through cluster approach

b. Outsourcing Transportation

Through this mechanism, the delivery of health commodities to health facilities is outsourced to a 3rd party contractor who manages the delivery of all supplies from the district store to the SDP or health facility. This process can be resource-intensive and might encounter certain structural and political barriers. The 3rd party determines how to reduce costs and optimize the transportation and distribution of health commodities from a given location to the intended destinations.

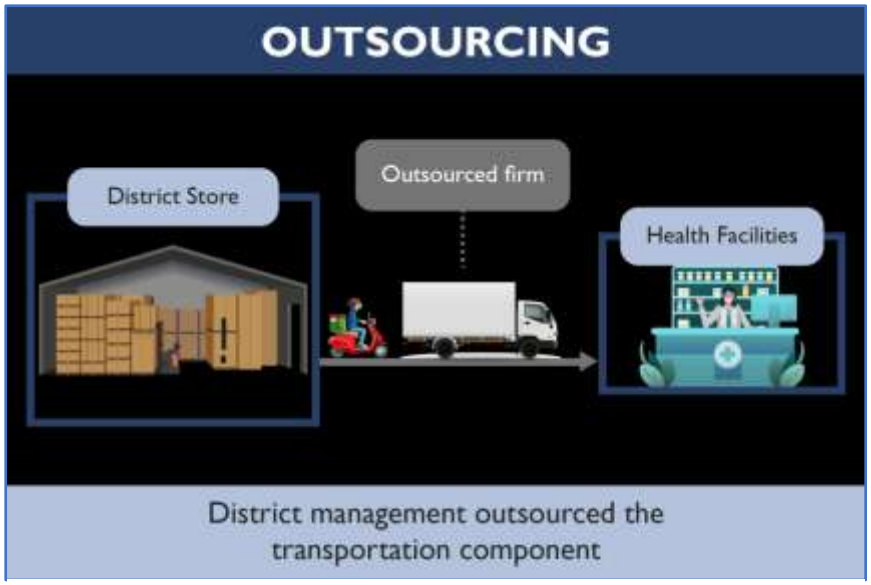


Figure 12: Outsourcing Transportation

c. Framework Contracts – System Driven Replenishments (Topping-Up Approach)

The existing province-wide deployed online LMIS (www.lmis.gov.pk) can serve as a tool for a system driven continuous replenishment. The district health department can establish a framework contract with a 3rd party transporter or contractor and provide them with the online log-in credentials for the LMIS, where it is assumed that product visibility is 100% for commodities until the last mile. The contractor would be responsible for ensuring acceptable stock levels in any facility and should immediately replenish any facility running out of stock or requisition supplies through an online continuous replenishment system. The contract should specify that in the case of late delivery of a product, the contractor will have to bear the prescribed penalty.

The following could be potential recommendations:

i. Incorporation of facilities' distances and min-max stock levels in the system
ii. Provision of LMIS login and password to 3rd party contractor
iii. Generation of stock-out auto-alerts to be sent to the contractor.
iv. Contractor to review the stock situation through LMIS and generate requests for products to the district store.
v. District staff to respond to the facility requests and issue the health commodities to facilities.
vi. The distributer will use a weight or volumetric system for the distribution of products. This will be pre-determined in the contract and invoicing would take place within the same parameters.
vii. The district stores personnel at dispatch will hand over the health commodities and the accompanying documents (2 copies of waybills or demand and issuance vouchers) to the driver responsible for delivering the health commodities to the health facilities.
viii. Health commodities must be handed over to facility staff and the facility staff will verify the items against the issuance voucher and provide a receipt voucher.

ix. One copy of the voucher should be handed to the driver and the second copy should be retained by facility staff for record purposes.

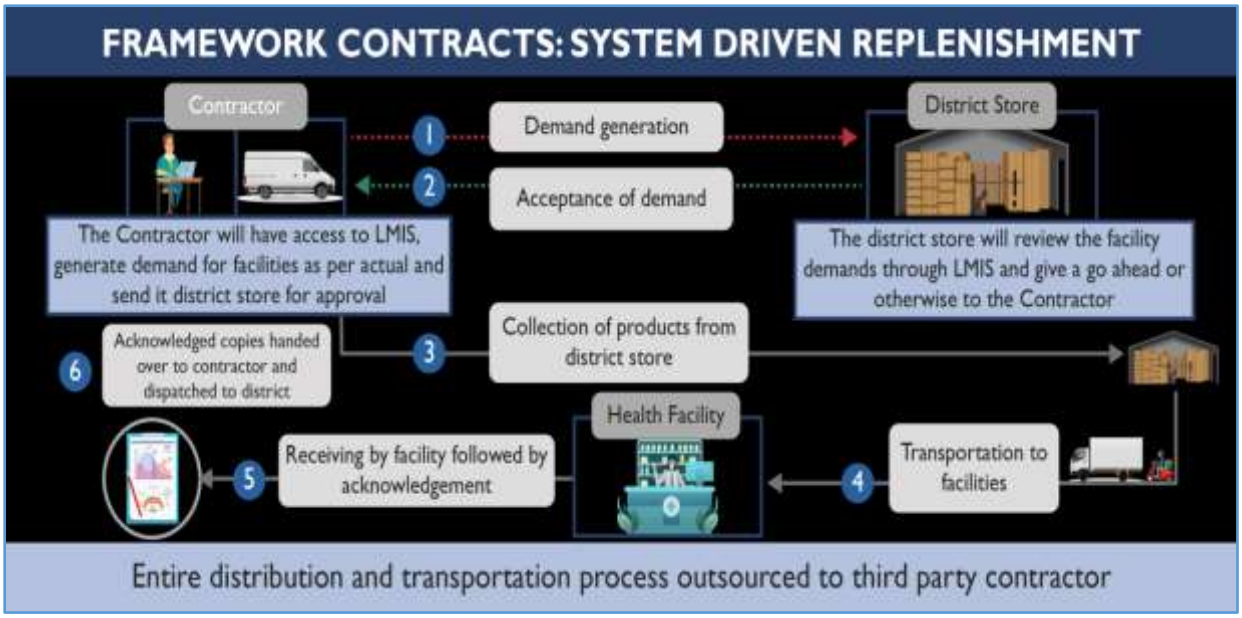


Figure 13: System-Driven Commodity Replenishment Model

4.5.5 Cold chain Management:

Cold chain management is generally referred at the management of 2 to 8 degrees centigrade of the temperature of a commodity from its manufacturing to storage, distribution, dispensing and consumption. It is essential during the transportation of vaccines and other cold chain items, to ensure their quality, shelf life, safety and efficacy. We can either utilize the ice boxes with ice packs or cold chain distribution vans as per the supplies volume to the facility level. Keeping a data logger with cold chain items assist us to monitor the temperature maintenance during the transportation process.

4.5.6 Lab Sample Transportation:

Lab samples transportation is an important area in the diagnosis of infectious diseases. In Pakistan, we are still facing the challenge of lab facilities at the district level for the diagnosis of most infectious diseases. Most infectious diseases samples are collected at the district level and then properly secured and transport to provincial and national referral labs for confirmation of disease.

ANNEXURE A: Safe Disposal of Medicines

Medicines of essential and non-essential drugs refers to the adoption of an appropriate and relevant method, by which the expired/damaged drugs can be discarded in an environment-friendly manner. These are the methods which involve minimal risks to public health and include those suitable for countries with limited resources and equipment. The adoption of these methods by ministries of health, environment and other relevant ministries, and their practical application, will contribute to the safe and economical elimination of stockpiles of unusable pharmaceuticals.

Drug Disposal Authorities

A local task force or advisory committee should be established at an early stage to assess, analyze and address the problem of drug disposal, and to monitor activities. Furthermore, it is suggested that such a task force has a maximum of five members and that meetings are held as near to the site of the stockpile as possible. Members may be chosen from:

- The drug regulatory authority or ministry of health;
- The ministry of the environment;
- The audit section of the ministry of health;
- Institutional pharmacists;
- A qualified hazardous waste expert may be appointed by the authority to be responsible for pharmaceutical waste disposal. If this is done the person appointed should become a member of the task force. The individual can be an expert in environmental management, a registered water chemist, hydrogeologist or sanitary engineer. The choice of expert depends on the technical problems to be faced.

Reasons of Waste Occurrence

There are different reasons as to why drugs' waste occurs:

Relevancy

Sometimes donated drug supplies were not relevant for the situation, for the level of care available. There were sometimes unknown by local health professionals and patients, and did not comply with locally agreed policies and standard treatment guidelines.

Quality

The quality of the supplies did not always comply with standards in the country.

Quantity

Some supplies maybe donated or purchased in the wrong quantities and some stocks couldn't be used before expiration.

Illegal/un- registered

Some supplies were under trade names which were not registered for the use in this country and sometimes without generic name on the label.

Improper Handling

Careless handling at various levels of storage, distribution and utilization also produce wastes.

STEPS INVOLVED IN THE SAFE DISPOSAL OF DRUGS

There are two major steps involve in safe disposal of unwanted or expired supplies. These steps are,

1. **Sorting**
2. **Disposal**

SORTING

The objective of sorting is to separate the pharmaceuticals into separate categories for which different disposal methods are required. The separation should be made into those that can be safely used and returned to the pharmaceutical supply system and those that require disposal by different methods. For example, controlled drugs (e.g. narcotics), antineoplastic drugs and antibiotics all require special methods of disposal. Substantial investment in human resources may be required for identifying and separating pharmaceuticals.

SORTING CATEGORIES

Controlled substances, Toxic or Hazardous Products

According to a published list by the Ministry of Health, determine which drugs are classed as cytotoxic, narcotic and which products are hazardous and ensure that materials in these categories are stored separately from the other items.

Flammable and/or water reactive chemicals must only be destroyed in a chemical waste disposal facility.

Antineoplastic drugs, previously called cytotoxics or anti-cancer drugs have the ability to kill or stop growth of living cells. They are used in the chemotherapy of cancer which is usually performed in specialized treatment centers. It is extremely unlikely that they would form part of an aid donation in emergencies. However, if unwanted and discharged into the environment they can have very serious effects, such as interfering with reproductive processes in various life forms. Their disposal must therefore be handled with care.

Disinfectants

In general disinfectants do not have an expiry date. They can be stored and gradually used over time so there is no real need to dispose off them. Large quantities of disinfectants must not be flushed into the sewer, as they may kill the bacteria in a sewage works and so stop the biological treatment of the sewage. Similarly large quantities should not be put into watercourses since the disinfectants will damage aquatic life. Small quantities of diluted disinfectant may be disposed of by discharge to a sewer providing the operation is supervised by a pharmacist and the quantities are strictly controlled to set limits. The guideline control proposed is 50 liters total per day, with the disposal spread over the whole working day.

If possible, disinfectants should be used, for example for toilet cleaning in hospitals. Some disinfectants with strong bactericidal and antiviral activity, such as Lysol (50% cresylic acid), may have an expiry date. If this date has past, the material can still be used for general disinfection purposes at an appropriate dilution decided by a pharmacist, or disposed of in a chemical waste disposal facility or a cement kiln. Many countries do not have chemical waste disposal facilities, so the materials may have to be shipped out of the country. However this is an expensive and complicated operation and should only be contemplated if there is no viable alternative.

The World Health Organization publishes chemical safety sheets for common disinfectants and pesticides. The sheets provide data on the chemical composition of the substance and indicate suitable methods of disposal.

In-date drugs and useful materials

Non-pharmaceutical useful materials, e.g. medical equipment, beds, wheelchairs, dressings, clothing, laboratory glassware, etc. which can either be utilized by the Institution or reallocated to other facilities, recycled, cannibalized for spare parts or disposed to a landfill.

Drugs which are in common use should be separated out and immediately used by the Institution or reallocated according to the needs and instructions of the Regional authorities. A list can be prepared giving details of the items available, quantities and expiry dates and circulated to others who can use the materials.

Chemicals such as acids, alkalis, reagents, phenol based chemicals used for cleaning floors, disinfectants, etc. If large quantities of these items are found a list can be prepared and offered to other potential users such as laboratories, universities, schools, etc.

Expired drugs

Solids: Tablets, capsules, granules, powders, etc

Semi-solids: Creams, lotions, gels, etc

Liquids: Solutions, suspensions, ampoules, etc

Aerosol: Canisters Sprays, foams etc

Non-Pharmaceutical expiry

Damaged pressurized cylinders

Devices & Implants

Gloves etc

<u>Basic Operating Procedures for Sorting of Essential Drugs</u>

Responsibility:

The basic responsibility regarding sorting of essential drug supplies for safe disposal is of EDOH/DHO in district but EDOH/DHO may designate or delegate the responsibility to district ware house manager (Pharmacist).

Role:

- To prepare the documents for approval of sorting and disposal of expired, damaged, unused and unidentified donated drugs.
- To execute the sorting procedure of spoil, expired, unused and unidentified donated drugs under his direct supervision.
- To adopt the safety measures according to prescribed guidelines/procedures during execution of sorting procedures of drugs in ware house.
- To advise the appropriate packaging and placement methods for storage of sorted drug supplies in ware house.
- To prepare the reports and recommendations for writing off of sorted drugs from records.

Procedures:

1. The in-charge ware house will ask the formal permission from EDOH/DHO for sorting of damaged, expired, unused and unidentified drugs present in the stock or ware house.
2. EDOH/DHO will formulate a committee which will monitor the sorting of damaged, expired, unused and unidentified drugs present in the stock or ware house.
3. The sorting procedure will be carried out on set date in presence of committee.
4. Sorting will be done in open or well ventilated and heat covered structure designated by the committee.
5. The staff will be well trained & equipped with protective equipment e.g. gloves, boots, overall, safety helmets, dust masks etc.
6. Sorting will be done as close as possible of stock piles and will be done in an orderly way.
7. The drugs will be categorized first and separated out as controlled drugs, uncontrolled drugs and toxic or hazardous drugs.
8. Then the material will be further separated out according to dosage form e.g. tablet, syrup, injections etc.
9. Then material will be further classified into in-date and expire materials.
10. The lists will be prepared in triplicate for both in-date/useful material and expired material.
11. The both type of material will be packed in appropriate packaging material (sturdy cardboard cartons, steel drums etc.) and labeled appropriately.
12. The label should clearly mention the contents, quantity, expiry date and other relevant information.
13. The packed drugs and other material will be kept in a dry, well ventilated and secure room (preferably separate room to avoid being confused with in date drugs and other material) over pallets.
14. The lists will be duly signed from in-charge ware house and committee and will be sent to EDOH/DHO with recommendation report.
15. On approval for disposal from EDOH/DHO the drugs and other materials will be handed over according to procedures for disposal and record will be maintained accordingly.

SAFE DISPOSAL

In general, expired pharmaceuticals do not represent a serious threat to public health or to the environment. Improper disposal may be hazardous if it leads to contamination of water supplies or local sources used by nearby communities or wildlife. Expired drugs may come into the hands of scavengers and children if a landfill is insecure. Pilfering from a stockpile of waste drugs or during sorting may result in expired drugs being diverted to the market for resale and misuse. Most pharmaceuticals past their expiry date become less efficacious and a few may develop a different adverse drug reaction profile.

There are some categories of expired drugs or defective disposal practices that carry a public health risk.

Methods of Safe Disposal

Constraints in funding for disposal of waste pharmaceuticals necessitate cost-effective management and methods. The main way to achieve this is to sort the material to minimize the need for expensive or complicated disposal method and then subject the drug to be disposed off according to the corresponding method.

Landfill

Landfill is the oldest and the most widely practiced method of disposing of solid waste. Properly constructed and operated landfill sites offer a safe disposal route for municipal solid wastes.

An appropriate landfill will consist of an excavated pit away from water courses and above the water table.

Each day's rubbish will be covered by soil to maintain sanitary conditions. Uncontrolled dumping of waste, which does not protect the local environment, should not be used.

Any solid drug disposed of to a landfill should be covered immediately by fresh municipal waste at the base of the working face of the landfill. It may be deemed necessary to transport the drugs some distance to the nearest landfill.

If a recycling Programme exists for the reuse of materials such as glass, aluminum or paper then packing materials and glass can be separated from the drugs supplies.

Special treatment for Antineoplastics

For antineoplastics drums should be filled to 50% capacity with drugs, after which a well stirred mixture of lime, cement and water in the proportions of 15:15:5 (by weight), should be added and the drums filled to capacity. A larger quantity of water may be required sometimes to attain a satisfactory liquid consistency. The drums should then be sealed by seam or spot welding and left to set for 7 to 28 days. This will form a firm, immobile, solid block in which the wastes are relatively securely isolated. The drums are then placed at the working face of a landfill which has been lined with an impermeable layer of clay or membrane.

Encapsulation

Encapsulation involves placing the drugs in a plastic or steel drum. When the drum is 90% full, fill the remaining space by pouring a media such as cement/lime mortar, plastic foam or bituminous sand. Seal the drums and then place at the base of the working face of a landfill.

For cytotoxic product, use a ratio of 40% cement, 30% water and 30% waste by weight well mixed and allow settling for between 7 and 28 days prior to landfill. This will form a firm immobile solid block in which the wastes are relatively securely isolated. The most economical ratios to achieve a minimum permeability of the blocks should be determined by experiment.

Inertization

The inertization disposal method involves firstly the removal of all packaging materials, (paper, cardboard and plastic) from the drugs supplies then grinding the supplies and adding a mix of water, cement and lime to form a homogenous paste which is then transported in the liquid state by concrete mixer truck to a landfill and decanted into the normal urban waste. The paste then sets into a hard harmless substance dispersed amongst the urban waste.

The process is relatively inexpensive and can be done in a relatively unsophisticated manner. The main requirements are a grinder or road roller to crush the supplies, a concrete mixer, a labor force and supplies of cement, lime and water.

The approximate ratios by weight used are as follows:

Drugs waste (65%)

Lime (15%)

Cement (15%)

Water (5%)

Sewer

Some liquids can be diluted with water and flushed into the sewers in small quantities over a period of time without any serious public health or environmental effect. If there are no sewers or there is no functioning sewage treatment plant, liquids (excluding cytotoxic products) can be first diluted with large volumes of water and poured into large water courses, providing they are immediately dispersed and diluted by the flowing river water.

Medium Temperature Incineration

In many countries there are no incinerators which meet emission control standards, however it is suggested that it is acceptable to destroy expired solid-form drugs supplies using a two-chamber incinerator that operates at the minimum temperature of 850˚C with a combustion retention time of at least 2 seconds in the second chamber.

Drugs supplies should not be destroyed by open burning at low temperatures as this will cause aerosol forms or the drugs to be released into the open air.

High Temperature Incineration

Industries such as cement kilns, thermal power stations or foundries usually have furnaces which operate at temperatures exceeding 850˚C and which have long combustion retention times and disperse exhaust gases via tall chimneys to a high altitude. Many countries do not possess and cannot justify economically expensive and sophisticated chemical disposal facilities. The use of industrial plant provides a viable and cheap alternative.

Cement kilns are particularly suitable for the disposal of expired drugs supplies, chemical waste, used oil, tires, etc. There are several features of a cement kiln which renders it suitable for the disposal of supplies. During burning the cement raw materials reach temperatures of 1450˚C while the combustion gases reach temperatures up to 2000˚C. The gas residence time at these high temperatures is several seconds. In these conditions all organic waste components are effectively destroyed. Some dangerous or toxic combustion products become adsorbed into the cement or are removed in the heat exchange equipment.

Cement producers in many countries, such as in Europe (Belgium, France, Germany, Greece, Italy, Spain, Sweden, and Switzerland), the USA, Canada, South America and Japan are keen to use alternative fuels as their use reduces the fuel bill for cement production without affecting the quality of the cement. With appropriate environmental impact control mechanisms in place there will be minimal impact on the surrounding area. It is recommended that discussions be held with cement companies and the appropriate environmental control agencies to arrange for the waste to be disposed of using a cement kiln.

Drugs should be introduced into the furnace as a reasonably small proportion of the total fuel feed. It is suggested that as a sensible "rule of thumb" figure, no more than 5% of the fuel fed into the furnace at any one time is drugs material. Cement kilns typically produce 1,500 to 8,000 tones of cement per day and therefore quite large quantities of material can be disposed of in a

short period It may be necessary to remove packaging and or to grind the drugs supplies to avoid clogging and blockage of the fuel feed mechanisms.

Antineoplastics should be segregated from other pharmaceuticals and kept separately in clearly marked containers with rigid walls. They should ideally be safely packaged and returned to the supplier for disposal.

If this option is not possible they must be destroyed in a two-chamber incinerator which operates at a high temperature of at least 1200°C in the secondary chamber, and is fitted with gas cleaning equipment. An after-burner (i.e. the secondary chamber) is important for the destruction of cytotoxic waste, as it is possible that antineoplastic solutions could become aerosolized following the initial combustion in the primary chamber. As a result, without a higher temperature secondary chamber, degraded antineoplastic material may be emitted from the chimney. The secondary combustion chamber consequently ensures that such antineoplastic substances are fully incinerated.

Antineoplastic drugs/waste should never be disposed of in a landfill other than after encapsulation or inertization. Work teams handling these drugs must avoid crushing cartons or removing the product from its packages. They may only be discharged in a sewerage system after chemical decomposition and must not be discharged untreated into surface water drains or natural watercourses.

Chemical Decomposition

If an appropriate incinerator is not available, chemical decomposition can be carried out in accordance with the manufacturer's recommendation, followed by landfill. However, chemical inactivation is tedious and time consuming, and stocks of treatment chemicals must be made available at all times or disposal of a small quantity of cytotoxic products/waste, this method is viable However for large quantities, e. g. larger than 50 kg, of cytotoxic, chemical decomposition is not practical, and these consignments need to be treated through repeated application of this method.

Basic Operating Procedures for Safe Disposal of

Essential Drugs

Responsibility:

The basic responsibility regarding disposal of essential drug supplies is of EDOH/DHO and MS in district and teaching hospital respectively but EDOH/DHO/Ms may designate or delegate the responsibility to district ware house manager (Pharmacist) or Institutional pharmacist.

Role:

- To prepare report for the review and decision of EDO/DHO regarding approval for safe disposal of sorted drugs.
- To correspond with manufacturer/donor/supplier for return or replacement of drug supplies.
- To make proper arrangement for the safe disposal of sorted drug supplies according to their nature and requirement.
- To ensure the safety measures during execution of safe disposal procedures.
- To prepare report/certificate of destruction for the drug supplies being disposed off.

Procedure:

1. The ware house manager will furnish a report to EDOH/DHO indicating the name, quantity, dosage form, date of manufacturing and period of storage of drug supplies.
2. EDOH/DHO will review the circumstances which led to the spoilage and make decision whether to accept the reported stock as unusable or have it inspected or lab tested.
3. Sample will be drawn, if required, in consultation with district drug inspector according to government regulations and will be sent to laboratory for quality assurance.
4. Once the decision of safe disposal is made, then EDOH/DHO will constitute a committee who will witness the safe disposal of unusable drug supplies.
5. On receiving approval for appropriate action regarding unusable stocks, the ware house manager in consultation with concerned manufacturer/donor/supplier/another source will specify and hand over the returnable stock for replacement or compensation or any other appropriate action according to government regulations.
6. The ware house manager (Pharmacist) will be responsible to make proper arrangement regarding site and method of safe disposal for essential drug supplies according to requirement and nature of supplies.
7. The warehouse manager will be responsible to communicate the date and place for safe disposal of drug supplies to committee and manufacturer/donor/supplier/any other source.
8. After safe disposal of drug supplies the committee will issue a duly signed certificate of disposal in triplicate. The certificate will indicate,
    - The drug supplies and their quantity being disposed off
    - Date and place of disposal
    - Method of disposal
9. One copy of certificate will be sent to EDOH/DHO (For onward submission), one copy to manufacturer/donor/supplier/or any other source and one copy will be kept with ware house manager for record.
10. This certificate of disposal will form the basis for writing off the disposed off quantity in records.

Principles of Microbiology Laboratory Safety and Waste Management

Medical Microbiology laboratory dealing with infectious material will maintain best practices for biosafety and biosecurity. Each laboratory must have Spill kits. They must have an eye wash station.

Contents of spill kit include:

1. Disposable gloves
2. Safety glasses
3. Hazard tape
4. Absorbent pads
5. Plastic bags
6. Disinfectant (for biological spill)

To mitigate biological hazards Personal protective equipment (PPE) should be provided for laboratory staff. PPE is important for protecting the user and the sample. Appropriate PPE should be worn at all times

1. Biological Hazardous materials include
2. Patient samples: Serum, sputum, pus, urine, stool etc.
3. Microorganisms: culture plates / vials, stored microorganisms etc.

Laboratory activities with potential of aerosolisation or risk of inhalational exposure would include:

1) Sample Processing:
   a) Separating needles from syringes
   b) Aspirating and transferring body fluids · Manipulating samples such as sputum, pus, other body fluids with syringes, needles, loops
   c) Expelling air from syringes
2) Bench work:
   a) Manipulating inoculation loops with live organisms · Sub-culturing / streaking live organisms · Spurting during loop flaming
   b) Cooling loops in culture media
   c) Harvesting and inoculating cell lines
   d) Pipetting (expelling last drop from Eppendorf) · Vortexing and centrifugation
3) Performing Admin work:
   a) Excessive traffic in workplace
   b) Manipulating contaminated worksheets
   c) Discarding used culture plates / tubes
   d) Talking, coughing, sneezing / eating (including chewing gums)
   e) Facility repair work

Employees must be trained to know the following:

- When PPE is necessary?
- What PPE is necessary?
- How to properly put on, take off, adjust and wear the PPE?
- Proper care, maintenance, useful life and disposal of PPE
- The limitations of the PPE.

In general, all laboratories will follow the guidelines as mentioned in

- International Health Regulations (IHR): Pakistan
- Pakistan Biosafety Rules 2005
- Pakistan Biosafety Guidelines 2005
- National Laboratory Biosafety & Biosecurity Policy 2017

laboratories will have a Waste Management Plan. Colour code for segregation of waste material is to be used. The colour coding as recommended by WHO, Institutional guidelines is to be adapted.

General guideline provided by WHO is given as below:

Waste Type	Classification	Colour Coding	Description & Disposal Method
Infectious	Hazardous	YELLOW	Infectious waste which requires disposal by incineration.
Infectious	Hazardous	ORANGE	Infectious waste which may be treated to render safe prior to disposal or alternatively it can be incinerated.
Cytotoxic / Cytostatic	Hazardous	PURPLE	Waste consisting of, or contaminated with, cytotoxic and/or cytostatic products which requires disposal by incineration.
Offensive	Non-Hazardous	YELLOW & BLACK	Non-infectious, offensive/hygiene waste which may be recycled, incinerated or deep landfilled.
Anatomical	Hazardous	RED	Anatomical waste which requires disposal by incineration.
Medicinal	Non-Hazardous	BLUE	Waste medicines, out of date medicines, denatured drugs, which requires disposal by incineration.
Dental	Hazardous	WHITE	Dental amalgam & mercury including spent and out of date capsules, excess mixed amalgam & contents of amalgam separators which requires disposal by recovery or recycling.
Domestic	Non-Hazardous	BLACK	This waste should not contain any infectious materials, sharps or medicinal products, and requires disposal by landfill.

Inventory Management

5. Inventory Management

5.1 Background

The inventory control measures are applicable everywhere to run our day to day life business to the operations of complex national and global corporations. Starting from a household level, we probably have a number of inventory control systems; for example, the milk in our kitchen. Think about the following questions:

- How much fresh milk do we keep in wer house?
- How often do we buy milk?
- What is the lowest quantity of milk we want to have before we buy more?
- How much milk do we want to have at any one time?
- Do we consume milk regularly, or does wer use fluctuate?
- How many people in wer house consume milk? Does this ever change?
- Do we have any financial or other constraints when we purchase milk, such as limited supply or transport?

Although we can use any other household item in this example, milk is a good one to compare with health products. Like milk, health products are staple goods; we do not want to run out of them, and each may have many uses. For example, we can use milk at breakfast with coffee and throughout the day when we cook and bake. Likewise, antibiotics are used in a variety of treatments. Using milk as an example also demonstrates that simply having a large quantity of an item does not ensure that we will always have supplies; both milk and antibiotics may spoil (or expire) over time. Although we may not need to have a formal inventory control system for milk, when we drive, we need a more formal system for ensuring the car has fuel—in this case, a fuel gauge (see figure 1). The worst and most preventable thing is for wer car to run out of fuel. Similarly, the worst thing that can happen in a health facility is to have a *stockout* (i.e., we run out of stock). The best way to ensure that we do not stock out in a health facility is to establish an inventory control system.

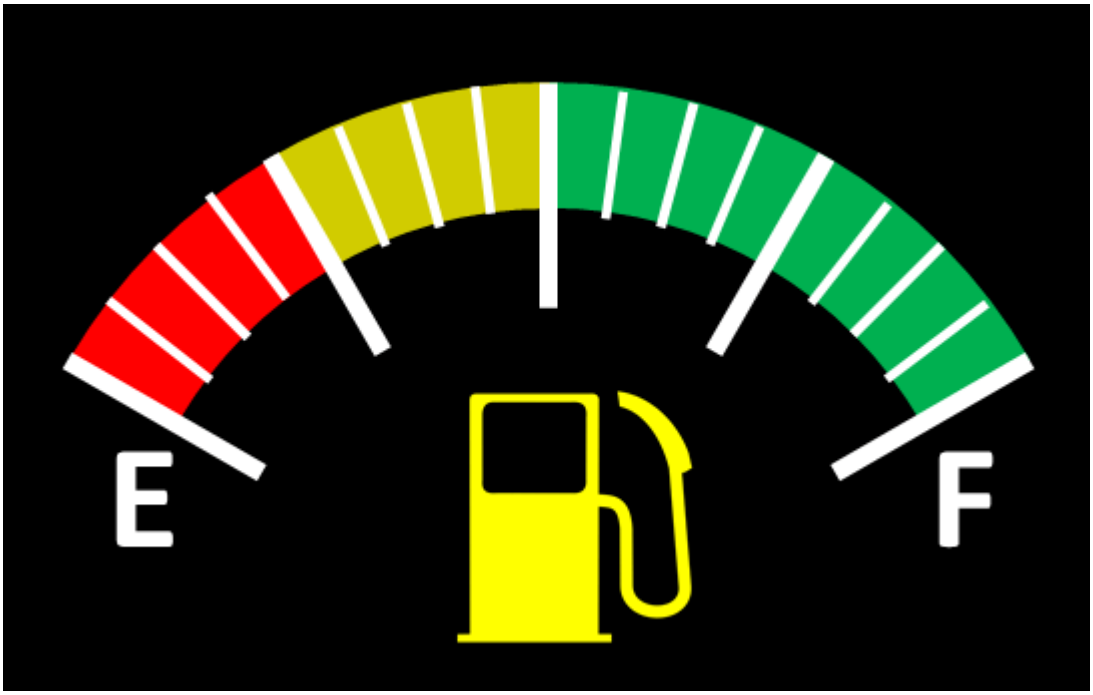


Figure 44: Vehicle's Fuel Gauge

A vehicle's fuel gauge helps we maintain wer stock level.

While driving, we monitor wer fuel consumption from time to time and decide when to purchase more gas. By assessing the supply status of the tank, we can calculate when to refuel and how much, depending on wer destination (and perhaps wer budget). Drivers often use the red warning area as an indicator of when to buy more fuel. In other cases, drivers replenish the tank on a specific day of the week, regardless of the level, adding enough fuel to reach *full*. In deciding on an approach, drivers are choosing a form of inventory control.

5.2 Key Inventory Control Terms

As we discuss inventory control systems, the following key terms are important:

Max-Min inventory control system: A max-min inventory control system is designed to ensure that the each store has adequate levels of stocks as per the range decided by the concerned health manager. Most successful inventory control systems used for managing health commodities are max-min systems of one type or another.

Max stock level/Max quantity: The max stock level is the level of stock above which inventory levels should not rise, under normal conditions. ***The max stock level is set as a number of months of stock (MoS) to be available at any given period***. Please note that the max stock level will vary for each commodity and is directly proportional to the rate of consumption/issuance of each healthcare product.

The max stock level can be converted to the max quantity (for example, the max quantity could be 120,000 units). The max stock level is fixed, whereas the max stock quantity varies as consumption changes. The max quantity is calculated by multiplying the average monthly consumption (which can change) by the max level (number of months). For example, 100 bed nets (AMC) × 6 months = 600 bed nets—the max quantity.

We must understand here that, if at any store, the level of stock on hand for a particular product is more than the established Max level, this will render the store as 'over stocked' for that particular product.

Min stock level/Min quantity: This is the level of stock at which the storekeeper / health manager will decide to requisite the products for replenishment of stocks. As with the max, the *min stock level should be expressed in months of stock* (for example, the *min level* is one month of stock); it can then be converted to a quantity. The min stock level is fixed, whereas the quantity varies as consumption changes. Depending on the design of the max-min system, reaching the min may be the trigger for placing an order (often called the reorder level or reorder point). In some systems, reaching the min may be an indicator to monitor stocks carefully until the next order is placed, or the emergency order point is reached.

Review period/Review period stock: This is the *routine interval of time between assessments of stock levels to determine if additional stock is needed***.** This term is also called the *order interval* or *resupply interval*, but review period is preferred because in some max-min systems, a review does not always result in an order being placed. ***Review period stock is the quantity of stock dispensed during the review period.***

Safety stock level: This is the additional buffer, cushion, or reserve stock kept on hand to protect against stockouts caused by delayed deliveries, markedly increased demand, or other unexpected events. The safety stock is expressed in number of months of supply, which can also be converted into a quantity.

Lead time stock level: This is the level of stock used between the time new stock is ordered and when it is received and available for use. The lead time stock level is expressed in number of months of supply, or as a quantity.

Emergency order point (EOP): This is the level of stock that triggers an emergency order; it can be reached at any point during the review period. The EOP must be lower than the min.

5.3 Three Types of Max-Min Inventory Control Systems

Three types of a max-min inventory control system are applicable to health commodity logistics systems: forced-ordering, continuous review, and standard.

As discussed earlier, an inventory control system is used to determine how much to order or issue and when to order or issue. For each of the systems, the same formula is used to determine how much to order or issue. The basic difference between the systems is the trigger for ordering or issuing, i.e., when the order should be placed or an issue made.

1. **In a *forced-ordering system***, the trigger for ordering is the end of the review period.
2. **In a *continuous review system***, the trigger for ordering is when the facility reaches the minimum level.
3. **In a *standard system***, the trigger for ordering is the end of the review period for the commodities that are at the minimum level.

In the following sections we will review how to calculate order or issue quantities, when the order/issue should be made, and the design formulas for each of the three systems.

In this section, we will use the verb *set* when referring to the design of a max-min system, and *calculate* when referring to the routine implementation of the system. System designers *set* levels in a max-min system, and storekeepers *calculate* the quantities to order or issue.

5.4 Determining How Much to Order or Issue

No matter which inventory control system is used, the formula for calculating the order, or issue quantity, is the same. This is true whether the system is an allocation (push) system or a requisition (pull) system. In an allocation (push) system, the quantity to issue is calculated; in a requisition (pull) system, the quantity to order is calculated.

To calculate the order or issue quantity, storekeepers must be able to convert established stock levels (max and min stock *levels*) into the actual *quantities* of product needed.

The storekeeper should use the following formula to calculate the quantity to order or issue for each product

Calculating Order or Issue Quantities
Max Stock Quantity – Stock on Hand = Order / Issue Quantity

Where…

- Max Stock Quantity = Average Monthly Consumption (AMC) **×** Max Stock Level
- Average monthly consumption (AMC) **=** average of the quantities of product dispensed to users or patients in the most recent three months (non-zero months)

Consider the scenario of health facility where the storekeeper is required to order a certain commodity e-g condoms. If the storekeeper knows that his Max-Level is 3 months and his emergency order point is 1 month. If the review period is monthly and it is the end of the month, then this will be right time to order the product.

He calculates that his average monthly consumption (AMC) is 100 condoms/month. He then calculates his max quantity as:

100 condoms (AMC) X 3 months (Max level) = 300 condoms (max stock quantity)

At the end of the month, he has 200 condoms on hand. With this information he calculates his order quantity as:
300 (max quantity) – 200 (stock on hand) = 100 condoms

Based on this calculation, we now understand that the store keeper needs to order 100 condoms this month.

5.5 Determining When to Place an Order or Issue

The difference between the three inventory control systems is the trigger for placing an order or issuing resupply. This section reviews the rules for the three types of max-min inventory control system: forced-ordering, continuous review, and standard system.

5.5.1 Forced-ordering max-min system

Even though this max-min inventory control system is called *forced-ordering*, this type of max-min system can be used in either a pull (requisition) or a push (allocation) system. In either a system, the decision for ordering or issuance of a particular healthcare product is taken at the end of each and every review period.

5.5.1.1 Storekeeper Decision Rule

In a forced-ordering system, the supplies to a particular health facility are provided by following the rules given below:

- At the end of each review period (e-g 3 months), the store keeper must review all stock levels and order or issue enough stock to maintain the stock levels at the max-level.
- If the stock level for any item falls below the emergency order point before the end of the review period, then the store keeper must place an emergency order to replenish the stocks.

In a forced-ordering max-min system, storekeepers do not use the min, because they always take action at the end of the review period. Therefore the trigger for ordering/issuance of stocks is the review period already decided.

Storekeepers must be careful not to run out of stock. Therefore, in addition to applying the decision rule for ordering, they are given an EOP. Storekeepers will know that they have reached the EOP if they frequently assess stock levels. This is why, in systems that place orders quarterly, stock status should be assessed more frequently. The results of a stock status assessment alert the storekeeper to the need to place an emergency order for any item that has reached the EOP.

5.5.1.2 Advantages and disadvantages of forced-ordering max-min system

A forced-ordering system has both advantages and disadvantages:

- The storekeeper's decision rule is simple: order/issue every item at the end of the period.
- Because orders are placed at regular intervals (i.e., the end of each review period), transportation can be scheduled for specific times, making it easier to ensure the availability of transport resources.
- Every facility orders or is resupplied at the end of every review period.
- Because all items are ordered/issued at the end of every review period, storekeepers do not need to constantly assess stock status, unless they think a potential stockout is possible in the advent of any unforeseen event.
- One disadvantage of a forced-ordering system is that orders for some items may be for small quantities; because all items are ordered, regardless of the stock on hand.

5.5.1.3 Forced-ordering Variation: Delivery Truck System

One variation of a forced-ordering max-min system is the delivery truck system, sometimes called a *topping up system*. It can also be called Vendor Managed Inventory (VMI) system.

The rules for the storekeeper and the considerations for the designer are the same as for a regular forced-ordering system.

The difference between a regular forced-ordering system and a delivery truck system is the way the deliveries are made. In a delivery truck system, a truck is loaded with supplies at the end of the review period. The truck and a delivery team travel to each facility, assess the stock, and leave (top up) an amount of each product that is sufficient to bring stock levels up to the max at that facility.

In the Pakistan settings, it is a common practice that the provincial department of health awards framework contract to selected vendors for provision of essential medicines and supplies to the healthcare facilities in the districts. The vendors who are awarded the framework contract approach the relevant district health authorities for raising the purchase order as per the demand of the respective districts. In this scenario, the framework contract covers the transportation cost and management of delivery of the commodities to the district stores and healthcare facilities wherever

applicable. The vendors/contractors ensure provision of the commodities in full or in partial as per the storage space available at the district warehouses and healthcare facility stores. The vendors/contractors make use of the VMI arrangements and provide supplies to the healthcare facilities/district stores.

There is a precedent of recruitment of third parties for warehouse management, inventory management and transportation of essential medicines and supplies to the district and sub-district warehouses by provincial departments of health in Pakistan. The third party vendors engaged for this purpose, ensure provision of supplies to the districts through the third party vehicles. The commodities for multiple districts are loaded in the trucks and are transported to the districts as per the requisition or consumption reports by the respective district departments of health. The distribution plan is conformed on the basis of commodity requirement for each district and the supplies are stacked in vehicle in a manner that first district on the route is the first one to receive the requisite quantity of supplies. This arrangement not only ensures cost effectiveness of the transportation system but also ensures implementation of standard inventory management protocols. This type of arrangements is best suited for the provinces with scattered geographical terrain or hard to reach areas such as Balochistan and KPK provinces. This arrangement has also proven its efficacy in the situations where supplies' distribution from central warehouses to the sub-level stores is more frequent due to rapid consumption.

Another example is vaccine distribution system in which the vaccines procured by the federal EPI are distributed to the provincial stores for further distribution. The cold storage trucks from the EPI store carry vaccines from the federal EPI stores to the provincial EPI stores where they are parked. At the time of loading the vaccines in the cold storage trucks, the team at federal EPI store ensures batch wise stacking of the vaccines. Moreover, on the basis of vaccine consumption data of the districts, the vaccines are stacked in a manner that the supplies for each district are placed in a sequence, thus avoiding the hassle at the provincial stores. Similarly, the district teams receive the vaccines from provincial stores and ensure that the vaccines can be unloaded in the healthcare facilities falling on the route of the truck. Please note that, in this case no private contractor/vendor is engaged for distribution and inventory management of vaccines, instead the department of health ensures inventory management of vaccines in line with the VMI protocols.

Please make not of the fact that the delivery truck systems can be either pull or push systems. In the former, the truck arrives, and the storekeeper completes the report/transaction record and orders from the truck. In the latter, the supervisor on the truck calculates the quantity to be issued and issues it from the truck. The supervisor may or may not complete the facility's report. In some cases, the supervisor and storekeeper complete the order form together. The difference for the designer is determining *who* should be trained to complete the order form—multiple storekeepers or just a few supervisors/delivery team members.

5.5.1.4 Advantages and disadvantages of the forced-ordering delivery truck system

The delivery truck system has several advantages over regular forced-ordering:

- The order is filled on the spot, so the facility does not have to hold quantities of stock while waiting for the next delivery. The lead time is zero, which lowers the lead time stock to zero. This lowers the min and, consequently, the max stock levels.
- Damaged or expired products can be put back on the truck for disposal (if this is the procedure for handling these products), taking advantage of space on the truck.
- The truck can be sent out with a full load of supplies, eliminating multiple small orders.
- The LMIS report can be completed and collected at the time of delivery. This is especially advantageous when reporting is delayed because of poor mail service, or when reporting is irregular.

- The training requirements are significantly less; only delivery team leaders need training, rather than all the facility staff.
    - If a supervisor goes on the truck for deliveries, he or she can provide on-the-job training and supervision at the various stops. This is helpful when transport for supervision alone is difficult and higher-level managers want to ensure routine supervision.

The delivery truck system can also have certain disadvantages:

- All types of max-min systems rely on their delivery trucks. However, the delivery truck system is particularly vulnerable to breakdowns. If the truck breaks down, the whole system breaks down. Alternate transport for emergency orders must be available.
- A sufficient number of staff must be available in the office to complete logistics management and other duties while team leaders are away making deliveries.
- The system may require larger trucks, as trucks always carry more stock than the actual stocks required at the destination facilities.

Automating data collection in delivery truck systems

Delivery truck forced-ordering systems can relatively easily take advantage of technology that can help improve the speed and accuracy of stock calculations. Instead of using a piece of paper, pencil, and calculators, delivery team leaders travel with laptops, cell phones, or other handheld devices where they enter stock-on-hand data and max stock quantities, and reorder the calculated quantities. Automating data collection on the delivery truck also greatly facilitates the data entry process at the central level. Data can be transferred directly to a database to produce national level stock status reports.

5.5.2 Continuous review max-min system

Of the three types of inventory control, continuous review max-min inventory control is probably the *least* appropriate for most health programs; but when it is appropriate, it can be very effective. Comparing continuous review with forced-ordering max-min systems shows how small variations in design can change the way an entire system functions.

5.5.2.1 Storekeeper Decision Rule

In a continuous review system, the storekeeper is told when to order and how much to order based on the following decision rule

- Review the stock level of each item every time we make an issue. If the stock level is at the min, or has fallen below the min, order enough stock to bring the level up to the max.

In a continuous review system:

- The review period is not fixed; a decision about whether to order is made each time a product is issued.
- The storekeeper must know both the max and min stock levels.
- The storekeeper does not need an emergency order point, because an order can be placed any time stock is needed.
- The storekeeper must assess stock status each time an issue is made. In a system with many items, this means that the storekeeper's workload increases; in a forced-ordering system, the storekeeper needs to assess stock status only when levels appear low enough to warrant an emergency order.

- The storekeeper must be able to order (pull) stock from the higher level, because the storekeeper is the only one who can determine whether the min stock level has been reached. A continuous review system must be a pull system.

5.5.2.2 Advantages and disadvantages of continuous review max-min system

Continuous review inventory control has both advantages and disadvantages.

Advantages include:

- The storekeeper's decision rule is simple.
- The system is more responsive and flexible because orders can be placed at any time.
- Small orders are eliminated because stock levels are at the min when an order is placed.

Disadvantages of a continuous review system include:

- Transportation resources are harder to schedule because orders can be placed at any time. A single facility can order pills one day, condoms the next, and HIV test kits the following week.
- In facilities with a large number of products, or a great deal of activity, the storekeeper's job is harder because the stock status must be assessed every time stock is issued.

5.5.3 Continuous Review System Variation: Two bin

One variation of continuous review max-min systems is the *two bin system*. In this case, the rules for the storekeeper and considerations for the designer are the same as for any other continuous review system.

The difference between a regular continuous review system and a two bin system is the way the storekeeper determines when the min stock level has been reached. In the two bin system, the storekeeper has two equal-sized bins (containers, boxes, cartons, sacks, or other receptacles) of each individual product (i.e., not a kit of products). When the first bin is empty, the min has been reached. An order is placed for another bin (i.e., a bin's worth of stock), and the storekeeper begins issuing from the remaining bin. The arrival of a new bin brings the stock level up to the max. The two bin system is designed to be extremely simple for the provider. The provider does not need to make calculations and paperwork is minimal. In an even simpler version of the two bin system, an order form is included at the bottom of each bin; the provider only needs to sign and date the form before posting it.

A two bin system designer's most challenging task is to choose an appropriate bin size. The min is equal to one bin, and the max is equal to two bins; but because the bin size is fixed, bins may need to be replaced more frequently, if demand increases. The bins must allow for some expansion in the program without risking product expiration.

5.5.3.1 Advantages and disadvantages of continuous review two bin max-min system

Advantages:

A two bin-system require less training than a normal pull systems because the only trigger to order is an empty bin. No calculations are required and paperwork is minimal.

Disadvantages:

If consumption for products is not stable, the bin size must be continually reviewed to ensure that CBDs are not overstocked or understocked on commodities.

5.5.4 Standard max-min system

Theoretically, the standard version of the max-min system is the most effective because it combines the decision rules of both forced-ordering and continuous review and, therefore, shares the

advantages of both. However, it also has disadvantages. Under some circumstances, the standard version may be the only choice. To understand why, we need to discuss both the implementation and design of standard max-min systems.

5.5.4.1 Storekeeper decision rule

In a standard system, the storekeeper is instructed when to order or when supplies should be issued and how much to order/issue, based on the following decision rules:

In a standard system:

- Review all stock levels at the end of each review period for products that are at or have fallen below the min, order/issue stock quantities up to their max levels.
- When to make an order or issue new stock is based on the min stock level and the review period. This means that the storekeeper must know the min, max, and review period.
- The storekeeper will need an emergency order point to ensure that a stockout does not occur between review periods.
- The storekeeper must assess the stock status at the end of each review period and at any time levels appear to be low enough to warrant an emergency order.

5.5.4.2 Advantages and disadvantages of standard max-min system

A standard system has advantages and disadvantages.

Advantages:

- Small orders are eliminated because an order is placed only when stock levels are at or below the min.
- In programs with many products, standard systems eliminate the need to assess stock status continually (as in continuous review) and to reduce the number of calculations that must be made because fewer products will be ordered or issued than in forced-ordering.

Two bin continuous review for community-based distribution (CBDs)

Two-bin systems have enormous potential for use in CBD programs. Many health programs train outreach staff (e-g LHWs) or local community members (often volunteers) to be CBD agents. Historically, CBD agents only supplied family planning products such as condoms and pills, referring customers to local clinics for injectables, IUDs, and sterilization. This made the two-bin system ideal because the family planning programs try not to overburden counseling and promotion activities with complicated forms and calculations. Two-bin continuous review systems, in these scenarios, can be appropriate for CBD programs. However, as CBD agents begin to distribute more and more products, including injectables, antimalarials, rapid diagnostic tests, etc., the two bin system may not be as appropriate. ***Remember! where transport is limited or products are numerous, two-bin continuous review systems generally are not used.***

This is a common practice in maternal and child healthcare (MNCH) programs to provide the supplies to their outreach healthcare workers in the form of a 'healthcare workers kit'. The educational background of these healthcare workers is usually not very good and it is difficult for them to follow the complex record keeping protocols and conduct regular consumption analysis to accurately requisite the supplies for replenishment of the stocks in their kits. The concerned MNCH program management has simplified the process of stock distribution by following the two bin method. Each healthcare worker is provided enough of the stocks on monthly basis to cater for the healthcare/family planning needs of their catchments population. The healthcare workers get replenishment of the supplies at the time of submission of their monthly reports at the respective

healthcare facilities. Thus, the staff based at healthcare facility does all the calculations of the consumption and replenishes the supplies in the kits of the healthcare workers as per their demand.

Disadvantages:

- The primary disadvantage of a standard system is that the min stock level is higher, increasing the likelihood of expiry and requiring more storage capacity, both of which mean increased costs.
- Storekeepers must learn the max, min, and EOP; know how to assess stock status; and be able to calculate the order or issue quantity. More training for the storekeepers may be required because their decision rules are more complex.

5.6 Setting Max-Min Levels

Max and Min levels are needed to be decided for some important reasons:

1- To avoid stockouts
2- To avoid overstocking of commodities to not to increase the risk of expiration or damage.
3- To avoid reaching stock levels below the emergency point. To achieve this target, we must set a min level high enough to ensure that the facility never completely runs out of stock.
4- To ensure that stocks are adequately accommodated comfortably within the storage capacity available at the store at appropriate storage conditions.

The ultimate goal is to avoid stockouts of essential health products. Moreover, the system should ensure that emergency orders are rarely placed, because such orders are time-consuming and, generally, expensive to fill.

The process is always started by setting the minimum stock levels. For this purpose we must determine three key components:

- **Lead time**
- **Review period**
- **Safety stock**

5.6.1 Step 1: Determine the lead time

Lead time is one of the most important factor for the health managers to calculate. ***Lead Time is the time between when stock is ordered or issued and when it is delivered and available for use at the storage facility/health facility.*** Therefore, ***the lead time stock level is the number of months of stock used after an order is placed or an issue is determined, and before we receive the new order.*** The minimum stock level must include the lead time stock level, because we will need stock to distribute after we place an order and are waiting for it to be delivered to our health facility. If it takes a month from the time we place an order until we receive and unpack new stock, the minimum stock level must be at least one month (Figure- 2)

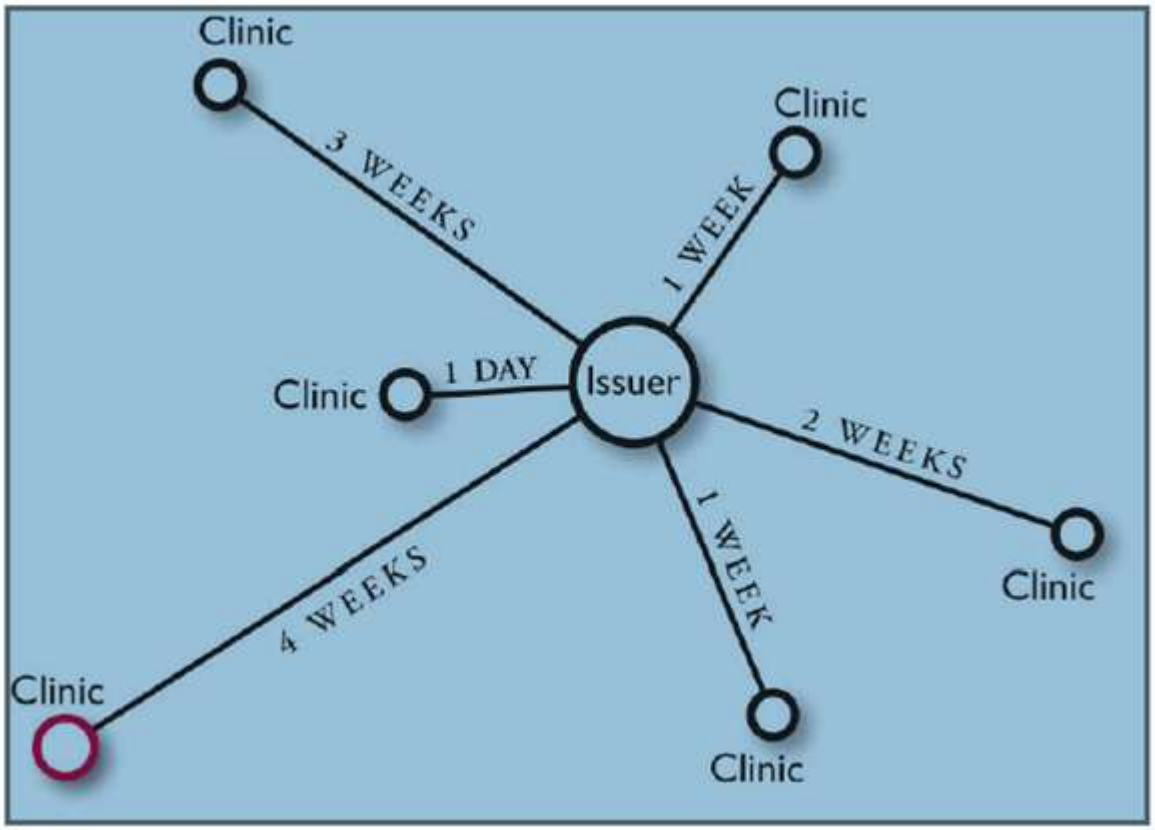


Figure 15: Calculating Lead Time Stock Levels

Because lead times are variable for different health facilities, accurately calculating the lead time stock level can be difficult. As the health managers, we could calculate the lead time stock level to equal the average of the lead time levels for the past two or three review periods, for the average facility. Determining the average can be tricky. If we used the lead time for a health facility which is located within an urban setting to set the lead time stock level for district to-facility deliveries, this calculation may not be correct for a rural health facility. To counter this issue, we should use an average for all facilities at the same level, if lead times are not substantially different among facilities. When in doubt, always take the facility with longer lead time as reference point.

Consider, however, a system for which transport is not routinely available, or where weather conditions (e.g., a rainy season) make selected roads impassable. In such situations, the health managers must use the longest lead time observed between the two least-reliable facilities. This will ensure that, under almost every conceivable situation, a stockout will not occur. But, increasing the lead time stock level increases the min and, ultimately, the length of the pipeline.

5.6.2 Step 2: Set the Review Period

A review period is the routine interval of time between assessments of stock levels to determine if an order should be placed or an issue of resupply made.

Usually the review period for government health facilities is set to be monthly or quarterly but it may vary due to multiple factors. Review period may be decided in according to the reporting period for any health facility or a program (e-g monthly LHWs report or monthly DHIS report). Gathering data for a routine report is usually an excellent opportunity to assess the status of supplies and order or issue supplies.

Remember that reporting periods may be more frequent than review periods. For example, a health facility may send reports on monthly basis, but only place orders quarterly. This is the case when it is difficult to replenish stocks at health facilities more (For example, when transportation and road condition difficulties occur).

In designing a max-min system, it is recommended that we use reporting periods as the review periods. By linking reporting and ordering, logistics managers are more likely to receive the information needed for central-level decision making. Moreover, Service Delivery Points (SDPs) are more likely to send in their reports when they hope to get something in return (i.e., resupply commodities).

As discussed in earlier sections, in a continuous review system, the trigger for ordering is when products reach their min stock level (not the end of the review period). So, even though from the storekeeper's point of view, there is no fixed review period; as a health manager, we want to set a review period about as often as we would like to have orders processed. For example, orders should not be placed as often as weekly, nor as infrequently as once a year. As the health managers, we should choose a desired review period to factor into the min. The desired review period is also used to help set the safety stock, if no better information is available.

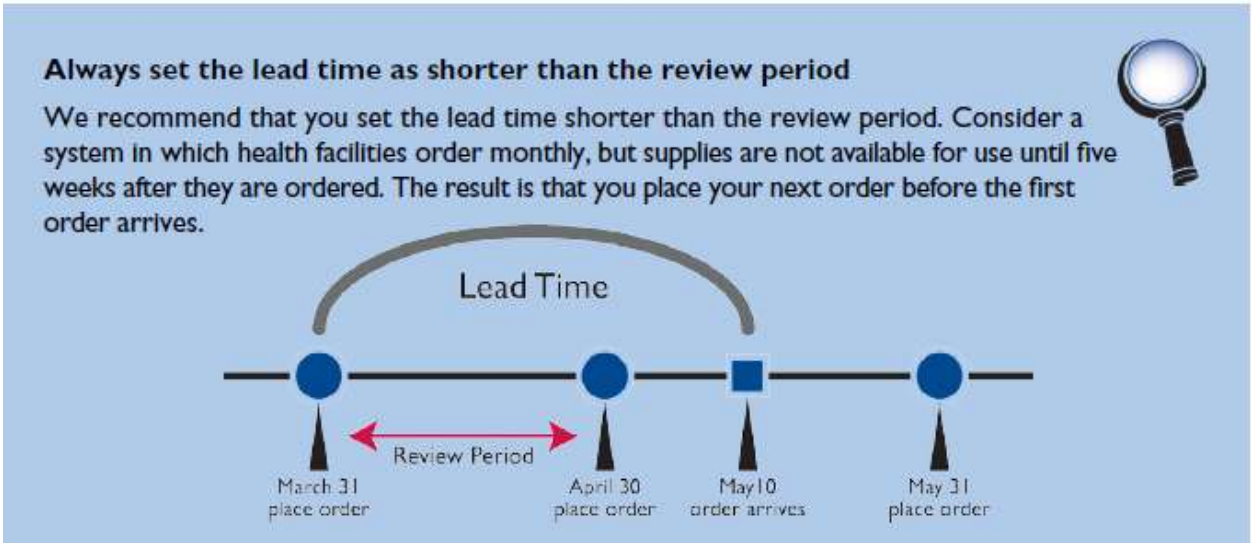


Figure 16: Lead time stock level vs Review Period

5.6.3 Step 3: Set the Safety Stock Level

Safety stock helps in protecting any health facility against unplanned situations, such as delays in deliveries, increased consumption, or product losses, including theft or expiry. Other terms for safety stock include *security stock* or *buffer stock*. The safety stock level is one of the most important decisions the system designer must make. How should the safety stock level be set?

Safety stock is the buffer, cushion, or reserve stock kept on hand to protect against stockouts that may be caused due to delay in deliveries, increased consumption or product losses. As a general guideline, the safety stock level should be equal to at least half of the review period.

Safety Stock ≥ ½ review period

How high should the safety stock be? Only the managers and personnel in the system assessing confidence in the system can determine this. Personnel must believe that the safety stock is sufficient to prevent a stockout, or they may begin to order more stock than they actually need. When demand is stable, and the logistics system functions well, the safety stock can be lower because there is less uncertainty. When demand is unstable, or the logistics system does not function well, the safety stock level should be set higher. In a new system, the managers should set the safety stock higher, monitor the system's performance, and lower the safety stock, if possible, as data on actual fluctuations in demand and supply become available. Remember, however, that setting a higher safety stock increases the quantities kept in stock, which, in small warehouses, may result in expired or damaged products. Having higher safety stock also means that more financial resources are being held in inventory.

5.6.4 Step 4: Set the Minimum Stock Level (Min Level)

After determining the lead time, setting the review period, and setting the safety stock, we can now set the min stock level. The min stock level should approximately be equal to the stock level we want the facility to have at the end of a *normal* review period. Set the min stock level high enough to account for the normal lead time needed to replenish stock and to cover unexpected delays and uncertainties in the logistics system. Take into account the following factors:

- Lead time may be variable.
- Consumption may be higher than expected, therefore we may need additional stock.
- Deliveries may be late.

The formula for setting the min stock level for forced-ordering and continuous review is the same. There is a special consideration for standard systems, which is discussed below.

For forced-ordering and continuous review max-min systems, the formula for setting the min stock level is as follows:

Min Level Formula (Forced Ordering & Continuous Review Systems)

Min Stock Level = Lead Time Stock Level + Safety Stock Level

For a standard system, the formula for setting the min is a little different. In the standard system, orders are placed at the end of the review period, but only for products that have reached the minimum stock levels. If a store is just above min level, we would not place an order at the end of the review period, and we would not have another chance to order until the end of the following review period. Consequently, the min must be set higher. For the standard system, the formula for setting the min stock level is as follows:

Min Level Formula (Standard Systems)

Min Stock Level = Lead Time Stock Level + Safety Stock Level + Review Period Stock Level

- In a forced-ordering system, storekeepers do not need to know the min stock levels. They only need to bring the stock level up to the max at the end of the review period. Why, then, establish a min in a forced-ordering system? First, we, as the managers, determine the max based on the min, as described below. Also, the min is the stock level we would like the facility to have on hand at the end of a normal review period. It must be high enough to prevent stockouts.

- In a continuous review system, the trigger for ordering is when products hit the min stock level, so the storekeeper definitely needs to know the min.
- Similarly, in a standard system, the trigger for ordering or issuing is at the end of the review period, but only for the products that have reached min. Therefore, the storekeeper must know the min.

5.6.5 Step 5: Set the Maximum Stock level (Max Level)

After the min stock level has been set, setting the max stock level is relatively easy. The formula for setting the max is:

Max Level Formula

Max Stock Level ≥ min stock level + review period stock level

We set our min stock level previously, and our review period is fixed (e-g monthly, bimonthly, or quarterly). Simply add the two values to find the max stock level. The *greater than or equal to* symbol (≥) indicates that we may want to set the max level higher than the sum of the min and review period stock level, when it is logically and economically sensible to store a larger quantity at a specific level in the system.

5.6.6 Step 6: Set the Emergency Order Point (EOP)

The EOP should not be set to equal the min stock level, because the min level includes the buffer stock as well. The EOP could be as high as the lead time stock level if urgent orders take as long to process as a routine order. In most cases, however, it should be possible to issue stock faster than normal in urgent or emergency situations. This is called the *emergency lead time*.

The EOP is defined as:

Emergency Order Point ≥ Longest Emergency lead Time

Decimal dilemma: Safety Stock and Lead Time:

When setting the lead time or safety stock, our answer may include half, or some other portion, of a month. For example, when review periods are quarterly (every three months), the safety stock level is set to at least one and a half months (1.5 months) of stock. Therefore, if the lead time is one month, the min stock level will be 2.5 months. It is difficult to work with partial months and difficult to teach storekeepers decision rules based on partial months. ***The best solution is to add lead time and safety stock and then round up to the next full month.*** For example: If the average lead time is three weeks, and the safety stock level is four weeks, the min = 1.75 months. For the ease of use, we can round this number up to two (2) months. It is unlikely that the additional stock required for rounding off will drastically impact the safety stock levels at the higher level stores.

5.6.7 Design Issues for Inventory Management Systems

There are two considerations while devising an inventory control/management system in a healthcare system setting:

1. What should be the length of pipeline (In time period)
2. Can we establish different max-min systems within the same level?

Both of these points are very relevant and bear practical value in designing an inventory management system. We will be discussing both of the scenarios in detail.

1- Analyzing the overall pipeline length

Setting max-min stock levels for each level of the system may result in a lengthy pipeline. For example, consider a situation in which the max-min levels are as depicted in table 1.

Table 7: Hypothetical situation of Min- Max- Levels at various levels of a supply chain

Level	Minimum Stock Level – Min (In Months)	Maximum Stock Level – Max (In Months)
Central Warehouse	6	12
Regional	5	9
District	3	6
Health Facility	2	3
Total	**16**	**30**

This analysis suggests that it may take as long as 30 months (two and one-half years) for a product to reach a customer after it has entered the country. Add to this the time from the manufacturer until the product has cleared the port and is placed in the central warehouse ready for distribution. The product could easily be more than three years old by the time the customer receives it.

Depending on the product, this could be the maximum time a product can be kept in storage. For essential medicines, a 30-month in-country pipeline is unacceptable, because some products have a shelf life as short as six months.

Possible solutions to this challenge may be one or more of the following:

- Shorten the review periods at one or more levels. This will reduce the pipeline length by reducing the max. (Remember that max ≥ min + review period.) Shorter review periods, however, mean that resupply happens more frequently, increasing the frequency of delivery and, perhaps, requiring additional transportation. Calculating order or issue quantities will also require additional labor. The review period can only be shortened if the designer can be certain that the shortened review period is still longer than the lead time, and that personnel can manage the increased workload.
- Reduce the lead time at one or more levels. Lead time is often extended by administrative requirements, such as obtaining signatures and approvals. Reducing the lead time reduces the min and max levels. System designers cannot, on their own, arbitrarily shorten the lead time from six weeks to four. To reduce the lead time, we must change the processes.
- Improve reliability in the system to reduce safety stock levels. Safety stocks are kept primarily because of uncertainty about the system's ability to provide routine service (i.e., uncertainty about either supply, or demand, or both). If we can reduce the uncertainty, we will be able to reduce both min and max levels. This is more easily said than done, however.
- Eliminate an entire level from the supply chain. This will result in a large resource savings and is probably the single most effective method to reduce the pipeline. For example, eliminating the regional level in this example immediately reduces the total pipeline length by nine months. An additional burden is placed on transportation from the central level to the districts, however, and the supervision burden of the central level may be increased. When a level is eliminated from the pipeline, it does not necessarily stop playing a role in the management of the system. Politically, it may be a difficult to eliminate a level in the system.

Government units, such as regions, may hesitate to yield control over valuable commodities; yet, where the pipeline is too long, eliminating a level may be the only appropriate solution.

2- Mixing max-min systems and levels

Max-min systems could be implemented in a variety of ways by doing the following:

- Recommend using different types of max-min systems at different levels—for example, standard for central to district and forced-ordering for district to clinics.
- Recommend using different max-min levels for different facilities at the same level—for example, a six-month max for rural clinics and a three-month max for urban clinics.
- Recommend using different max-min levels for different products within a facility—for example, a three-month max for ARV medicines and a six-month max for contraceptives. Such strategies, however, have consequences that the system designers must be aware of.
- Managers at the next level up (e.g., district level) may find it extremely difficult to manage facilities with different rules, systems, and levels.
- In pull systems, training for lower-level facilities is more complicated if the max levels are different for each facility.
- Ordering forms work best when the formula for ordering can be printed on the form. With different max-min levels, this can be challenging. For example, if some facilities establish their max quantity as AMC × 4 months and others as AMC × 3 months, we would not be able to write both of those options in one column heading of a form. Likewise, writing AMC × max stock level may not give the facility enough information to complete the calculation.
- We could set the safety stock level for rural clinics higher than that for urban clinics, resulting in higher min and max levels for rural clinics. This means that more financial resources are tied up in inventory, and more storage space is needed. Higher minimums and maximums may increase the potential for products to expire.

An important exception to mixing systems is CBD programs, for which a two bin continuous review system is sometimes recommended, because it is a relatively simple system and does not complicate inventory control procedures elsewhere in the system.

It can be recommended that some levels be push and others pull—for example, pull from central to district, and push from district to facilities. In chapter 1, we suggested that facilities at the *same* level— for example, facilities—should not be both push and pull; however, *between* levels, different push and pull systems can be recommended when appropriate. Some logistics systems are designed as pull systems from the central level to the level above the delivery point, where the system then changes to a push system. This allows service delivery staff to focus on serving customers, while staff at higher levels are responsible for determining what quantity to issue.

5.6.8 Selecting an Appropriate Max-Min System

To implement a max-min inventory control system, we must select from five choices, including:

1. forced-ordering
2. forced-ordering/delivery truck
3. continuous review
4. two bin continuous review
5. standard

Our selection is critical to the success of the logistics system. In addition to selecting a system, we need to set the max and min levels and determine whether each level should be a push or pull system.

The following factors should influence our decision on the appropriate max-min system:

5.6.9 The number of items managed by the program

More than any other factor, the number of items managed will influence our choice of an inventory control system.

- For a system that manages only a few items (one or two), and if the consumption of those items is relatively stable (i.e., it is not a new or rapidly expanding program) two bin continuous review may be appropriate.
- For a system that manages a large number of items (more than 100), however, a continuous review system would be difficult to manage without making transport impossible. A standard system works better, because the number of orders placed will be lower than for any other system, and the timing of the orders will be fixed. A forced-ordering system is usually impractical for a large number of items; many items would be ordered, and many of those orders would be for small quantities.
- For a system that manages a small number of items (perhaps 1–20 items), a forced-ordering system is probably the most appropriate, because it is not difficult to calculate 20 order quantities. There is usually no particular advantage to using a standard system for a small number of items, and as we have seen, stock levels are much higher in a standard system. A continuous review system would work for a small number of items, but only where reliable transportation is available and inexpensive.
- For a program managing many items (between 20 and 100), our selection depends on many factors, such as the quantity and quality of transport and storage, who is best equipped to make calculations, how well supervision is carried out, and other factors discussed below.

5.6.10 The type of products managed

Designers must consider the types of products managed by the program. Going through a segmentation process might be helpful for certain designers. *Segmentation* is a process of reviewing and analyzing product and customer characteristics to identify commonalities and then organizing the supply chain into segments to best respond to customer needs or product requirements. Not all products are the same and not all customers are the same; supply chains managers need to take this into account. Certain product characteristics can influence the type of max-min system selected.

- **Seasonality of disease or unpredictability of demand.** For products with seasonal consumption, a continuous review system may work best to ensure that products are not always ordered unless they are at the min level.
- **Bulkiness of a product.** For products that are particularly bulky, for example insecticide-treated bed nets, a standard system may not be the most appropriate. These products need higher min and max stock levels, which require more storage space.
- **Shelf life of a product.** For products with an extremely short shelf life—for example, laboratory reagents with a shelf life of three months—a standard system may not be the best, as the min and max stock levels are higher, requiring more inventory to be kept, which could increase the chance of products expiring.

5.6.11 The quality and quantity of transport available

Transport availability should be our second consideration in selecting a max-min system. If transport is always available, and the infrastructure (e.g., roads and bridges) good, a continuous review system may be feasible. When transport is limited, either a forced-ordering or standard system is best, because it is easier to make transport available for scheduled times (and to schedule routine maintenance). With limited delivery schedules, we may also be able to *piggyback* or share transport resources with other programs—for example, delivering contraceptives and vaccines at the same time.

5.6.12 The level of investment in/commitment to capacity building and training

Any max-min system will require some training at all levels of the service delivery system. The training requirements, however, may determine the kind of system we implement. For example, at the facility level we may want to keep service providers focused on service and not on extensive calculations and stock assessment. We must first decide on a push or pull system. Pull systems require more training at all levels, especially at the facility level because they are placing the orders. We may elect, therefore, to have a push system, and either use a forced-ordering or standard max-min system. A delivery truck forced-ordering system requires significantly less training investments because the delivery teams receive most of the training. The health facility staff only need to know when the truck will be arriving and the basic stock recordkeeping skills.

5.6.13 The current or expected level of reporting

In forced-ordering and standard systems, reports may come in regularly with orders; in continuous review systems, reporting may not be on a fixed time schedule. Regular reporting can be used as a supervision tool: if a report is submitted on time, the facility tells we how it is doing. In a forced-ordering delivery truck system, we dramatically improve reporting rates from the level to which we are delivering, because we collect and complete the reports during the delivery. Where reporting systems are poor (e.g., limited or slow postal service and/or having to rely on personal deliveries or expensive express package services), the delivery truck system helps improve reporting.

5.6.14 Whether an allocation (push) or requisition (pull) system is best

Our decisions about allocation or requisition help determine our choice of max-min systems. To implement a requisition system, we need staff with the ability and motivation to make the appropriate calculations. At the service provider level, the system should be as simple as possible to keep providers

working with customers rather than filling out forms and making calculations. If we decide to use an allocation system, we cannot choose continuous review. An allocation system will mean more extensive training for the upper level, because they do all the calculations for their supervisees, and they have to understand how to use the data they are receiving to do the calculations. In some systems, lower levels are expected to pick up supplies regularly from higher levels. In such cases, the difference between allocation and requisition is blurred, because the lower and higher levels may calculate the order together.

5.6.15 The Monitoring and Supervision system

A delivery truck system helps reinforce supervision because the supervisor arrives with the supplies. This requires additional supervision resources, however, because supervisors must be out of the office for extended periods. Forced-ordering also forces routine reporting, which allows supervisors to check math errors and changes in consumption. In a standard system, if no products are needed, a report might be skipped. The same is true in continuous review. It is difficult to supervise outlets that are not visited regularly and do not report regularly; absence of information is not a positive sign.

5.6.16 The availability of storage space

A standard system requires the most storage space, because the min and max levels are higher. The lead time in the delivery truck system is zero, so the min will be lower and will require less space. For two bin continuous review systems, the designer must be careful when selecting the bin size; they may need to create custom (and perhaps expensive) *bins* for storage. Forced-ordering and continuous review systems require similar amounts of storage space.

The factors involved in selecting max-min systems are summarized in figure 4 given below:

FACTOR	FORCED-ORDERING	FORCED-ORDERING DELIVERY TRUCK	CONTINUOUS REVIEW	TWO-BIN CONTINUOUS REVIEW	STANDARD
Number of items	Few to a small number	Few to a small number	Few	Few	Many
Transport	Needed only at fixed times	Needed only at fixed times	Needed continuously	Needed continuously	Needed only at fixed times
Training	Staff at all levels must be well trained	Staff receiving supplies do not need as much training	Staff at all levels must be well trained	Staff receiving supplies need not be trained or have good literacy skills	Staff at all levels must be well trained
Reporting	Report required with each order helps improve data submission	Ensures that completed reports are actually picked up	May not receive reports often	May not receive reports often	If no items are needed, no report is submitted
Push or pull	Either	Either (usually push)	Must be pull	Must be pull	Either
Supervision	From reports only	Opportunity to include with delivery, but requires more supervisors	From reports only; irregular	From reports only; irregular	From reports only
Storage	Neutral	Lead time is zero, so less room is needed	Neutral	Requires creating numerous "bins"	Extra room needed for additional buffer stock

Figure 17: Factors for selecting a Max-Min Inventory Control System

Management Information System

6. Management Information System

Information is at the centre of the logistics cycle (Figure 1). Without it, the logistics system could not be managed effectively. Managers gather information about each activity in the system and analyze the collected information to coordinate future actions. For example, information about inventory levels and consumption must be gathered to estimate the quantity of a certain product for procurement.

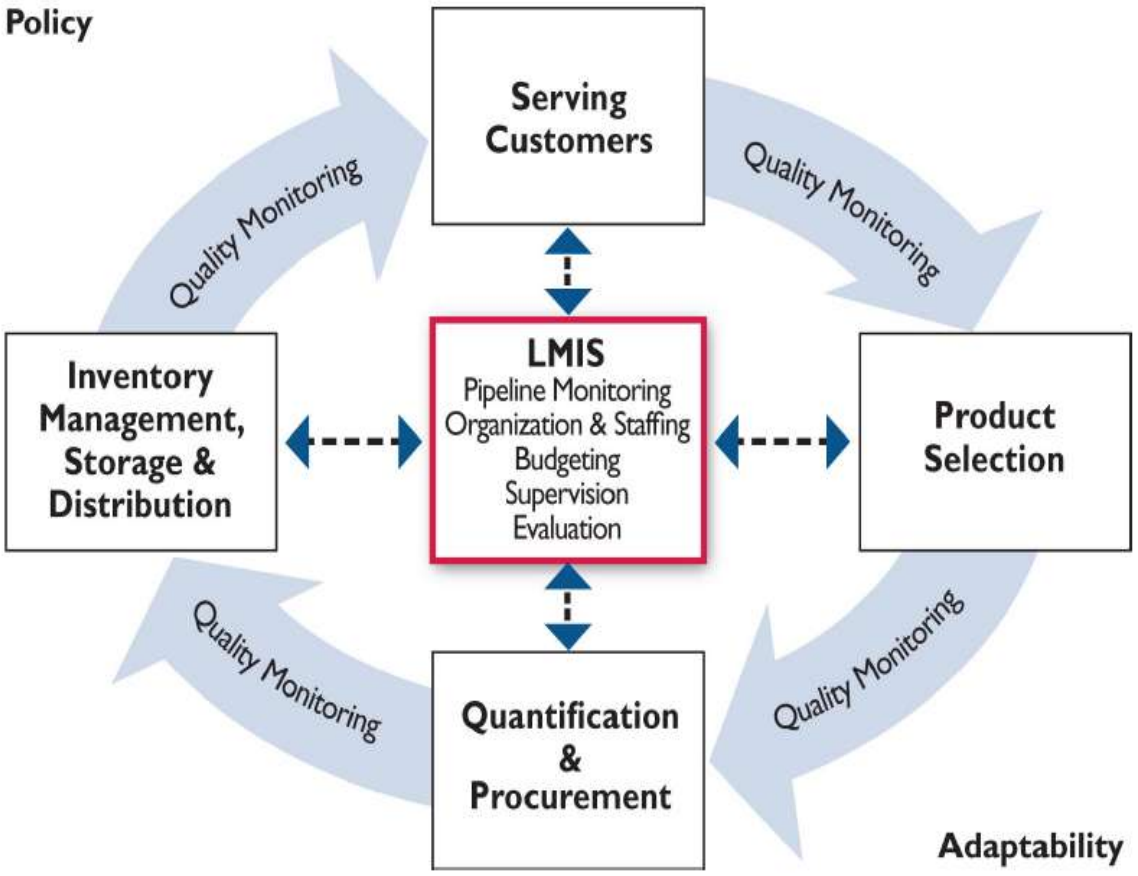


Figure 58: The logistics Cycle

The main purpose of an information system is to provide necessary information to decision makers. The essential data points for decision making are as follows:

1. How long will the current supplies last in terms of months of stock (MOS)?
2. What are the consumption patterns?
3. Are we having losses from the system that require us to act?
4. Do we need to order more supplies now?
5. Where are the supplies in the pipeline?
6. Do we need to move supplies from higher to lower levels?
7. Do lower-level storage facilities need more resources?
8. Are products about to expire? Can these products be distributed before expiry, or do we need to discard these products and remove them from the pipeline?

9. Do supplies flow regularly through the pipeline? Do we need to adjust our pipeline to account for bottlenecks in the system?
10. How many service delivery points are out of stock, understocked, or overstocked?

6.1 LMIS Data for Decision Making

Decisions for improving the logistics system can only be made if they are based on appropriate data. Some of the following data elements may be useful to collect data in an LMIS. This is not an exhaustive list through, and programs should consider their local context and needs to list down data elements.

1. **Consumption data:** The quantity of stock dispensed to users or used during a particular time period.
2. **Stock on Hand (SOH):** The quantities of usable stock available. It should be noted that the Items that are unusable are not considered part of stock on hand; they are considered losses to the system and adjusted accordingly. The LMIS should be able to report stock on Hand at each level of supply chain i-e from central ware house to the SDP level stores.
3. **Transaction data:** Information related to every issuance and receiving of the commodities at all levels of supply chain
4. **Adjustments/Losses:**
    i. ***Losses*** are the quantity of stock removed from the pipeline for any reason other than consumption by clients or use at the service delivery point (due to expiration, theft, damage, etc.).
    ii. ***Adjustments*** are the quantities of stock issued to or received from other facilities *at the same level of the pipeline*. Also, adjustments may be administrative corrections made to stock keeping records, for example, when we count stock and find a different amount from the quantity listed on the bin cards. For this reason, adjustments may involve either positive or negative changes to stock.

Collecting information in LMIS, whether paper based or electronic, is not without cost. Each element of information should be judged on its utilization. The information which is not going to be used should not be collected as it will increase the cost and effort on the part of the staff based at healthcare facilities or warehouses.

LMIS is distinct from Health Management Information System (HMIS), as it collects only logistics data, while HMIS gathers information about patient characteristics and services related data.

6.2 Components of LMIS

The paper-based system is still in use in many programs across the globe. However, partial or complete replacements have been quickly carried out. The basic components of LMIS remains the same in both the forms. The web-based logistics management information system (LMIS) is designed in the context of health sector logistics information of the province. The system brings in district-and sub-district level supply chain data. With a unified system for reporting and requisitioning, the web-based LMIS system can integrate information from all levels.

Following are the key components of the LMIS

1. Warehouse management system (applicable to central/provincial warehouses)
2. Inventory management system (applicable districts or possibly Tehsil level stores)
3. Consumption reporting system (facilities)
4. LMIS Stats
5. Analytics/Dashboard

6.2.1 Warehouse Management System (WMS)

The warehouse management system (WMS) is usually operational at the larger stores, mostly at the federal or provincial level. WMS can also be used in tertiary care hospitals, having a high turnover of commodities. Stock registers and bin cards are the two basic recording formats where paper-based system is used. Following data elements will need to be captured for an effective WMS.

1. Opening balance. Each product should be recorded as per the physical stock count. The opening balance is equivalent to closing balance of last month/last transaction.
2. Whenever a shipment is received at the warehouse, it is recorded instantly in the stock register or electronic WMS. Product's batch wise quantities are entered into the system.
3. Storage locations are assigned within the warehouse as per the volume of incoming commodities. Placement is usually achieved through electronic LMIS, with preexisting mapping of racks.
4. Issuing to lower levels of supply chain is a continuous process from the provincial warehouse. The paper based issue vouchers are filled in triplicates, the initial dispatch being saved by the warehouse, the second one is retained by the receiving store and third (signed) is returned back to provincial store as a record of receiving at the lower store. In case of electronic WMS, all this process is carried out in the web-based system.

In the context of the areas with special circumstances and considerations for difficult geographical terrain, scarcity of adequate storage spaces, trained human resource and funds and overall security situation WMS may be made operational at sub-provincial or regional stores. But the decision would lie with the competent authorities to make such arrangements.

6.2.1.1 Physical inspection

One of the essential steps after receiving the stock is physical inspection. Specific personnel (store manager) must be assigned to inspect each of received stock for any visible damages (change of color, breakage of cartons, dampness etc.) Commodities having any problems should be separated from the usable commodities.

The name, batch number and quantities of the physical damaged commodities need to be recorded and sent back to the supplier. Official communication should be generated and kept in record for future reference. In case of large and costly shipments, and additional physical inspection may be carried out the supplier's site before the shipment. This inspection ensures compliance by supplier in terms of product quality and packing before shipments has taken place and prevents later returns and hence the resultant costs. For products requiring physical inspection, no issuance should be carried our before that.

6.2.1.2 Drug Testing

Physical inspection cannot assess the pharmacologic efficacy of drugs. Thus, drug testing is an essential feature of ensuring received drugs are of requisite quality. Government drug inspectors collect samples of batches and send to lab for testing. Drugs should not be issued to lower levels until a clearance report is received from Drug Testing Laboratory (DTL).

6.2.2 Inventory Management System for Large Stores: District and DHQ Hospital Stores

This system is designed for large stores such as the district's main medical stores or big hospitals stores. It captures data for the complete life cycle of store operations. Good storage practices in stores are required to implement this software. The following needs to be ensured for smooth implementation of an inventory management system:

1. Opening balances of the products of each batch needs to be entered into the system correctly – as per physical stock count
2. Stock receipt must be entered on time in the system
3. First Expiry First Out (FEFO) principle must followed
4. Due consideration should be given to VVM in case of Cold chain items
5. Stock issuances must be done through the system
6. Physical stock count (Stock must be counted and adjusted accordingly at regular intervals)

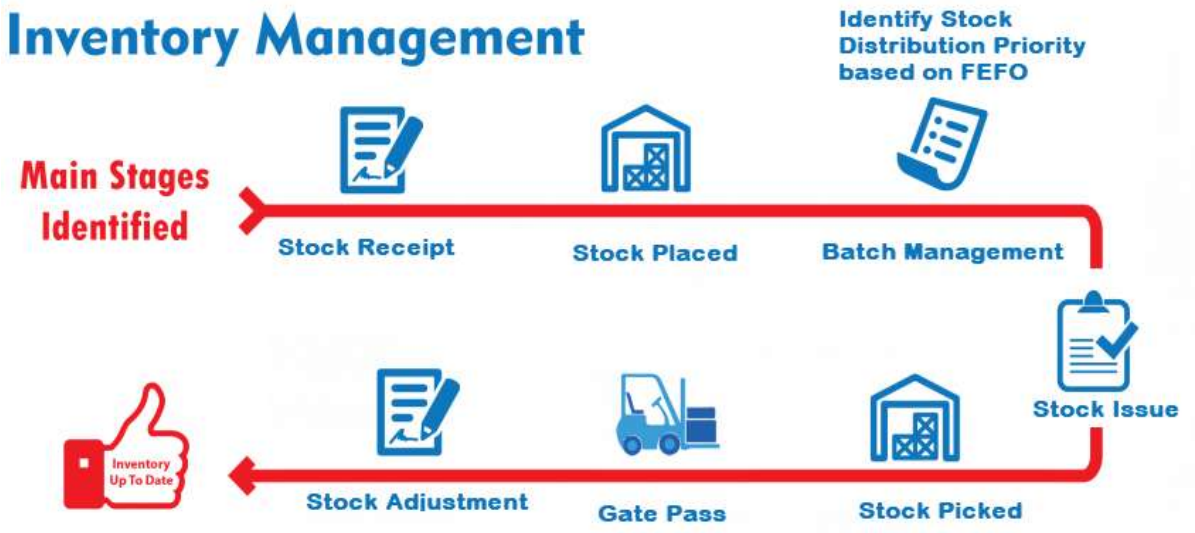


Figure 19: Record Keeping Process for Inventory Management

After login, users directly reach the main screen of the system.

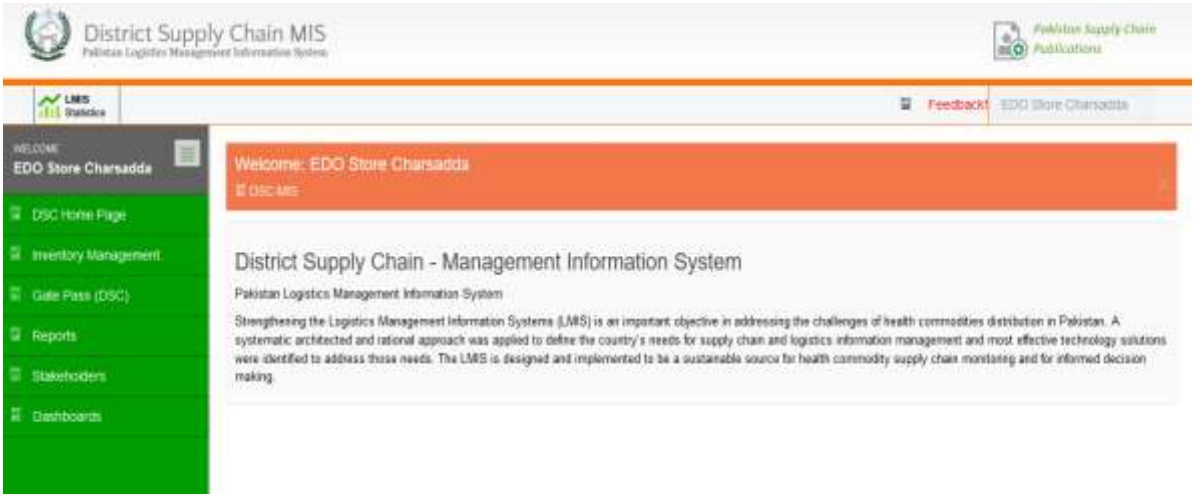


Figure 20: LMIS system welcome page

6.2.2.1 Stock receiving and incoming

As and when health commodities are received from the supplier, the product's batch wise quantities must be entered into the inventory management system. The written records, such as invoices and packing lists, may be referred to for this purpose.

However, before inputting the data in the system, the following information must be known by the Store Manager/Keeper:

6.2.2.2 Physical inspection

After receiving the stock, the store manager/keeper must physically inspect each pack of received stock for any visible damage, VVM stage, signs of dampness, or any other issue he/she may notice which is abnormal for a specific commodity. Commodities with any sort of issue(s) must be placed and marked separately from usable commodities.

On an immediate basis, formally communicate the name, batch number, VVM stage and quantity to supplier of physically damaged commodity/commodities with a copy to DHO and Provincial Procurement Cell. Keep the communication in record for future references.

Record the appropriate Physical Inspection value from one of the drop downs in the system: NA, In Process, Completed.

Table 8: Recording of Physical Inspection Details

Physical Inspection	Description	Action
NA	Commodities which does not required physical inspection.	Stock can be used for issuance
In Process	Physical Inspection is in process	Stock cannot be issued till Physical Inspection is in process
Completed	Physical Inspection completed	Stock can be issued as per demand

6.2.2.3 Drug testing has been done or not?

For Drug Testing Laboratory (DTL), Government Drug Inspectors randomly visit the district stores and collect the random samples. It may or may not be on the day of receiving the stock. Users can choose DTL options from the dropdown value as per actual situation.

Table 9: Recording of Drug Testing Status

DTL	Description	Action
NA	Commodities which does not require DTL like Cotton Wool, Syringes, etc.	Stock can be used for issuance
In Process	Government Drug inspector collected sample and sent to Lab for testing.	Stock cannot be issued till DTL is in process
Completed	Drug inspector after receiving the DTL report, Allows store manager / keeper to issue the stock	Issue the stock as per Demand

f) The product profile details need to already be present in the system
g) The manufacturer name must already be in the system
h) Product secondary packing (carton) must be entered into the system to calculate space

i) Product funders are identified

j) The waybills must contain batch number, VVM for cold chain items, expiry date, and quantities of the products

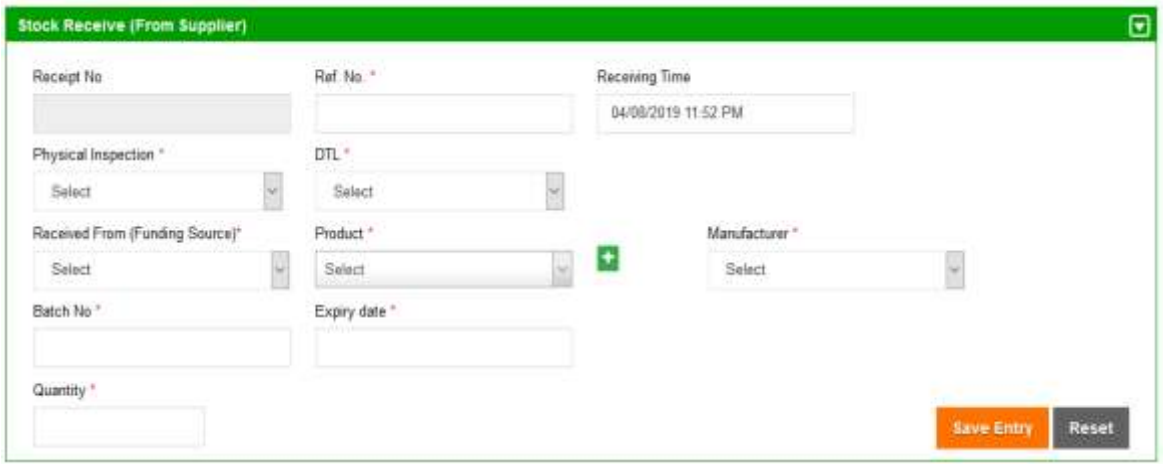


Figure 21: Stock receiving from supplier

If the product is coming from another store where an inventory management system is operational, the user the "Stock Receive (Store)" menu option to receive the stock. Users of the system must have the voucher issued number from the store sending stock. The user searches the voucher number in the system, and if recorded correctly, entries of the received products will appear automatically for further processing.

The system gives a unique number, e.g. R190400001, to each stock receipt. Each entry begins with "R", the next two digits denote fiscal year while the next two denote month. The last five digits denote serial number in each month, which resets to 00001 on the 1st of each month.

R	1	9	0	4	0	0	0	0	1
Receipt	Year		Month		Serial number (resets on 1st of each month)				

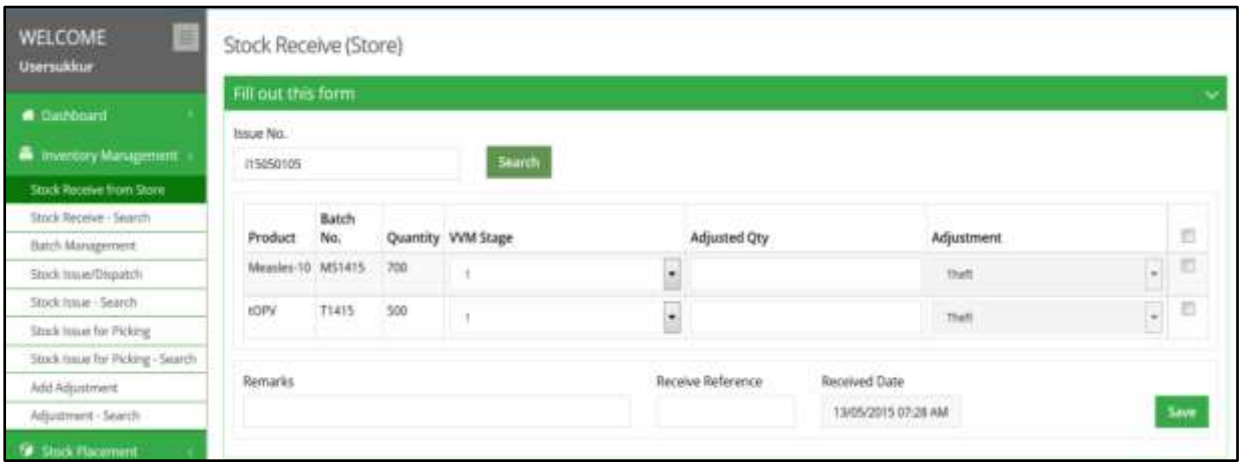


Figure 22: Stock receiving from another store

6.2.2.4 First Expiry – First Out (FEFO) or Batch Management:

After entering the stock in the system, it is important that batches are issued per FEFO (First Expiry First Out) principle. Due consideration should also be given to VVM in case of cold chain items, ensuring that patients receive them in good condition and with time to use before their expiration dates. The inventory management system provides an automatic system to freeze those batches which have more shelf-life/VVM stage 3 or 4. The store keeper can, for any reason, override this feature using batch management. This override is recorded in the system audit log.

Figure 23: Batch management

6.2.2.5 Stock placement

The system provides an efficient way to place stock. By default, the received stock quantity is identified as un-allocated and the appropriate storage location needs to be identified. The system provides facilities with information to identify storage location based on the following parameters:

1. Area: This can be a separate location like rooms or separate premises
2. Row: This can be a room or location within a room if a racking system is not installed
3. Rack: This can be stack of cartons if a racking system is not installed
4. Rack type: This is optional if a racking system is not installed, but typical options are single and double
5. Pallet: This is optional if a racking system is not installed, typically there are four pallets in a double rack and two in a single rack type
6. Level or shelf number: This is optional if a racking system is not installed

Users need to have the following information to place stock:

1. Store location for stock placement needs to be generated and identified
2. Product batch number and quantity to be placed at specific location must be known

Using a selected facility, the system places the entered quantity at the selected location and subtracts that amount from the un-allocated quantity.

Figure 24: Stock placement

6.2.2.6 Stock Issuance:

Stock issue is an important step of the store. The system gives a unique number to each stock issue which begins with I, the next two digits denote fiscal year, and the next two denote month. The last five digits denote serial number in each month.

I	1	9	0	4	0	0	0	0	1
Issue	Year		Month		Serial number (resets on 1st of each month)				

The following information must be known before issuance of the stock:

1. Issuance date
2. Issue reference number
3. Issued by
4. Issued to store
5. Product
6. Batch
7. Quantity
8. Expiry date
9. VVM in case of cold chain products

The system offers batches per FEFO guidelines so that the maximum use of a products' shelf life can be utilized. VVM consideration is also applicable in case of cold chain items. A voucher can be printed if required after each issuance which serves as evidence for issuance and the designated authority can sign and keep it as a record. The electronic copy is also saved in the system, which cannot change, and the audit log keeps track of each issuance.

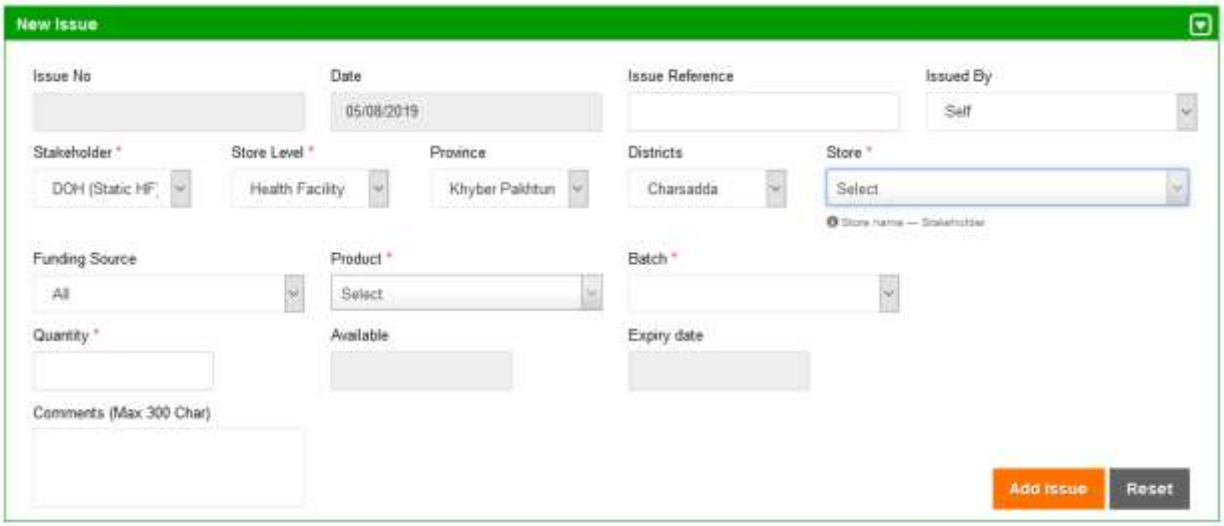


Figure 25: Stock issuance

6.2.2.7 Stock picking

Stock picking is an important step of inventory management. The system provides users with a list of vouchers based on the search date that are queued for picking and ultimately distributed.

Users first pick the stock electronically from the system which provides the physical location of the specified products within the store.

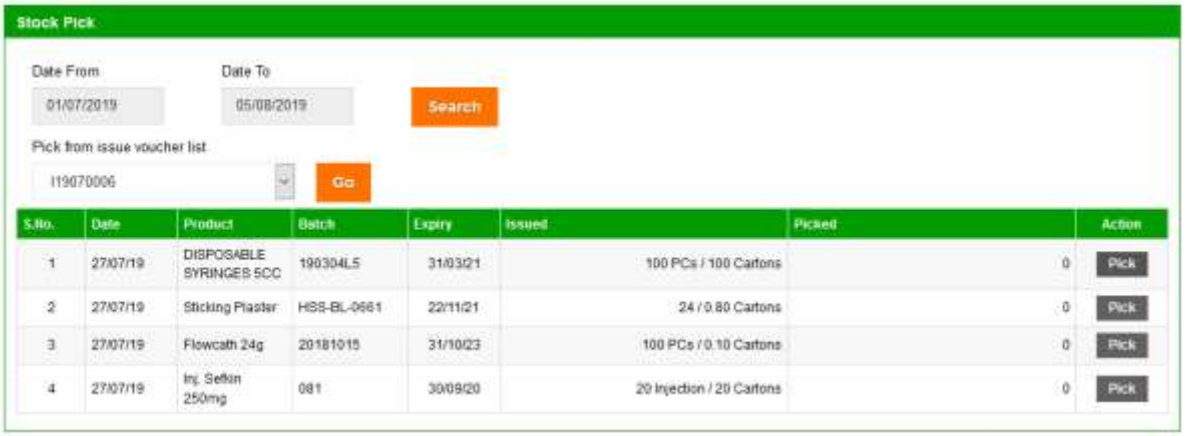


Figure 26: Stock picking

6.2.2.8 Stock adjustment

It is important that stock records are accurate and reflect physical stock. Sometimes stock is wasted or lost and this change in physical stock must be captured in the system. The system assigns a unique number to each stock issue, which starts with "A". The next two digits denote fiscal year and following two denote month. The last five digits denote serial number in each month.

A	1	9	0	4	0	0	0	0	1
Adjustment	Year		Month		Serial number (resets on 1st of each month)				

Following information needs to be available to the user when entering the adjustments and must be known before issuance of stock.

- Adjustment date
- Adjustment type, such as lost, wasted etc.
- Reference number
- Product and batch number
- Quantity to be adjusted
- Any additional comments for adjustment

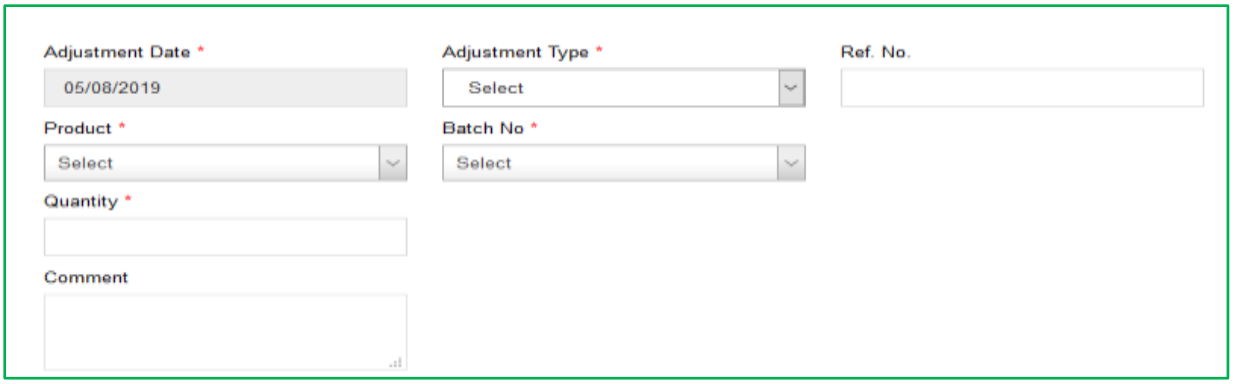


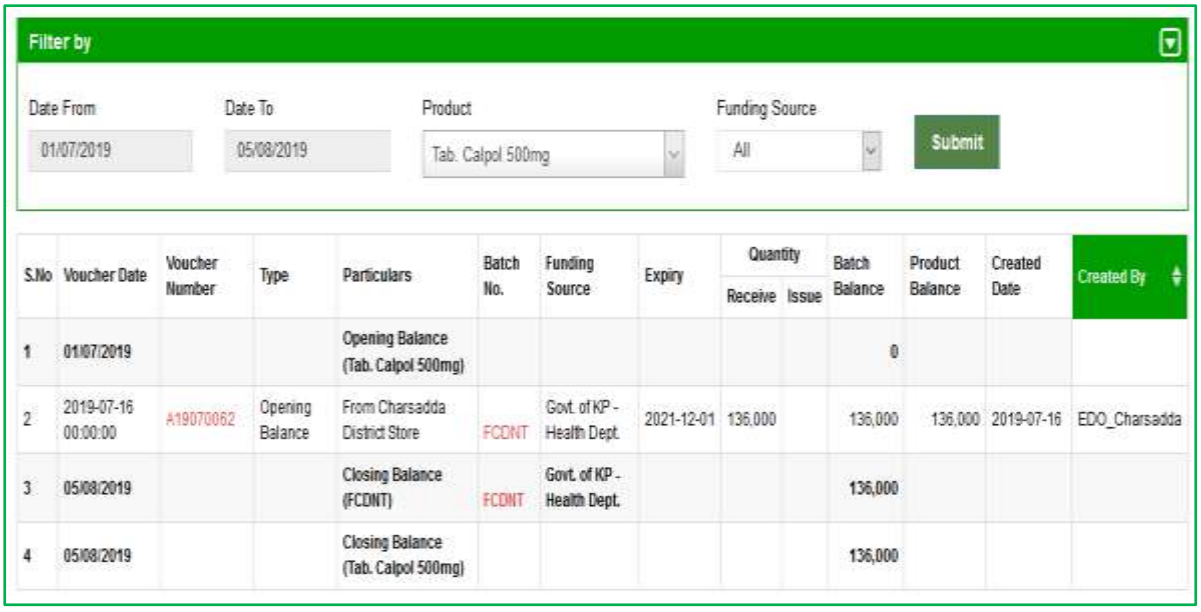
Figure 27: Stock adjustment

6.2.2.9 Record keeping and stock ledger

Every store has a stock register. The store keeper is responsible for the stock register and entering all stock related details such as brand name, generic name, strengths, dosage forms, quantity, batch and lot number, VVM in case of vaccines, expiry date, and receiving date. The available manager will put their initials at the end of each entry.

The inventory management system offers automatic creation of electronic stock register to include:

- Transaction reference (such as issue voucher number or name of recipient)
- Transaction type (including receipts, issuance, losses, and adjustments)
- Product name and description including the form (capsule, tablet, liquid suspension, Vial etc.) and strength
- Stock on hand or opening balance
- Closing or ending balance
- Closing balance product



S.No	Voucher Date	Voucher Number	Type	Particulars	Batch No.	Funding Source	Expiry	Quantity		Batch Balance	Product Balance	Created Date	Created By
								Receive	Issue				
1	01/07/2019			Opening Balance (Tab. Calpol 500mg)						0			
2	2019-07-16 00:00:00	A19070062	Opening Balance	From Charsadda District Store	FCDNT	Govt. of KP - Health Dept.	2021-12-01	136,000		136,000	136,000	2019-07-16	EDO_Charsadda
3	05/08/2019			Closing Balance (FCDNT)	FCDNT	Govt. of KP - Health Dept.				136,000			
4	05/08/2019			Closing Balance (Tab. Calpol 500mg)						136,000			

Figure 28: Stock ledger

6.2.3 Integrated Supply Chain Dashboards

The district integrated supply chain dashboards are a management tool which are interfaced with all provincial health information systems and consolidate supply chain, services, and demographics data into a single platform at the district level. The objective of a district supply chain dashboard is to provide critical information at the district and sub-district levels. The dashboard would improve visibility, efficiency, accuracy, and timeliness of supply chain function. A team of domain experts will manage the information system.

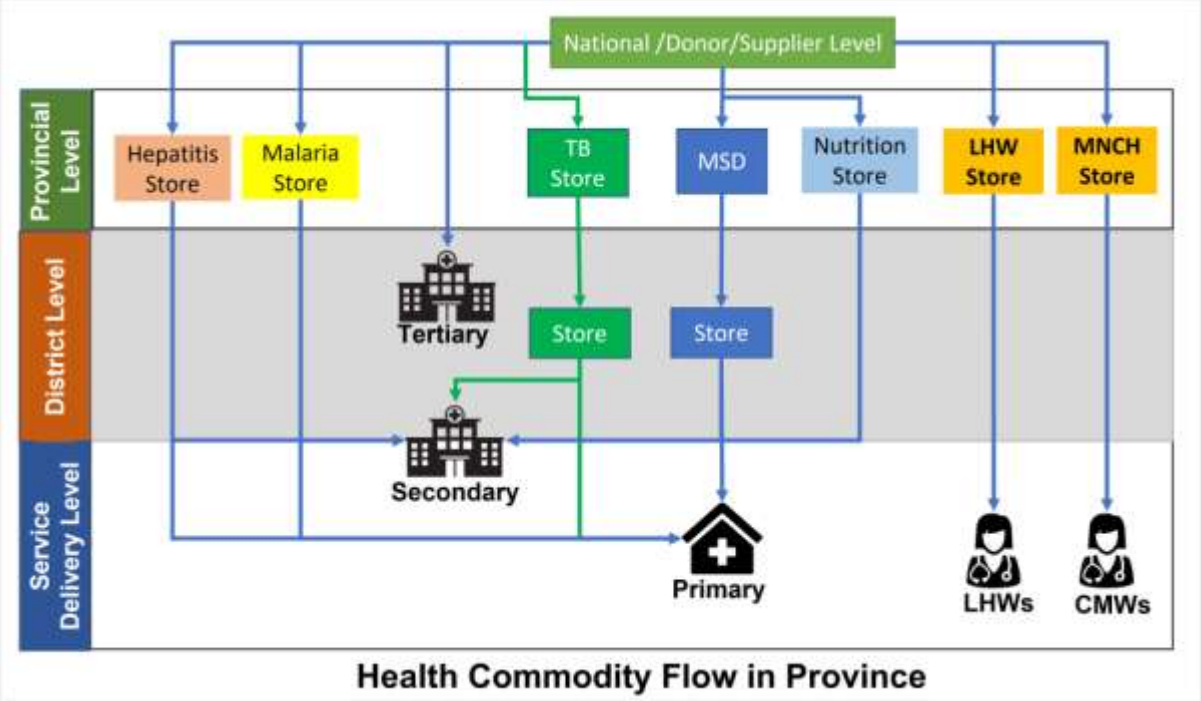


Figure 29: Health commodity flow in province (Example DoH Khyber Pakhtunkha)

The district supply chain dashboards will consist of three components; analytical dashboards, inventory and warehouse management, and interfaces with other MISes.

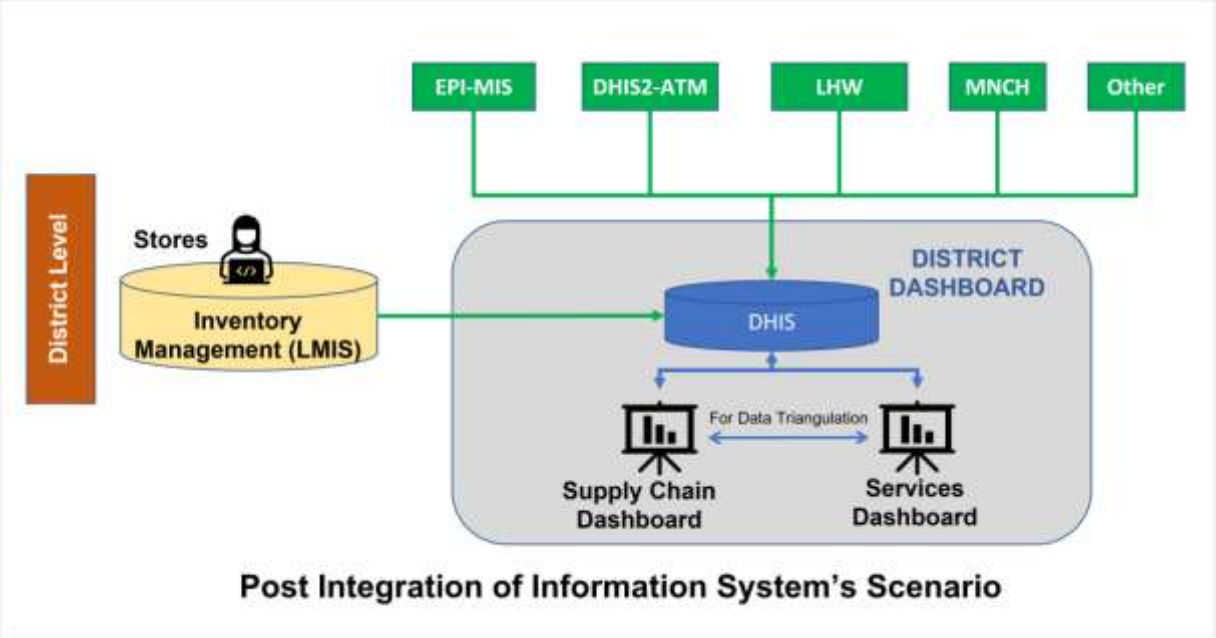


Figure 30: Overall information system architecture in province (Example DoH Khyber Pakhtunkha)

The district supply chain dashboard shows stock availability and stock out status at district and sub-district levels as well as consumption trends for different medicines.

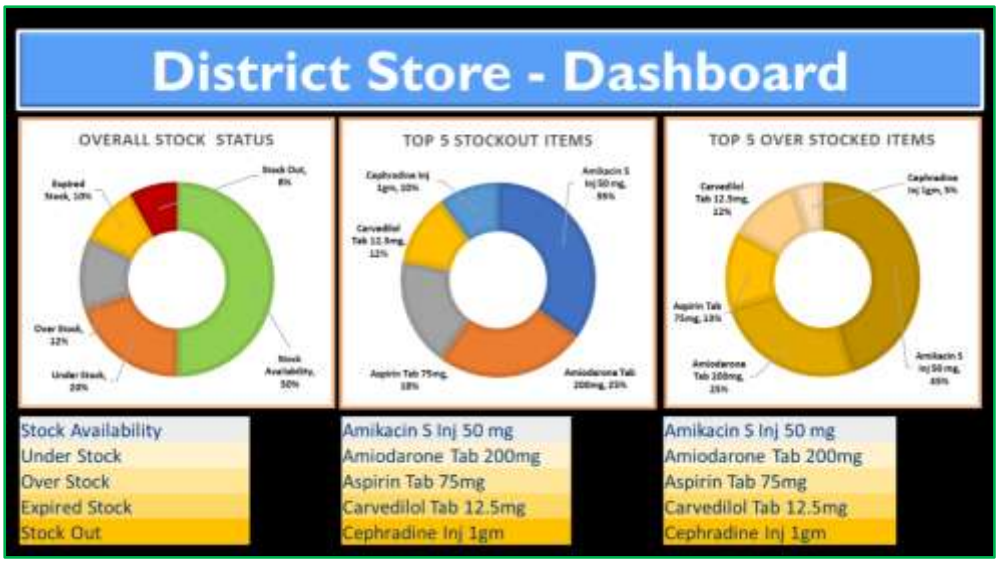


Figure 31: Dashboard: District store

Figure 32: Dashboard: Health facility

Monitoring & Evaluation in the Context of Supply Chain Management

7. Monitoring & Evaluation in the Context of Supply Chain Management

7.1 Background

Monitoring and Evaluation (M&E) is a process of continual gathering of information and assessment of the collected information to measure the progress of any project in accordance with the pre-defined goals and objectives. Moreover, this process helps the managers in assessing whether there are unintended effects from the project and its activities. M&E is vital part of the project cycle and encompasses every step from project inception till its conclusion.

Generally, ***monitoring*** is carried out to *track progress and performance* of various project activities and processes for adequate decision-making surrounding the implementation of the project. However, ***evaluation*** provides more generalized insight for establishing *to what extent the initiative has achieved its goals or objectives.*

Monitoring and Evaluation is carried out for many different purposes. Monitoring systems provide managers and other stakeholders with regular information on progress relative to targets and outcomes. This helps the managers to keep track of progress, identification of issues and gaps, amend the operations based on the experience, and align and justify the resource allocations to carry out the project activities. Also, regular monitoring helps to identify any challenge right at its outset and propose relevant solutions to mitigate the ill-effects of the challenges. Thus, regular monitoring is considered to be a critical part of good management. Periodic evaluation is also considered to be good practice, and can be used to investigate and analyze why targets are or are not being achieved. Therefore, Monitoring & Evaluation is incorporated at every step of the project cycle.

For understanding purposes, key reasons for the M&E are listed below:

I. Ensuring across the board accountability: demonstrating to donors, taxpayers, beneficiaries and implementing partners that expenditure, actions and results are as agreed or can reasonably be expected in the situation.
II. Efficient operational management: provision of the information needed to co-ordinate the human, financial and physical resources committed to the project or program, and to improve performance
III. For strategic management: provision of information for setting and adjusting objectives and strategies.
IV. Capacity building: building the capacity, self-reliance and confidence of beneficiaries and implementing staff and partners to effectively initiate and implement development initiatives.

Monitoring and evaluation should be evident throughout the lifecycle of a project, as well as after completion. It provides a flow of information for internal use by managers, and for external use by stakeholders who expect to see results, want to see demonstrable impacts, and require accountability and trustworthiness on the part of the public sector. Governments and organizations are accountable to stakeholders and this requires them to both achieve expected outcomes and be able to provide evidence that demonstrates this success. As a consequence, increasing attention is now being given to

Monitoring: Ongoing and routine collection and analysis of measurements or indicators to determine progress toward objectives.

Evaluation: Periodic comparison of objectives with accomplishments and how the objectives were achieved, involving a more formal and structured system assessment.

funding rigorous impact evaluations that are capable of providing solid empirical evidence about whether or not a particular type of development intervention works.

At sectoral level monitoring and evaluation can:

- improve project and program design through the feedback provided from midterm, terminal and ex post evaluations
- inform and influence sector and country assistance strategy through analysis of the outcomes and impact of interventions, and the strengths and weaknesses of their implementation, enabling governments and organizations to develop a knowledge base of the types of interventions that are successful (i-e what works, what does not and why)
- provide the evidential basis for building consensus between stakeholders

Whereas, **at project level** monitoring and evaluation can:

- provide regular feedback on project performance and show any need for 'midcourse' corrections
- identify problems early and propose solutions
- monitor access to project services and outcomes by the target population;
- evaluate achievement of project objectives
- measure the impact of the project on various indicators (including those relating to project objectives and other areas of concern)
- incorporate stakeholder views and promote participation, ownership and accountability

The same principles and methods apply to the supply chain management system for any public or private sector organization. As established in the earlier sections of these guidelines that ensuring smooth supply of commodities lies at the heart of any program, monitoring and evaluation activities ensure that the supply chain system works as per the targets set by the program management.

In public sector healthcare service delivery programs, governments are required to ensure availability and access to the essential medicines, equipment and other supplies to the healthcare providers so that standard healthcare services can be delivered to the communities. Therefore, there is a dire need to monitor not only the efficiency but also the efficacy of the commodity supply chain systems in a public sector healthcare delivery system owing to the accountability to the exchequer money and to meet the national and international commitments such as providing **Universal Healthcare Coverage (UHC)** and meeting the **Sustainable Development Goals (SDGs)** 2030.

Furthermore, the M&E ensures that the performance management of the supply chain systems is assessed in a timely and standardized manner to provide effective feedback to the program management for appropriate decision making.

> ***In conclusion, Together M&E provide the basis for performance management. Another key to performance management is aligning performance metrics to the goals and objectives of the program.***

Continual monitoring of the programs and projects becomes even more important in those settings where the resources are scarce and the ensuring of commodity availability at the last mile becomes a challenge due to various geo-political circumstances. Example of such areas in Pakistan may be Balochistan, some districts of southern Punjab, some remote districts of interior Sindh, some remote districts and newly merged districts (NMDs) in Khyber Pakhtunkhawa (KP). Governments have been facing considerable challenges in provision of quality healthcare services and associated commodities for such areas. In this scenario, this chapter is aimed to provide a hands-on guide for the provincial and district level managers to carry out quality monitoring and evaluation to assess state of affairs pertaining to effective supply chain of essential public health commodities to the last

mile without delays. Further, the managers must be able to address challenges in resource allocation, wastage, pilferage of medicines, warehousing and distribution of commodities.

7.1.1 Chapter Objectives

After going through this chapter, the readers will be able to learn:

- Basic Concepts and key terms for Monitoring & Evaluation
- Role of M&E in strengthening supply chains and the overall goal of product availability
- Essentials of developing an M&E framework and workplan
- Organizing the information collection
- Level specific information required for carrying out monitoring and evaluation activity
- Key areas to be focused while writing an M&E report
- Connection between objectives, interventions, and indicators
- How to select and use indicators to measure system performance
- Data collection methodologies, including routine monitoring and periodic evaluation
- Steps in planning and conducting a supply chain assessment
- Various tools that can be used for M&E for supply chain management

7.1.2 Basic Concepts of Monitoring and Evaluation

It is important for a reader to develop an understanding of important basic concepts relating to M&E. For this purpose, table 8.1 shows some important M&E key terms:

Table 8.1. Glossary of Key M&E Terms

M&E Term	Definition
Monitoring	Monitoring of program or intervention refers to the systematic collection of data related to performance and strategic indicators of the program to track and measure the progress toward program objective. It is the routine process that occurs throughout the life cycle of a program. It includes: - Regular follow up of activities during the implementation process to track progress - Ensure activities are proceeding as per the approved plan - Continuously identifying problems during implementation and addressing them
Evaluation	Evaluation is a periodic assessment from time to time to determine where we are supposed to be. It helps in determining - Whether we are doing the right things - Whether we are doing things right - Is there any better way of doing it - Is the program sustainable in terms of technical, operational and strategic activities implied by the program - The areas of improvement in subsequent phases of the program implementation
Baseline	It refers to the measurement of a situation before the start of any activity/program/intervention. It is necessary for: - To measure the change - To measure the progress - To calculate the value of Key Performance Indicators (KPIs)
Analysis	The conversion of raw data into information is known as analysis. The format of the analysis must be useful for decision making.
Objective	A specific, measurable and smart statement outlining the desired accomplishments or results of a program or an intervention;

M&E Term	Definition
Indicator	It refers to specific, measurable and observable data points, which let you track helps in tracking and measuring progress toward planned results that a project or program is intended to achieve within the stipulated time.
M&E plan	M&E plan also refers to indicator matrix or data collection plan is a critical tool used for planning and monitoring data collection of indicators. It also guides indicator data collection, analysis and reporting etc.
Quantitative data	Quantitative data is primarily based on numerical format and collected in number. Therefore, it involves analysis using specific statistical techniques to answer questions like who, how much, what, where, when, how many, how and how often.
Qualitative data	Qualitative methods collect data is typically in the form of words or descriptive data such as (interviews, documents, observation (observing something), sensing something (see, smell, touch, taste and hear) audiovisual material, video recording) and as such is harder to analyze than quantitative data.
Inputs	Input is a type or set of resources needed to be required to implement a program or activity including supplies, personnel, policies, funds, facilities etc.
Process	It refers to a range of activities as well as interventions wherein inputs are used to accomplish objectives of the project as well as desired results including training, supervision and reporting
Outputs	Outputs are the results that are achieved/obtained after the implementation of activity at the project/program level. They are the tangible, immediate and intended product of activity (including the number of personnel trained, the material developed on M&E and availability of material for use)
Outcomes	These are considered as midterm or intermediate results, which are measured at ground level in the program target population, which may be the result of given intervention such as a change in behavior, skill and policies that related to program e.g., product availability, improved- access and –skills
Impact	It refers to long-term results/outcomes of project intervention, achieved at the population level (including changes in the morbidity, mortality or total fertility rate)
Feedback	Dissemination of information among decision-makers as well as personnel at all level, based on information received.

7.2 Desk Monitoring

Desk monitoring is also known as passive monitoring which refers to in-depth review and examination of collected data through M&E data source and checklist from the target population. It includes various analysis techniques such as trend analysis etc.

Desk monitoring has the following attributes:

i. Requires review of records available
ii. Relies on already available data (monthly reports, stock registers, Management Information systems (MIS) logistics reports etc.) For effective desk monitoring the available data must be reliable and accurate
iii. Incomplete data availability may not reflect the actual picture of performance and may not be useful for the decision-making process
iv. Requires fewer resources in terms of time, financial resources and human efforts.

7.3 Field monitoring

It refers to the process of collecting first-hand data from the field by adopting a systematic approach and tools.

This mode of monitoring has the following attributes:

i. Requires a collection of first-hand information and data through direct observation
ii. New data is collected by the monitor using a standardized data collection tool.
iii. Data accuracy and reliability is cross-verified by using Data Quality Assessment tools.
iv. Additional data in the form of monitors' observations are made use of while making any decision.
v. Requires additional resources such as financial and human resources

7.4 Types/Modes of Evaluation

The programmatic evaluations can be classified into following types based on the objectives of the evaluation process:

i. Process Evaluations

Process evaluations, also called implementation evaluations, are the most frequently used type of evaluation. They review how a program is implemented and focus on how a program actually operates. In the context of a logic model, process questions address inputs, activities, and outputs. Process evaluations can be beneficial throughout the life of a program, however they are often used when a program is implemented to ensure compliance with statutory and regulatory requirements, program design requirements, professional standards, and customer expectations. Early program evaluations can identify processes that can be made more efficient and mitigate compliance issues at a later date. A process evaluation may also be appropriate during the latter stages of a program life cycle when there is a need to assess program efficiency or effectiveness in achieving output goals.

Quality Monitoring

Why is quality monitoring a continuous process? Changes in the organizational environment and policies can affect a supply chain (e.g., health sector reform, integration, privatization, cost recovery). Changes in resources (financial, human, capital) that are available to the system can affect a supply chain. adding new services with new commodities, which may have different storage and distribution requirements (HIV and AIDS programs, Expanded Program on immunization [EPI], etc.), can affect the supply chain.

ii. Outcome Evaluations

Outcome evaluations, as the name implies, assess program outcomes. Thus, the focus is on the output-outcome portion of the logic model. Outcomes can be immediate effects of a program or more distal. In general, the closer an outcome is to program outputs, the clearer the linkage between the two. That is, outcomes measured immediately after outputs are generated are less likely to be affected by outside factors that can cloud the relationship between outputs and outcomes. A simple scenario is provided to illustrate the added complexity of measuring outcomes as they become more distal from the program. In addition to intended outcomes, outcome evaluations should address unintended outcomes. Referring to the scenario provided, skills gained through training may make trainees more attractive to other employers and result in higher turnover. Attention to the entire

environment of a program is important to ensure significant contextual factors are not overlooked and competing influences on outcomes are considered.

iii. Cost-Benefit Evaluations

Cost-benefit evaluations can be considered a special case of outcome evaluations. For these evaluations, program outputs and/or benefits are compared to input costs to provide a ratio of cost to benefit. Because both costs and benefits are often difficult to assess, there can be substantial challenges implementing this analysis. Returning to the scenario provided, a survey may determine the extent to which trainees use their new skills, but assigning a value to skill use is not straightforward.

iv. Impact Evaluations

Impact evaluations are designed to measure the net effect of a program by comparing actual program results with counterfactual data. Excluding all potential causes of an outcome can be a difficult, expensive proposition and is sometimes impossible. Because of their cost and required expertise, and often the need to plan the evaluation during initial program design rather than after program implementation, impact evaluations are not common. Although impact evaluations should be planned during program startup, they should not be undertaken until program operations are mature so that the true effect of the fully implemented program can be assessed.

The most straightforward way to isolate program impact is to randomly assign subjects (individuals, counties, cities, etc.) to treatment and control groups, i.e., groups that receive and do not receive program services. Experimental design is critical and factors such as group size and composition must be carefully considered to ensure a valid statistical sample. Treatment and control groups must also be sufficiently isolated to prevent spillover effects. This can be challenging since many programs cannot provide services selectively. An alternative to random assignment is to construct the control and treatment groups to be similar in ways that are considered important. Again, there is the issue of selective delivery of services and the additional issue of whether all important attributes have been considered in forming comparison groups. Advanced statistical techniques can be effective in isolating program effects in some cases; however, extensive data about the program and potential causal influences is often required.

GOAL & OBJECTIVES

Goal. A statement, usually general and abstract, of a desired state toward which a program is directed (usually not measurable)

Objective. Specific statement describing the desired accomplishment(s) or results of an intervention or program; how the goal will be achieved (objectives should be measurable and should address existing problems, program weaknesses, and/or client needs

There are two types of mode of evaluation including:

Inward-facing evaluation: it is designed to demonstrate value and effectiveness to funders, researchers, policymakers and other audiences external to the program. This mode of evaluation employs qualitative data analysis and case studies data to document e.g. general perspective of the community on the effectiveness of an intervention and the perception of end-users concerning its strengths and weaknesses such as mothers' assessments of the accessibility of vaccination camps held on particular days.

Outward-facing evaluation: undertaken to inform program implementers as well as recipients how well the intervention is working. This kind of evaluation is outcome-focused and renders the quantitative data analysis methods measuring indicators such as vaccination rates either specified by external funding agencies to ensure comparability with baseline data and/or with similar interventions elsewhere or developed by implementers.

From these modes, one may conclude that inward-facing approaches have the potential to generate findings that are of practical value to implementers in improving intervention effectiveness, on the other hand, outward-facing modes are more likely to produce results that are perceived as generalizable, robust and reliable, though they may lack internal validity.

It is evident from the discussion above that purpose of monitoring and evaluation is to help the managers in tracking the progress of the project/intervention to achieve specific goals and objectives decided by the program management.

7.5 Goals and Objectives - Explained

At this stage we need to grasp the concept and relationship between goals and objectives. An example of a typical goal for a communicable disease control (CDC) program is to reduce morbidity and mortality due to communicable diseases in the country. Specific objectives developed by the concerned program to achieve this goal could include:

- To establish sentinel and routine surveillance points for ensuring early detection and recording of the notifiable disease cases in 100 percent of primary level public healthcare facilities
- To provide early diagnosis and prompt treatment with effective medicines to 85% of cases of priority communicable diseases
- To provide effective infectious disease prevention services to 100 percent of population at risk
- To provide pre-referral treatment and timely referral services to 100% of confirmed cases of priority communicable diseases with highest reported morbidity and mortality
- To establish functional linkages with the national reference laboratories and other relevant sectors to deal with the zoonotic and vector borne diseases
- To strengthen program management capacity, M&E, and procurement and supply management (PSM)

Please do note that these are overarching objectives for the CDC program. Considering the fact that multiple sections of a program are operational simultaneously to complement each other in achieving one particular objective such as financial and admin section, technical section, procurement section etc. To further elaborate, we know that an efficient supply chain system requires multi-faceted approach to achieve the goal of commodity security. To achieve this target, teams working on product selection, forecasting and quantification, procurement, distribution, warehousing and healthcare facilities work together to accomplish the target of commodity security for that particular program. Therefore, each team would have its own objectives as per their scope of work. This is the work of the M&E Team to connect these dots and portray overall picture of the programmatic performance and identify the strengths and weaknesses in the system so that the decision makers can re-strategize to keep the program on track and ensure that pre-defined objectives meet the standards and timelines.

Also, the list of objectives can be tailored and enhanced to cover all the relevant areas which lead to achieve the programmatic goal/s.

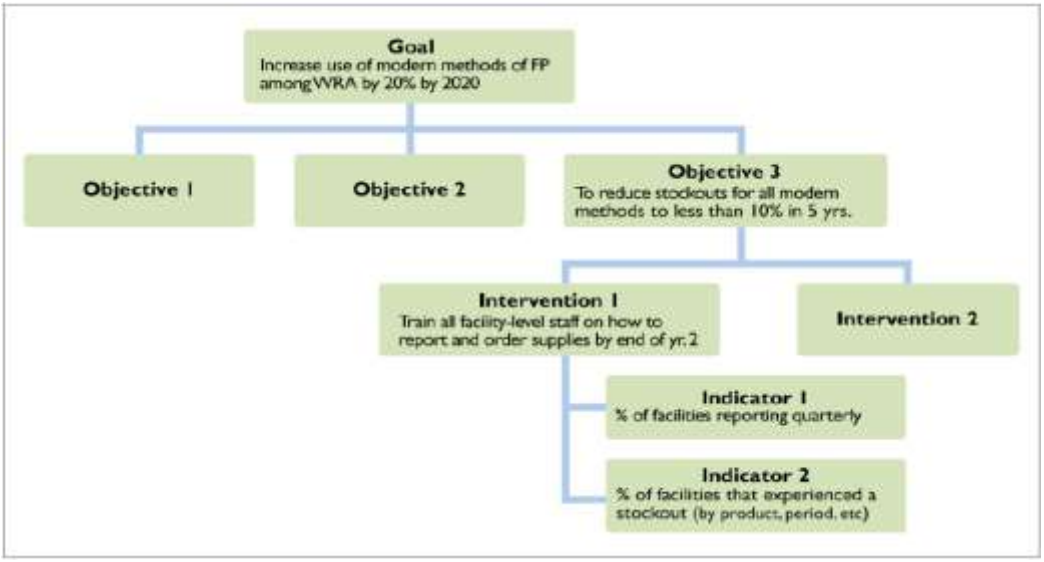


Figure 33:Relationship between goals, objectives, interventions and Indicators

7.6 Scope of M&E and Supply Chain Indicators

Considering the importance of monitoring and evaluation in the program cycle, it is fundamental to define who will conduct the monitoring and evaluation activity and provide regular feedback to the program team based on the findings of the monitoring activity. This is crucial to understand that each and every staff member performing any particular function in the program contributes in the monitoring and evaluation process. For further elaboration, a vaccinator working in EPI program is responsible for vaccinating all the eligible children in the catchments population. To perform this function efficiently, the vaccinator needs to provide regular feedback to the supervisor about consumption of vaccines and sufficiency of available stocks of vaccines at the health facility. If the vaccinator doesn't monitor the stocks of the vaccines available at the vaccination center, it won't be possible for him to provide adequate feedback to the supervisor. As a result, the vaccination center may face sudden stock-out of situation for vaccines or in some cases there may be piling up of vaccines at that particular vaccination center. In addition, recording and reporting of vaccines consumption and stocks position for each vaccination point will help the supervisors to gauge the performance of vaccination staff and the center.

Similarly, the healthcare staff working at different levels of healthcare service delivery system such as tehsil/taluka, district, provincial and national levels perform specific monitoring functions pertaining to their programmatic role.

This is imperative to has a designated team which is responsible to carry out systematic monitoring and evaluation as per the performance indicators delineated by the higher management. Therefore, every program has notified the M&E cell which collects specific data through desk and field monitoring and provide regular feedback in the form of periodic M&E reports and with the recommendations for improvement.

As elaborated earlier, Monitoring & Evaluation is a core function of a program which spans the whole program cycle, it is imperative to constitute a team of professionals bearing relevant skills to undertake this essential task. In an ideal scenario, the team must be skilled to perform following functions

1- Understand the scope of the program (Goals and objectives) and its implementation process
2- Develop quantifiable indicators (input, output, outcome)
3- Develop a robust Monitoring & Evaluation framework/plan aligning the geographic and programmatic scope
4- Finalizing the type of data to be collected, identify the data sources and their means of verification and Develop customized data collection, recording and analysis tools
5- Conduct desk review and on-sight field visits to collect the relevant information
6- Write technical reports based on the findings of the M&E activity and provide feedback to the program team
7- Recommend strategies and action points to address the issues and challenges identified thus keeping the program on track
8- Provide capacity building platform for the program management and field staff

As mentioned above, developing an M&E plan is one of the key functions of the M&E team, a detailed elaboration is required to understand the process of development of an M&E plan which is given in the section below.

For an M&E team It is crucial to define the context of monitoring before planning the monitoring activity. The context of M&E will be different for each level of administration.

In public supply chain management system (SPM) settings, ***provincial authorities*** are required to take on tasks like product selection, forecasting and quantification, procurement, warehousing and distribution of the commodities. The concerned authority would like to monitor these particular tasks to gauge the performance of provincial management staff in carrying out above mentioned functions. Therefore, the monitoring tool required for assessing the provincial level functions should include only the relevant indicators pertaining to provincial level functions.

While at district level, usually, the district managers are required to play different roles in ensuring the smooth supplies of commodities to the service delivery points (*Health Facilities* in this case).

On the other hand, the district level authorities are required to carry out different functions or different level of same functions being performed at provincial level. From M&E perspective, district level authorities will be monitored and evaluated related to supply chain functions like inventory management, warehousing and distribution to the lower levels of administrative units such as Tehsil /Taluka stores and ultimately to the healthcare facilities.

Lastly, the healthcare facilities have altogether different role in the supply chain (based on the level of healthcare facility i-e primary, secondary or tertiary healthcare levels). The primary function of the health care facilities in a supply chain system is receiving of the supplies provided by the district (or provincial stores in some cases), maintain their appropriate *inventory records* and *store* them in appropriate conditions till these supplies are *consumed.*

This is evident from above discussion, that every level is required to perform some specific functions as per the responsibility level and therefore, the performance of each level should be gauged as per the functions they are mandated to perform.

This leads to an important conclusion that *the monitoring indicators may vary for each level of administration as per their role in the supply chain system.* At the same time, some of the functions are common for each level irrespective of the responsibility level. Examples of some common functions irrespective of level of administration are:

1- Inventory Management
2- Appropriate warehousing
3- Distribution of the commodities

4- Reporting

While, some of the functions are specific to the level of administration such as:

1- Product selection – provincial program management
2- Forecasting and quantification – provincial and district level program management
3- Procurement – Provincial and district level program management
4- Consumption – service delivery point/Healthcare facilities

Therefore, it is important for the M&E team to decide the scope of the monitoring and delineate the relevant indicators as guided by the scope of the M&E activity.

In the ensuing sections various commonly used indicators for monitoring and evaluation of a supply chain system are explained in detail. But for the purpose of understanding some of the output indicators of a supply chain system are enlisted below:

- Percentage of facilities that had a stockout (during a defined time period, for a specific product or set of products)
- Inventory expired or damaged
- Percentage of facilities reporting/submitting complete reports/submitting reports on schedule
- Percentage of facilities that keep accurate logistics data for inventory management
- No. of health facility requisitions fully entertained by the district/provincial stores (order fill rate)
- The number of personnel trained in supply chain management.

7.7 Developing Monitoring & Evaluation Plan

An M&E plan encompasses the complete supply chain landscape for monitoring as well as evaluation. Performance of the health programs mainly depends upon linking the planned information acquired from several data collection systems to the decision making. A 'program fiscal year activities' and 'M&E plan' are interrelated but different from each other. The program fiscal year activities include a range of activities and deliverables that will be carried out for the whole of next year, while the M&E plan links those activities to the overall goals and objective defined in the M&E plan and explains the methods of measurement and evaluation of these interventions during the monitoring and evaluation process.

The M&E findings identify the problems, the magnitude of the problems and suggest recommendations to take an action. This should also provide a solution to the problem, identification of key personnel to act, the resources required for action to be taken and the expected timeframe for measuring the outputs and outcomes.

The best way to define the objectives of the monitoring and assessment is by measuring the impact on the system, program, or population. Let us assume the aim is to lessen stockouts of the entire family planning modern methods such as pills, implants, injectables etc. to less than 12% in five years. The subsequent step is to determine the set of activities that will be undertaken to accomplish the objective. In this regard, the aforesaid objective may be supported with the intervention to train all staff at the facility level on 'how to report' and 'order supplies' by the end of the second year. Once the objectives and interventions are identified, criteria should be defined to prioritize the activities according to their feasibility and the availability of resources.

Initially, one should consider the objectives and score them. Then score the interventions within each objective to assess the feasibility of accomplishing the overall objective or intervention. Score each objective and intervention on a scale of 1–3, with 1 being a low priority, feasibility, or level of resources; and 3 being high.

These parameters can be defined as:

1. **Priority**: how large and how broad the impact will be, whether this is an important precursor or first step for, or synergy with, other objectives and initiatives.
2. **Feasibility:** the extent of political support, relevant policies, logistics system infrastructure, and cultural support.
3. **Resources:** if available resources (such as knowledge, skills, materials and funds) meet, exceed, or fail to meet the resource requirements. Assign a score that reflects the level of resources available, compared to what is required to accomplish each intervention.

A sample work sheet layout for delineating the objectives as per their priority is provided in the table given below.

Table 30: Objectives and interventions worksheet

	Priority*	Priority	Available Resources (vs. requirements)
Objective 1			
Interventions • •			
Objective 2			
Interventions • •			

Once the M&E team has prioritized the objectives and interventions, they can develop and &E workplan as per the format shown in the table given below.

Table 11: M&E Workplan Worksheet

	Desired State	Assumptions	Indicators	Data Sources	Frequency of data collection	Person(s) Responsible	Resource Requirements
Objective 1							
Interventions • •							
Objective 2							
Interventions • •							

Objectives and Interventions prioritized from table 1

The workplan finalized and encoded as per the sample worksheet will enable the M&E team to initiate the monitoring activity in a more systematic way and provide help in generating actionable information for the decision makers at the completion of monitoring activity.

7.8 Key Monitoring Activities

Key monitoring activities include:

1. **Performance tracking and monitoring**
2. **Human resource performance monitoring**
3. **Supply chain performance monitoring**

7.8.1 Performance tracking and monitoring

Performance tracking and monitoring is the major area of concern for the district level staff who are responsible for managing warehousing and distribution of commodities to the health facilities.

It includes:

- Monitoring and analyzing trends of availability of essential medicines and other supplies such as vaccines, family planning methods through the program life cycle
- Analyzing and root causing the product consumption trends (increased or declined) with segregation to various levels i-e from provincial stores to the district and subdistrict stores and ultimately to the health facility level
- Analyzing products stockouts and availability trend to improve commodity availability at the SDPs and availability of sufficient buffer stocks of the public health supplies at all stores.

7.8.2 Human resource performance monitoring

The program management needs to assess the human resource performance involved at each level of the supply chain including carrying out product selection, forecasting and quantification, procurement and distribution, inventory management, warehousing and distribution/consumption. The M&E team must conduct training need assessment and propose capacity building plan for the workforce as per need assessment findings and observations. Following workforce assessment could be carried out:

- Assessment of availability of trained technical human resource to collect and analyze data for guiding the program management on appropriate product selection and conduct realistic forecasting and quantification for the products selected for procurement
- Assessment of availability of human resource trained on standard procurement protocols/rules developed by each provincial government
- Assessment of availability of trained store-keepers at provincial, district and sub-district stores including the healthcare facility level stores
- Assessment of availability of trained MIS operators at least at the provincial and district levels for ensuring timely collection, compilation, analysis and reporting of logistics data at all levels of the district supply chain.
- Assessment of supply chain staff turnover ratio at the provincial and district levels (at least)

Sources of data include human resource records, staff daily attendance records, HRM MIS reports (if implemented), training management information system (TIMS) if implemented.

7.8.3 Supply chain performance monitoring

Supply chain performance monitoring is one of the major parts of conducting M&E at provincial and district level. The ultimate objective of supply chain monitoring is to ensure the commodity availability at the last mile without delays. It includes close monitoring of the complete supply chain system of a department and identifying bottlenecks at each supply chain level, which affects and delays the availability of stock at the health facilities levels which are ultimate consumption points in the supply chain system.

To calculate the stock sufficiency at the provincial, district and health facilities level, an understanding of some important terminologies and indicators is required. These terms are explained below:

Table 12: Indicators of Supply Chain Performance Monitoring Terms

Stock on hand	The available quantity of usable stock. Unusable items are not counted as stock on hand instead considered as losses to the system. *Data Sources: The data source for this measurement includes stock ledger or register available at the health facility, monthly logistics reports and data collected during field monitoring visits to health facilities*
Consumption	The quantity of stock dispensed to users or used during a particular period of time. *Data Sources: The data source for this measurement includes monthly reports generated by the health facility e.g., District Health Information Software (DHIS) reports, LMIS monthly reports in case of vaccines and contraceptives, and data collected during field monitoring visits to health facilities*
Losses and adjustments	The quantity of stock removed from the pipeline due to some reason (such as theft, expiration, damage etc.) other than use at the SDP or consumption by clients is termed as **losses** whereas the quantities of stock issued to or received from other facilities at the same level as the pipeline are known as **adjustments**. *Data Source: The data source for this measurement includes stock ledgers, monthly reports, LMIS reports, and data collected during field monitoring visits to health facilities*
Average monthly consumption	The term refers to the consumption of stock in the last three months with non-zero consumption. The average of the last three non-zero months is calculated by dividing the sum of consumption and dividing the resultant quantity by 3 $$\boldsymbol{Average\ Monthly\ Consumption} = \frac{\boldsymbol{consumption\ of\ last\ 3\ (non-zero) months}}{\boldsymbol{3}}$$ *Data Source: The data source for this measurement includes stock ledgers, monthly reports, LMIS reports, and data collected during field monitoring visits to health facilities*
Months of stock	This indicator is used to assess the stock sufficiency at any store. The measure allows the monitor to determine how long the supplies will last at the current rate of consumption for a given health facility. $$\boldsymbol{Months\ of\ stock\ on\ hand} = \frac{\boldsymbol{Stock\ on\ Hand}}{\boldsymbol{Average\ Monthly\ Consumption}}$$ *Data Source: The data source for this measurement include stock ledgers, monthly reports, LMIS reports, and data collected during field monitoring visits to health facilities*

7.8.4 Data Quality Assessment and Validation

Data quality assessment and validation is an essential mandate of M&E team. M&E team is required to plan and conduct field monitoring visits to carry out this crucial task.

These focused monitoring visits help the program management to validate the findings and observations recorded during ongoing monitoring of the program. As we have learned earlier that health facilities act as ultimate *consumer* in a public healthcare service delivery system. The data quality and validation visits are best suited for the health facilities. But considering different scope of responsibility at provincial and district level, the data quality and assessment visits may also be carried out to evaluate that the procurement team has ensured timely procurement of the selected public health commodities/equipment. Similarly, the provincial and district stores can be visited to ensure the appropriate inventory management and best practices of warehousing and distribution are being followed by the respective stores. Furthermore, the DQA visits to the health facility level stores will help in assessing the quality and validity of consumption data. Consumption data is crucial to be validated because most of the pilferage and wastages occur at the service delivery points and chances of errors in recording and reporting of the consumption data are highest at the health facility level.

In the existing healthcare system, all the health facilities report on pre-defined indicators. Each health facility is required to share its reports with the respective authorities in the district through standardized protocols defined by the concerned departments and programs. Based on the desk analysis of the monthly reports, the district authorities may prioritize and plan their field monitoring visits.

This becomes especially relevant in the case of logistics data because the district authorities need to assess and validate the stock levels and its data being reported in monthly performance reports by the health facility.

The purposes of field monitoring visits include:

i. Stock monitoring
ii. Performance assessment (human resource, supply chain system, reporting)
iii. Data quality assessment (data availability, accuracy, and timeliness)
iv. Observations of storage warehousing conditions and practices
v. Training needs assessments
vi. Identification of challenges and gaps
vii. Supportive supervision and on the job training (OJT), where required

7.9 Monitoring Tools

After determining the purpose and method of monitoring, the data collection approach, the monitor requires a standard data collection tool for conducting field monitoring visits. Generally, monitoring involves several data collection methods, it normally requires several types of data collection tools such as quantitative, qualitative or combinations thereof. Such tools are used to collect the data required to report on the indicators selected for the overall assessment of system performance. Existing monitoring tool and checklist, or even a new tool can be developed, which is a lengthy process that requires testing and validation.

As described in the earlier section of M&E scope, the data collection tools for monitoring of a supply chain system should be developed while keeping in view the exact role the particular unit/section is performing in the supply chain system so that the M&E team can deduce relevant information only. For example, collecting data related to procurement performance during a monitoring visit to health facility will be irrelevant.

It is commonly observed that, the M&E team while carrying out a DQA/monitoring visit to a district or health facility aims to collect as much data as possible to apparently make their visit more fruitful. This is fine if there are abundant human and logistic resources available to conduct such a visit but rationalization of the resources consumed and the amount and quality of data collected must be ensured.

Therefore, while developing the M&E tool, the managers must ensure that only the relevant parameters are selected for data collection purpose. Too lengthy data collection tools/checklists require extra ordinary efforts and resources which may not be a suitable option in a setting where resources are already scarce. Additionally, collecting too much information makes objective analysis difficult thus the M&E team is unable to provide appropriate feedback to the staff being monitored and to the authorities for adequate decision making.

At the same time, the monitoring tool must be able to capture all the relevant information as well as the objective data to objectively gauge the performance of supply chain system function/element being monitored.

For example, the district managers may be interested in knowing the number of health facilities with stockouts in a given month for certain commodities such as Anti TB (ATT) drugs, or antimony-based injections for treatment of Cutaneous Leishmaniasis, or the number of health facilities with no

designated staff for managing the commodity storage and distribution. Similarly, the managers may need insight into the number of medicines with the short date of expiry or vaccines at VVM stage 2 present at the health facility or the number of medicine stores with appropriate storage/warehousing conditions.

This is also one of the best practices to develop a data entry tool in appropriate software such as MS Excel/SPSS for the purposes of simple and complex data analysis. Moreover, developing a data entry sheet in a software guides the monitors to assess the objectivity of any parameter. To further explain this, just consider a scenario of data collection tool developed to monitor district TB Control Program store Quetta. The monitor has included following question in the data collection tool for the provincial store keeper:

'Please explain the mode of distribution of ATT medicines to the tehsil/Taluka stores?'

This question seems very relevant but we know that we might get different responses to this question from different district store keepers. This situation may lead to difficulty in objectively scoring the distribution function performance for different district stores as the distribution process may vary for every district owing to the geographical terrain, availability of logistics and human resources and amount of ATT drugs being distributed to the sub-district stores. It is proposed that instead of including open ended questions, close ended question technique can be more helpful in this situation. *If the question had been drafted as 'Does the district store distributes ATT medicines to Tehsil/Taluka stores using its own vehicle?'* The response of the district store keeper can be recorded in the form of Yes/No and the monitors can objectively describe the findings as *'Number/percentage. of district TB Control Program stores with/without adequate availability of logistics for distribution of ATT drugs to sub-district level stores'.* We can see that this kind of information provided to the authorities will help them in rationalizing resource allocation for ensuring adequate distribution of ATT drugs to all sub-district level stores.

In summary, the data collection and monitoring tools not only facilitate the collection and recording of relevant data but also help in performing more structured and objective monitoring while filtering unnecessary details.

A sample monitoring and data collection tool for performance assessment and logistics performance for district level supply chain system is given at the end of this chapter.

7.10 Steps involved in Planning Data Quality Assessment visits

Field monitoring must be carried out systematically for better utilization of time, efforts and resources involved in a field activity. Major steps involved in field monitoring are described in figure 8.1 given below:

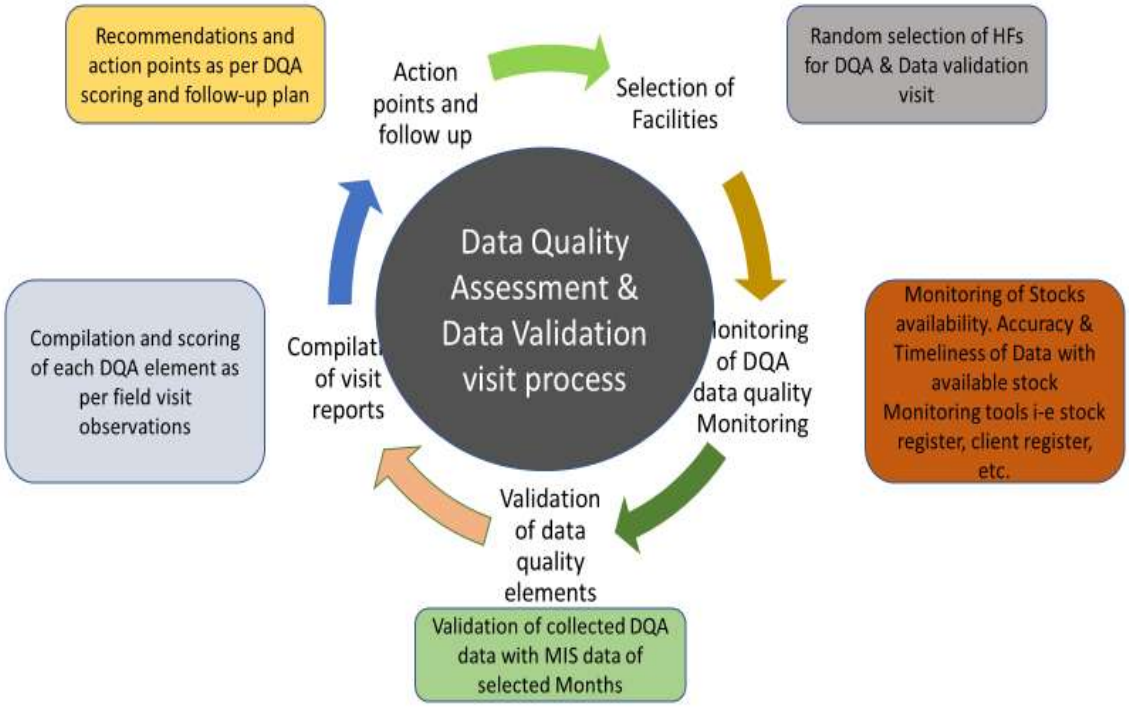


Figure 34: Field monitoring visit process

Selection of Health Facilities: The first step includes the selection of health facilities to be monitored during the data quality assessment (DQA) visit. This selection will be made through a random/convenient sampling method, depending upon the availability of time and resources including financial and human resource. As a general rule, at least 5% of the health facilities of the districts must be monitored during DQA on monthly basis.

A practical guideline for planning and executing the monitoring field visit is generally used and is explained in figure 2 and Table.

Table 13: Field monitoring visit guidelines

Field Monitoring Visit Guidelines
I. Before starting monitoring field visit: – *Identify the objectives of the field monitoring and categories of health commodities to be studied [vaccines, Rapid Diagnostic Test (RDTs), medicines etc.].* – *Secure financing for all the study teams' costs, including travel and accommodations.* – *Standardize monitoring tool available to meet the objectives of filed monitoring visit as well as to meet ongoing monitoring needs.* – *Determine the appropriate sample size and develop the sampling frame of the facilities to be visited. The main purpose of the sampling design is to avoid a convenience sample. Randomly select the facilities as much as possible.*
II. Calculating the sample size and selecting visit sites – *Compile a list of the total number of facilities in the district* – *Document the total number of each type of facility (warehouse, hospital, SDP) and the location and distribution of facilities* – *For a statistically significant sample, use a standard sampling formula, which often yields a large sample size. In case of resource constraints, visit a default number of a minimum of 5 percent of health facilities*
III. During monitoring – *Review completed data validation records to clarify any data inconsistencies. This is a very important step to ensure that the monitor is collecting complete and accurate data.* – *Enter the data collected into the chosen database or spreadsheet for further analysis.*
IV. Following the assessment – *Conduct data analysis.* – *Present the preliminary results, conclusions, and recommendations based on field monitoring.* – *Write the report of results, conclusions, and recommendations.* – *Disseminate the final report to key stakeholders.*

Monitoring of DQA elements: During the monitoring visit, the quality of supply chain components (receiving, storage, distribution, reporting) is being monitored, which generate critical information for decision-makers, which is helpful to ensure commodity security at the district and health facility level. During the DQA visit to selected health facilities following DQA elements is being monitored.

i. **Data Availability:** monitoring of the availability of contraceptive and medicine data at the health facility
ii. **Data Accuracy:** comparison of physical stock register entries with physical counts of contraceptive and medicines in the health facility
iii. **Data Timeliness:** rating the timeliness of reporting by accessing the last three previous months from MIS and rating it as per their reporting rate into MIS

Scoring of each DQA element: The field monitoring results must include commentary on the quality of data being reported and can be presented in the form of numbers, tables, bar diagrams, charts, pie charts, etc. Gaps in the data quality must be identified along with possible reasons for these gaps.

Recommendations and action points:

The monitoring activity becomes futile without the recommendations put forth for addressing the issues and challenges. The recommendations must objectively and indicate the actions to be taken. Examples of recommendations include:

- The district storekeeper requires training on the recording of logistics data in daily activity registers
- The health facility XYZ store is overstocked with anti-malarial medicines so stocks must be relocated to the nearest health facility ABC where stocks of anti-malarial medicines are insufficient.
- The desktop computer at the District Store needs to be replaced.

Stages involved in Developing Recommendations

1. ***Developing*** *a combined summary of the important points and observations during monitoring of a program/intervention. This step includes SWOT analysis i.e., S = Strengths, W = Weaknesses, O = Opportunities, and T = Threats).*
2. ***Identifying*** *vital current conditions and assumptions that are critical for program success and that may positively or negatively influence the project/program objectives and interventions.*
3. ***Comparing*** *results and integrate learning from past assessment and evaluation into program design for any significant changes in program design etc.*

Reaching the ***recommendations*** *for supply chain system strengthening.*

7.11 Monthly progress review meetings

Monitoring is a continuous process and different approaches for monitoring are adopted for this purpose. One of the important strategies is to hold monthly meetings of the relevant staff. This is a routine practice in the department of health and vertical programs and includes the field staff at provincial and district levels on a monthly and quarterly basis. These meetings not only provide an opportunity to field staff to interact with the higher authorities but also provide a forum for performance review.

The agenda of monthly review meetings must be clearly defined and must be objective to maximize the output of this activity. Some of the agenda points may be the review of the implementation status of decisions taken in earlier monthly meetings, periodic performance review, a compilation of reports during intra- and inter-district meetings, providing feedback, and conveying instructions and distribution of commodities and supplies.

Review of logistics data reports must be an essential agenda point for these meetings. The district-level managers must ensure the recording of meetings minutes and sharing of these minutes with participants and relevant authorities within the district. A simplified template may be used for recording the minutes of the meeting.

N.B. This is an online module for recording and generating meetings minutes which is available in LMIS implemented at the provincial and district levels. The MIS operator of the district must enter the minutes of the meetings in the meeting module. As soon as the MIS operator enters the minutes of the meeting in this module, the minutes will be shared with all the relevant staff with authorized access to WMS and LMIS.

7.12 Monitoring, Evaluation and Learning Cycle

It is very crucial to ensure that trained staff are available at all levels of the supply chain level to perform their designated duties. As the availability of trained personnel is crucial to commodity security, which in turn is a mandatory pre-requisite for uninterrupted service delivery by respective departments and programs.

Each staff member performs a specific function about the establishment of a smooth supply chain system in their jurisdiction. Some of the staff members will be assigned to compile and analyze the

logistics data from the health facilities at regular intervals and others may be involved with the storage and distribution of supplies. Hence each staff member needs to fully understand their roles and must be capable to perform the assigned function.

It is evident from the table given above that each staff member has a defined role and there is a set of skills required to perform that role efficiently. It is the responsibility of the managers to assess the training needs and ensure the capacity building of staff. The capacity building can be conducted through formal training sessions and workshops, informal training during monthly review meetings, and on the job training during supportive supervision field visits.

Table 14: Job Description of District and Subdistrict Level Supply Chain Staff

Level	Designation	Responsibilities related to Supply Chain Management	Capacities required
Provincial	Director Program and Program Management Unit (PMU) Team	- Ensure appropriate product selection - Conduct FASP, quantification of the selected product for procurement - Ensure procurement of the selected product in required quantities - Establish standard warehouse facility to accommodate all the procured quantities - Ensure timely and rationalized distribution of commodities to the district stores and health facilities - Ensure availability of standard inventory records - Capacity building, M&E and generating technical reports	- Understanding of basic principles of product selection, FASP and Quantification - Understanding of public procurement rules - Understanding of best practices for storage and distribution of different commodities - Understanding of latest logistics management information systems (LMIS) - Understanding of basic principles of M&E, training need assessment protocols, and best practices for generating actionable information for rationalized decision making
District	DHO /T.B /Malaria/AIDS focal person	- Arrangement of commodities - Analysis of consolidated logistics data and reports of the district to assess stock sufficiency in the district - Conduct desk and field monitoring - Providing feedback - Capacity building of the staff - Conducting monthly review meetings	- Understanding of procurement rules and regulations - Understanding of data quality assurance elements - Understanding of standard monitoring procedures and protocols - Skills to operate LMIS independently - Data analysis skills - Training skills
District	District storekeeper/EPI Store Incharges	- Ensure implementation of standard warehousing and storage practices - Inventory management - Maintaining stock ledgers - Capacity Building of Tehsil and health facility level storekeepers - Monitoring of district and sub-district level stores	- Understanding of best storage practices - Inventory management skills - Training skills - Understanding of standard monitoring procedures and protocols - Understanding of MIS
District	District MIS operators	- Compilation of monthly reports shared by health facilities - Ensure visibility of logistics data through MIS - Training of MIS operators working at sub-district level stores and health facilities	- Hands-on experience in operating MIS - Training skills

Health Facility	The health facility in charge	- Ensure timely submission of monthly stock status reports - Monitoring of store located within the health facility for best storage practices and inventory management - Regular review of stock status of commodities available in the store - Capacity building of the staff on the best storage and inventory management practices	- Understanding of data quality assurance elements - Understanding of standard monitoring procedures and protocols - Skills to operate LMIS independently - Data analysis skills - Training skills
Sub-District Level (Tehsils and Health Facilities)	Sub-district level storekeepers	- Ensure implementation of standard warehousing/ storage practices - Inventory management (Receiving supplies from the district store and issue to the clients) - Maintaining stock ledgers - Ensure timely requisition of supplies	- Understanding of best storage practices - Inventory management skills - Understanding of MIS
Sub-District Level MIS Operator	Data entry operators	- Generation of monthly reports for the respective store and health facility - Ensure visibility of logistics data through MIS	- Hands-on experience in operating MIS

All key monitoring activities can be summarized as depicted in table 6.

Table 15: Best Practices of Monitoring and Evaluation

Monitoring Activity	Details	Purpose	Frequency	Tool	Responsible
Performance tracking and reporting	Tracking and reporting of supply chain KPIs related to stock status (stockouts, over or adequate levels)	To ensure commodity availability and security at district and SDP levels	Quarterly and need-based	MIS dashboards and stock summary reports	MIS operator and storekeeper
Data quality assessment and validation visits	Random data quality assessment visits to ensure data validity, accuracy and timelines	To promote data analysis decision making through the availability of quality data	Monthly (visits to 5% of SDPs through purposive sampling)	Field monitoring visit tool	DHO staff
Monthly Progress review meeting	Progress review meetings to be conducted with district and health facilities staff to discuss and review performance	To improve overall performance and coordination among the team	Monthly	Minutes of Meeting	DHO and Facilities Staff
Capacity building on data use and analysis	Capacity building of storekeepers and MIS operator through refreshers, workshops and training on the utilizing of data using different analysis	To enhance capacities of the existing workforce to use data statistics for data-driven decision making and preemptive action to perform in a more efficient way	Need-based	Certificate of training	DHO and Facilities Staff

7.13 Logistics Monitoring Tool for District Store

Logistics Monitoring Tool for District Store

Name of Storage Facility: _____	District: _____
Department: _____	Facility Type: _____
Visit Date: _____	Monitoring Officer: _____
Name of facility In-charge: _____	Name of store-keeper: _____
Name of LMIS Operator: _____	Date / Year of training received: _____

SECTION A: HUMAN RESOURCE			
	Data entry operator Observe if the DEO is:	*Observation*	*Comment*
1	Able to log into the system independently. (User name and password)	☐ Yes ☐ No	
2	Able to browse through the application independently.	☐ Yes ☐ No	
3	Able to enter consumption data independently.	☐ Yes ☐ No	
4	Able to validate data from the system and stock register independently.	☐ Yes ☐ No	
5	Ask about the support mechanism to use LMIS? (If yes, name the concerned support person)	☐ Yes ☐ No	
NOTES (OPTIONAL):			

SECTION B: STORAGE CONDITION			
	Storage	*Observation*	*Comment*
1	Is there adequate space available for the storage of commodities?	☐ Yes ☐ No	
2	Is storage space cleaned properly?	☐ Yes ☐ No	
3	Direct sunlight observed	☐ Yes ☐ No	
4	Pallets available	☐ Yes ☐ No	

5	Good cross ventilation	☐ Yes ☐ No	
6	Cold chain available with electricity backup i.e. Generator/Solar etc.	☐ Yes ☐ No	
7	Frozen Ice Packs present for emergency situation	☐ Yes ☐ No	
8	Thermometer hanged on wall and temperature chart maintained	☐ Yes ☐ No	
9	Thermometer/data logger placed in cold chain and temperature chart maintained	☐ Yes ☐ No	
10	Supplies properly stacked*	☐ Yes ☐ No	
11	FEFO** methodology followed; due consideration given to VVM in case of vaccines/cold chain items	☐ Yes ☐ No	
NOTES (OPTIONAL):			
Explanatory Notes: **Placed the commodities in an orderly manner i.e. bottles/pack/carton placed as per direction mentioned and their batch number and expiry visible from the front* ***First Expiry First Out*			

SECTION C: INVENTORY CONTROL (BASED ON OBSERVATIONS OF BIN CARDS/STOCK CARDS AND LMIS FORMS)			
Inventory		*Observation*	*Comment*
1	Are bin cards used?	☐ Yes ☐ No	
2	If yes, entries are proper	☐ Yes ☐ No	
3	FEFO methodology followed, due consideration given to VVM	☐ Yes ☐ No	
4	Is the stock register maintained to date according to prescribed procedures?	☐ Yes ☐ No	
5	Issue/receipt vouchers files are maintained?	☐ Yes ☐ No	
6	Do the supplies match with the quantities received from Central/ Provincial/ district store/ Donor? (compare Monthly Report with Requisition)	☐ Yes ☐ No	
7	Are the monthly inventory reports being prepared and submitted regularly?	☐ Yes ☐ No	
8	Are the commodities received regularly and from where (Provincial store/ Central warehouse)?	☐ Yes ☐ No	
9	What is the mechanism of commodity distribution?	☐ Yes ☐ No	
10	Is there any product stock out during the last three months?	☐ Yes ☐ No	

11	Is requisition sent for resupply of commodities on a monthly/quarterly basis as per prescribed procedure? (as per Contraceptive Logistic Manual)	☐ Yes ☐ No	
12	Does the physical stock count of commodities confirm quantity in the inventory record? On the date of visit*	☐ Yes ☐ No	

NOTES (OPTIONAL):

Explanatory Notes:

**Verification of actual stock present in-store/warehouse with stock register*

SECTION D: QUANTITIES OF STOCK OBSERVED ON THE DATE OF INSPECTION

Sr. #	*Name of the item*	*Quantity available in the stock register*	*Quantities physically verified*	*Average monthly consumption (AMC)*	*Sufficiency in number of months (MOS)*	*Comments*
1	ABC					
2	XYZ					

SECTION E: COMPARISON OF LMIS WITH STOCK REGISTER AND MONTHLY REPORT DATA

(In each box write the value listed) *Month/Year:*

Sr. #	*Product*	*Stock Register Data*		*Monthly Report*		*LMIS*		*Remarks*
		Opening Balance	*Closing Balance*	*Opening Balance*	*Closing Balance*	*Opening Balance*	*Closing Balance*	
1	ABC							
2	XYZ							

SECTION F: OBSERVATIONS, ACTIONS AND RECOMMENDATIONS:

Section	*Major observations/issues*	*Action taken/recommendation*
Human Resource Issues		
Training Needs		
Storage Conditions		

Inventory Management		
Use of LMIS		
Data Quality		
Any other		

FINDINGS:	
1	
2	
3	
RECOMMENDATIONS:	
1	
2	
3	

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