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**Diploma in Pharmacy 2<sup>nd</sup> Year**  
**Hospital & Clinical Pharmacy**  
**Chapter 3 : Supply Chain and Inventory Control**

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# HOSPITAL & CLINICAL PHARMACY

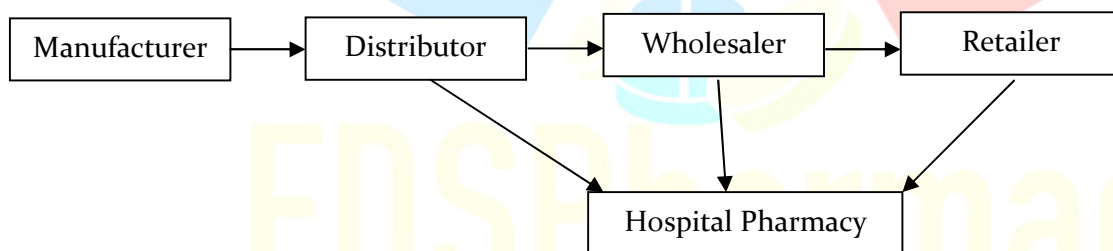
## Chapter 3

### Supply Chain and Inventory Control

## SUPPLY CHAIN

- Pharmaceutical supply chain is the link through which prescription medicines are manufactured and delivered to patients.
- Supply chain network is highly complex, requiring a number of steps that need to be taken to make medications available for and accessible to patients.
- Multiple government agencies, hospitals, clinics, drug manufacturers, drug distributors, pharmacy chains, retailers, research organisations, and the FDA are involved in the pharmaceutical supply chain.
- This very supply chain is responsible for distributing prescription drugs, OTC medicines, generic drugs, and biologics with different handling requirements and operational objectives.

**Following Chart can help to understand the supply chain of drug to hospital Pharmacy**



## PREPARATION OF DRUG LISTS

- It is a process to categorize the drug with their generic names, strength and form.
- It is prepared by country's pharmacist, chemical and pharmaceutical staff.

### Some Drug lists :

- High Risk drugs
- Emergency drugs,
- Schedule H<sub>1</sub> Drugs,
- NDPS (narcotic drugs and psychotropic substances).
- Reserve Antibiotics.

## High Risk Drugs

→ High risk drugs have an increased risk of causing significant harm to the patient if used incorrectly.

→ These medicines include :

- Medicines with a low therapeutic index.
- Medicines posing a high risk when administered through the wrong route or when errors occur in other system

### High Risk Drugs list

1) adrenergic agonists IV ( Epinephrine , norepinephrine , )
2) adrenergic antagonists IV ( propranolol , prazosin , atenolol )
3) anaesthetic agents ( general ) inhaled and IV ,( Ketamine , propofol
4) anti Arrhythmic agents ( lidocaine , procainamide ) .
5) antithrombotic agent ( anticoagulants) : heparin , argatroban
6) Hypoglycemic Agents ( metfomin . )
7) sedative agents ( alprazolam , diazepam )
8) narcotic drugs : Codeine , morphine
9) neuromuscular blocking agents : succinylcholine
10) Insulin IV and subcutaneous .

## Emergency Drugs

→ Emergency drugs are essential to meet the immediate therapeutic needs of patients and which are not available from any other approved source in required time to prevent risk or harm to patients.

Or

- These are the drugs which may be required immediately in emergency conditions to prevent the risk or harm to patients and can save their life,
- These drugs have onset of action , and are administered by such route which facilitate onset of action like : Epinephrine in cardiac arrest.

1) Inj. Adrenaline	2) Inj. Lidocaine	3) Inj. Dexamethasone
4) Inj. Atropine	5) inj. Adenosine	6) Inj. Deriphyllin
7) Inj. Nor-adrenaline	8) Inj. Hydrocortisone	9) Inj. Avil
10) Inj. Calcium gluconate	11) Inj. Vasopressin	12) Inj. Diclofenac
13) Inj. Sodium bicarbonate	14) Inj. Midazolam	15) Inj. Ethamsylate
16) Inj. Amiodarone 25% Dextrose	17) Inj. Naloxone	18) Inj. Flumazenil
19) Inj. Nitroglycerin	20) Inj. Diazepam	21) Inj. Potassium chloride
22) Inj. Succinyl choline	23) Inj. Paracetamol	24) Inj. Digoxin
25) Inj. Dopamine	26) Inj. Methylprednisolone	27) Inj. PAM
28) Inj. Dobutamine	29) Inj. Heparin	30) Inj. Mephentermine
31) Inj. Lasix	32) Inj. Aminophylline	33) Inj. Phenergan

## Schedule H, Drugs

→ Schedule H, drugs comprise of sensitive antibiotics, habit-forming medications, and drugs with severe side effects if used without supervision and prescription of a registered medical practitioner.

Or

- These are the sensitive antibiotics and habit forming drugs , which are not allowed to sale or distribute without a prescription of a registered Physician or pharmacist.
- This Schedule was implemented to rigorously regulate the medications that were included for the general public welfare.

1) Alprazolam	2) Ceftibuten	3) Feropenam
4) Balofloxacin	5) Ceftizoxime	6) Gemifloxacin
7) Buprenorphine	8) Ceftriaxone	9) Imipenem
10) Capreomycin	11) Chlordiazepoxide	12) Isoniazid
13) Cefdinir	14) Clofazimine	15) Levofloxacin
16) Cefditoren	17) Sodium codeine	18) Meropenem
19) Cefepime	20) Cycloserine	21) Midazolam
22) Cefetamet	23) Diazepam	24) Moxifloxacin
25) Cefixime	26) Diphenoxylate	27) Nitrazepam
28) Cefoperazone	29) Doripenem	30) Para-aminosalicylat
31) Cefotaxime	32) Ertapenem	33) Pentazocine
34) Cefpirome	35) Ethambutol	36) Prulifloxacin
37) Cefpodoxime	38) Hydrochloride	39) Pyrazinamide
40) Ceftazidime	41) Ethionamide	42) Rifabutin
43) Rifampicin	44) Sparfloxacin	45) Thiacetazonedol
46) Tramadol	47) Zolpidem	

## NDPS ( Narcotic drugs And Psychotropic substances )

- Narcotic Drugs : The opioids and their derivatives are called narcotic drugs .
- Psychotropic substances : psychotropic substances are chemical substances which change the function of nervous system , and alter the mood , perception , consciousness like alcohol , marijuana , nicotine .
- The NDPS Act, 1985 forbids cultivation, production, possession, sale, purchase, trade, use and consumption of narcotic drugs and psychotropic substances, except for medical and scientific purposes under license.

### NDPS Drugs

- Alprazolam,
- Amfepramone,
- Barbitol,
- Benzphetamine,
- Bromazepam,
- Camazepam,
- Chlordiazepoxide,
- Clobazam.
- Clonazepam,
- Clorazepate,
- Clotiazepam,
- Cloxazolam,
- Delorazepam,
- Diazepam,
- Estazolam,
- Ethchlorvynol,
- Ethinamate,
- Ethylflazepate,
- Fludiazepam,
- Flunitrazepam,
- Flurazepam,
- Halazepam,
- Haloxazolam,
- Ketazolam,
- Lefetamine,
- Loprazolam,
- Lorazepam,
- Mazindol, etc



## Reserved Antibiotics

→ The reserved antibiotics are those antibiotics which are reserved for the treatment of suspected or diagnosed infection caused by multi-resistant organism, and they are used when all other antibiotics have failed.

1. Aztreonam
2. Carumonam
3. Colistin (Oral)
4. Ceftaroline
5. Cefiderocol
6. Ceftobiprole
7. Ceftazidime + Avibactam
8. Ceftolozane + Tazobactam
9. Colistin (Injection)
10. Dalbavancin
11. Dalfopristin + Quinupristin
12. Eravacycline
13. Fosfomycin (Injection)
14. Imipenem + Cilastatin + Relebactam
15. linezolid
16. Minocycline (Injection)
17. Oritavancin
- 18) Polymyxin B (Injection)
18. Tedizolid
19. Daptomycin
20. Faropenem
21. Iclaprim
22. lefamulin
23. Meropenem + Vaborbactam
24. Omadacycline
25. Plazomicin
26. Polymyxin B (Oral)
27. Telavancin
28. Tigecycline

# Procedure of Drug Purchases

- **Drug Purchase** : means to obtain or get different types of medicines from external network.  
→ Or
- Purchasing means to gain different types of medicines from the external network.
- It is a routine function of any pharmaceutical company, and it also represents as one of the tactical avenues of the company.
- It is very essential for a pharmaceutical company to maintain a proper inventory of different medicines in the drug store and it should also ensure that these medicines are available to the pharmacists at affordable prices.

## Purchase Procedure

Following steps are involved in the purchase procedure:

### 1) purchase request form / Purchase requisition :

- The pharmacist prepares the drug list to be buy and fills purchase request form.
- This form provides information regarding required drugs , their quality and quantity.
- This form will be sent to administration for approval , after approval it will sent to purchasing officer.

### 2) Quotation Invitation :

- Now the Purchasing officer send this form to different suppliers and ask their quotations.

### 3) Purchase form :

- The purchasing officer check all the quotations and select suppliers on the price , quality etc. and place the purchase orders.

### 4) Receipt of good products :

- When the ordered products delivered to the purchasing department , their quality , quantity and prices are checked . If the any product miss the desired quality , quantity ,or price they should retuned to supplier.

### 5) Payment :

- After satisfactory completion all these process , the purchasing officer pay the amount to the suppliers.



## Tender/e-Tender Process

- It is a process in which a person or organisation, who need goods / services etc. invites the other parties to submit a proposal to provide their goods or services.
  - Or
- Tender is the process in which hospital invites bids for drugs that should be submitted within the given time limit.
- Tenders are advertised to offer opportunities to a different supplier, facilitate competition, and ensure availability of greater offers to select forms.

### Tender process includes the following steps :

1. Tenders are invited from various suppliers.
2. Suppliers send the tenders in sealed envelope before the due date.
3. Tenders are opened on due date and time in the presence of representatives of suppliers.
4. Purchase officers from the received tenders prepare a comparative statement.
5. Order is placed to the supplier which has quoted lowest rate. However, quality, supply period, other expenses like freight, sale tax, packaging and forwarding charges should also be considered.

### E-Tender

- E-tender is the process in which tenders are sent and received by electronic means, instead of old paper-based technique.

## INVENTORY CONTROL

- **Inventory** : All the items, goods, materials and manufactured product a company have for sell is called Inventory.
- **inventory Control** : Inventory control is a process of maintaining a business stock level to fulfill the customer's demand and to minimize cost.

### Inventory control techniques

- 1) **ABC analysis** : It is a inventory management technique that determine the value of inventory items on the basis of their importance to the business .
- 2) **VED Analysis** : It is also an inventory management strategy that classifies the materials according to their importance

		No. Goods	Expenses	Rs	Need of care
V. Vital	A	10%	70%	70 Rs	Good care, Good Storage, Evaluation
E.Essensial	B	20%	20%	20 Rs	General care ,general storage no evaluation
D. Desirable	C	70%	10%	10 Rs	No care, no storage , no evaluation

ABC = Always Better Good

**3) Economy Order Quantity (EOQ) :** It is a method to purchase appropriate quantity of raw material for manufacturing at one time , to minimize ordering and caring cost .

**Ordering Cost :** It includes all those expenses are related to ordering , like traveling cost expenses during traveling etc .

**Caring Cost :** It includes all those expenses are related to goods like transportation charge , insurance , room rent , storage expenses etc.

Formula  $EOQ = \sqrt{\frac{2 \times A.D. \times O.C.}{C.C.}}$  A. D. = annual demand , O.C.= ordering cost  
C.C . = Caring Cost

### Key Points of inventory Control :

- Minimum level of stock
- Maximum level of Stock
- Average requirement
- Dangerous level of stock
- Re-ordering Quantity .

### Lead Time

- It denote the time gap up between placement of an order and its delivered time .

### Reorder Quantity Level :

- ❖ It is a process of inventory control , when the level of stock material reach at specific level , then new order is placed to maintain stock level .
- ❖ Reordering Level = maximum consumption x maximum reorder period

### Inventory Turnover :

- It means how many times an inventory of a company is sold or used in a particular time period.
- It is calculated to see if a business has an excessive inventory in comparison to its sales.

Inventory Turnover  $\frac{\text{cost of goods sold}}{\text{average inventory}}$

## Cost of goods sold :

- It is the value of goods sold during a particular time period.
- Average Inventory : It is a estimated value of goods used in a specific time periods . it includes total amount of raw material and products are manufactured.

$$\text{Average Turnover} = \frac{\text{beginning inventory} + \text{Ending inventory}}{2}$$

$$\text{Inventory Turnover} = \frac{\text{cost of goods sold ( 50 cr )}}{\text{average inventory (3 cr )}}$$
$$\frac{50 \text{ cr}}{3 \text{ cr}} = 16.66 \text{ times}$$

It means a company has sold its inventory 16.66 times in last year .

## INVENTORY MANAGEMENT OF CENTRAL DRUG STORE

### Inventory Management :

- It is a process in which different types of actions are taken place like ordering , storing , using , and selling a company 's inventory.
- It has a record of each new and returned product enters in warehouse or out from here.

### Some key points of Inventory management :

- ◇ Storage conditions
- ◇ FIFO , FEFO methods
- ◇ Expiry drug removal
- ◇ Documentation

# Storage Conditions

Considering protection , drugs are kept in the storage room under different conditions like in different temperature , darkness , dryness . various Storage conditions on the basis of temperature :

## 1) Room Temperature :

- Majority of pharmaceuticals are stored at room temperature , room temperature is considered between 20-25 ° C

## 2) Cool Storage Condition :

- It defined between 8-15 ° C , Antibiotics and hormone etc are stored in this temperature .

## 3) Cold Storage condition :

- It is defined between 2-8 ° C , Vitamins , Vaccines etc are stored in this temperature .

## 4) Fridge Storage condition :

- It is defined between - 4 to 2 ° C , Insulin and some types of eye drops etc. are stored in this temperature .

## Methods of Storage

→ All the medicines must be stored according to the guidelines are provided on the label . like that storage instructions should be provided on label .

### Storage of Tablets

- Store in a cool and dry place , protected from light and moisture .

### Storage of Capsule

- Store in a cool and dry place , protected from light and moisture

### Storage of Emulsion

- It needs to be protected from light , stored in cool and well closed container .

### Storage of Suspension

- Store in cool and dry place protect from heat and light .

### Storage of Ointment

- It needs to be protected from light and heat , stored in cool and well closed container .

### Storage of Syrup

- Store in cool and dry place protect from heat and light .

### Storage of Injection

- Store below 25 ° C , protect from light .

## Distribution of Drug

- It means providing drugs to the patients , they may of two types in hospital .
  - ▲ Indoor or In- patients,
  - ▲ Outdoor or Out-patients.

## Maintaining Cold chain

- It means to provide 2-8 ° C temperature to any product like vaccines , during manufacturing , storing , transporting ,and distribution , to maintain their potency .

## Devices Used for Cold Storage :

- ❖ Refrigerator
- ❖ Thermometer which indicate the temperature level .
- ❖ Cold boxes for storage and transportation .
- ❖ Ice packs

## ILRs ( Ice lined Refrigerator )

- Ice lined refrigerator is a type of refrigerator which has an extra function where cold ice water , or ice packs are filled . they maintain the inside temperature at a safe level in case of electricity fails.

## Walk In Cold Rooms ( WIC )

- Walk- in cold room is a cold storage condition on a large scale and it provide a constant an comfortable temperature throughout the space.

## FIFO and FEFO

- **FIFO** : Means First In, First Out It is a method in which the product came first in the warehouse is taken out first , to avoid expiration.
- **FEFO** : It means First Expire, First Out . In this method the products whose expiry is closest are out first , to avoid expiration.

# Expiry Drug Removal and Handling and Disposal

## Expiry

- There is a time period and condition in which a drug is good for use , and ending this time period or missing the specific condition ( temperature , darkness ) in which a drug is good , called Expiry .

## Removal and Handling of expired Drugs

- ➔ It is a process of store management to remove the expired drugs from store and to handle properly so that they should not be given to use .
- ➔ Following actions can be taken for handling expired drugs
  - ▲ The expired drugs must be separated from usable drugs .
  - ▲ Where these drugs are kept , there should be a notice like " out of Use "
  - ▲ The expired drugs must be destroyed as recommendation of local waste management .

## Disposal of Expiry

- ➔ Drugs Disposal of expiry drugs means destroying the expired drugs so they can not used .
  - ➔ Disposal methods recommended by the International Authorities
1. **Returning to the Manufacturing :** The Manufacturer has good disposal method at its disposal .
  2. **landfill :** This is the oldest and best way for disposal of solid waste ,In this method the waste materials are placed into land . The municipal waste should be used to cover this site .
  3. **Waste Immobilisation ( Encapsulation ) :** In this method , the pharmaceuticals are packed in a plastic or steel drum , solid and semi solid materials are filled 75 % of drum , then mixture of lime , cement and water in 15: 15: 5 ratio is filled , then mouth of drum sealed and placed in landfill and cover with municipal solid waste .
  4. **Sewer :** Syrups and IV fluids are diluted with water and flushed into sewer , in small quantity , over a time period .
  5. **Incineration :** In this methods the waste material are given high temperature heat to be destroyed .
  6. **Chemical Disposal :** In this chemicals are used to destroy the expired drugs .

## Disposal of Narcotics

- ➔ Narcotics drugs should be disposed in supervision of a pharmacist or the police , and public should not be allowed to prevent abuse .

## Narcotic Drug Disposal Methods

- Waste encapsulation
- Waste inertisation
- Incineration

# Disposal of Cytotoxic Drugs

→ Cytotoxic waste is associated with cytotoxic drugs, containing chemicals that are toxic to cells. This includes materials, equipment, and residue contaminated with cytotoxic drugs. Cytotoxic drugs (or anti-neoplastics) are administered to cancer and multiple sclerosis patients to prevent cell multiplication and growth.

## Types of Cytotoxic Wastes

- Syringes
- Vials
- Needles
- Gloves
- Personal clothing and equipment
- Respirator masks
- Air filters

## Disposal Methods for Cytotoxic Drugs

- Return to supplier
- Incineration at high temperature
- Waste encapsulation

# Documents for Inventory Control

Inventory Control includes the following documents

- Stock Requisition (SR)
- Pick and Issue (PI)
- Issue Confirmation (CI)
- Over the Counter (OC)
- Stock Return (SN)
- Inventory Adjustment (IA)
- Physical Inventory Purchase Input (IP)
- Stock Transfer Issue (TI)

## Stock Requisition (SR)

- ▲ Reserves quantities of stock items from an on-hand supply for later delivery.
- ▲ This reduces the available quantity.
- ▲ If items are not immediately available, they may be backordered and later filled by having the Backorder Servicing program run.

## **Pick and Issue (PI)**

- ◆ Schedules previously reserved items to be picked up for delivery and releases them from a reserved status. This function is performed by creating a Pick Ticket Report (IN8o).
- ◆ From this report, the warehouse can determine the stock item, the quantity, and the bin number of the items that are to be picked up.
- ◆ It also creates the corresponding Issue Confirmation (CI) document.

## **Stock Issue Confirmation (CI)**

- Confirms to the system that previously reserved and released items have been issued from the warehouse to the buyer.
- The on-hand quantity of the warehouse for this item is reduced by the amount issued.

## **Over the Counter (OC)**

- Issues requested items directly from the on-hand quantity. As the items are issued immediately upon request, in effect, "over-the-counter," backordering is not allowed.
- Once an "Over the Counter" transaction is successfully completed, an Over the Counter Issued Report will be produced, identifying the requestor and the stock items issued.

## **Stock Return (SN)**

- ⇒ Allows the original buyer to return previously issued items. At the option of the issuing warehouse, a return charge may be imposed.

## **Inventory Adjustment (IA)**

- ❖ Allows warehouse management to adjust quantities or unit values of on-hand items due to a change in on-hand quantities or unit costs.
- ❖ These adjustments alter inventory and cost of goods expense balances.

## **Physical Inventory Purchase Input (IP)**

- Allows warehouse management to adjust quantities of on-hand items due to a change in on-hand quantities at a specified unit costs.
- These adjustments alter inventory and cost of goods expense balances.

## **Stock Transfer Issue (TI)**

- ◆ Initiates the transfer of items from one warehouse to another.

## **Stock Transfer Receipt (TR)**

- Recognizes the receipt of transfer items by the receiving warehouse. On-hand quantities of receiving/issuing warehouses are adjusted



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