Revised

GUIDELINES FOR

GOOD STORAGE PRACTICES

IN MEDICAL STORES

AND HOSPITALS

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Contributers - Revised Edition

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I. DEFINITIONS AND CONCEPTS

Storage: The term used to describe the safe keeping of starting materials, packaging materials, components received semi-finished, in-process and finished products awaiting dispatch. The term is also applied for safe keeping of materials and drug products in drug stores, pharmacies, hospitals, etc., under the specified conditions.

Storage Conditions: The conditions specified for storing the product e.g. temperature, humidity, container, etc.

Quality: The ability of a drug product to satisfy the users need.

Quality Control Unit: Means any person or organizational element designated to be responsible for the duties relating to quality control.

Material: A term used to cover stating materials, intermediate products, packaging materials and components and finished products.

Starting Material: Any substance used in the manufacture of a medicinal product excluding packaging materials.

Intermediate Product: A partly processed material which must undergo further processing before it becomes a finished product.

Dosage Form: Refers to the gross physical form in which a drug is administered to or used by a patient.

Drug Product: A dosage form containing one or more active therapeutic ingredients along with other substances included during the manufacturing process.

Packaging Material: Any material used in the packaging of a product. It does not normally include the outer packaging or transit cases used for departmental transportation or shipment of orders.

a) *Primary Packaging Material*: A packaging material which is in direct contact with medicinal product.

b) *Printed Packaging Material*: A packaging material which is imprinted with a text.

Finished Product: A medicinal product which has completed all stages of manufacture, including packaging.

Batch: A specific quantity of a drug and/or other material that is intended to have uniform character and quality, within specified limits, and is produced according to a single manufacturing order during the same cycle of manufacture.

Lot: A batch, or a specific identified portion of a batch, having uniform character and quality within specified limits, or, in the case of a drug product produced by continuous process. It is a specific identified amount produced in a unit of time or quantity in a manner that assures its

having uniform character and quality within specified limits.

Lot Number (Control Number or Batch Number): Any distinctive combination of letters, numbers, or symbols, or any combination of them, from which the complete history of the manufacture, processing, packing, holding, and distribution of a batch or lot of drug product or other material can be determined

Manufacture, Processing, Packing or Holding of a Drug Product: includes packaging and labeling operations, testing, and quality control of drug products.

Component: Any ingredient intended for use in the manufacture of a drug product.

Active Ingredient: Any component that is intended to furnish pharmacological activity or other direct effect in the diagnosis, cure, mitigation, treatment, or prevention of disease, or to affect the structure of function of the body of man or other animals.

Inactive Ingredient: Any component other than an "active ingredient".

In-Process Material: Any material fabricated, compounded, blended, or derived by chemical reaction that is produced for, and used in the preparation of the drug product.

Strength:

i. The concentration of the drug substance (for example weight/weight, weight/volume, or unit dose/volume basis) and/or

ii. The potency, that is, the therapeutic activity of the drug product as indicated by appropriate laboratory tests or by adequately developed and controlled clinical data (expressed, for example, in terms of units by reference to a standard).

Stability: The degree of resistance to chemical and physical changes. The efficacy of the preparation must remain constant (or change only within the limits specified by legal provisions) until the date of expiration.

a) *Chemical Stability*: The components making up the preparation should remain chemically unchanged, that is, their change should be within the specified limits.

b) *Physical stability*: The initial physical properties (shape, taste, solubility, crystalline form, disintegration time, dissolution, colloidal properties, etc.) of the pharmaceutical preparation should remain unchanged, that is, their changes should be within the specified limits.

c) *Microbiological Stability*: Sterility or resistance to the growth of microorganisms should remain unchanged. During storage, the efficacy of preservatives should change only within the specified limits.

d) *Therapeutic Stability*: The therapeutic effect of the pharmaceutical preparation should remain unchanged.

e) *Toxicological Stability*: There must be no significant change in the toxicity of the pharmaceutical preparation.

Expiration Date: The date placed on the immediate container label of a drug product that designates the date through which the product is expected to remain within specifications. If the expiration date includes only a month and a year, it is expected that the product will meet specifications through the last day of the month. Kinetically it is the time required for 10% of the material to disappear.

Expiration Dating Period: The interval of time that a drug product is expected to remain within specifications as detonated from stability studies on a limited number of batches of the product. The expiration dating period is used to establish the expiration date of individual batches.

Accelerated Testing: (**Stress Testing**): Studies designed to increase the rate of chemical or physical degradation of a drug substance or drug product by using exaggerated storage conditions. The purpose is to determine kinetic parameters, if possible, and/or to predict the tentative expiration dating period.

Stability Indicating Assay: The assay which is sensitive and selective to determine quantitatively the active ingredient in the presence of its decomposition products.

Shelf-Stability: The stability of the drug or drug product at ambient room temperature (15 - 35° C)

Overage: The excess quantity of drug that must be added to the preparation to maintain at least 100% of the labeled amount during the expected shelf-life of the drug.

Temperature Control: All following temperatures in Degrees Celsius.

Cold Place: The temperature does not exceed 8° C.

Refrigerator: The temperature is thermostatically controlled between 2° and 8° C.

Freezer: The temperature is thermostatically controlled to no higher than -10° C.

Cool Place: The temperature is between 8° and 15° C.

Warm Place: Any temperature between 30° and 40° C.

Room Temperature: The temperature is between 15° and 30° C.

Excessive Heat: Any temperature above 40° C.

Extreme Temperature Fluctuations: The packaged drug product should be cycled through temperature conditions that simulate the changes that may be encountered once the drug product is in distribution.

Storage Temperatures: The actual storage temperatures (numerical) used during stability studies should be specified.

Extremes of Temperature and Humidity in Pharmacy: Temperature above 40 ° and RH above 70% are

considered to be the extremes of temperature and humidity respectively.

II. PREMISES AND FACILITIES

Premises and other areas to be utilized for storage purposes should comply with the prescribed minimum standards. They should be located, constructed, serviced and maintained so as to protect the stored materials, from all potentially harmful influences such as undue variations of temperature and humidity; dust and odor; entry of animals vermin and insects.

Basic Requirements

Facilities must be provided for:

1. The safe and orderly receipt or dispatch of all materials, products or components.
2. The safe sampling and cleaning of any incoming materials to prevent contaminating the areas of other material.
3. Sufficient separation or segregation of pharmaceuticals, veterinary, food products, chemicals, disinfectants and cleaning materials to eliminate the risk of unacceptable chemical or organoleptic cross contamination.
4. The safe storage of hazardous materials (pressurized gases, flammable solvents and explosive materials).
5. The storage of temperature-sensitive materials as appropriate in deep freezes, cold rooms or air conditioned areas.

6. The storage of cleaning equipment and materials
7. Appropriate personnel service facilities such as toilets, etc.
8. The safe charging of powered forklifts and trucks
9. Secure storage of any controlled drugs (e.g. drugs of addictions, narcotics)
10. The separation or segregation of reception and dispatch facilities
11. Effective lighting permitting all operations to be carried out accurately and safely.
12. The safe storage of materials requiring dry or humidity controlled conditions.
13. Racking and shelving must conform to the requirements of the Good Manufacturing Practice (GMP).
14. Maximum safe working loads should be displayed.
15. To allow access for cleaning and to avoid harboring pests, racking should be positioned at least 0.5 m form the walls of the warehouse and the bottom layer of pallets should be supported at least 0.3 m above the floor.
16. Forklift trucks should be provided with overhead protection against falling objects, and if used frequently in the open, weather protection and lighting.
17. Only electric powered (or hand operated) trucks should be used in enclosed spaces. Diesel powered Trucks should be avoided to decrease contamination

18. Adequate washing facilities should be provided, including hot and cold water, soap or detergent, air driers or single service towels, and clean toilet facilities easily accessible to working areas.

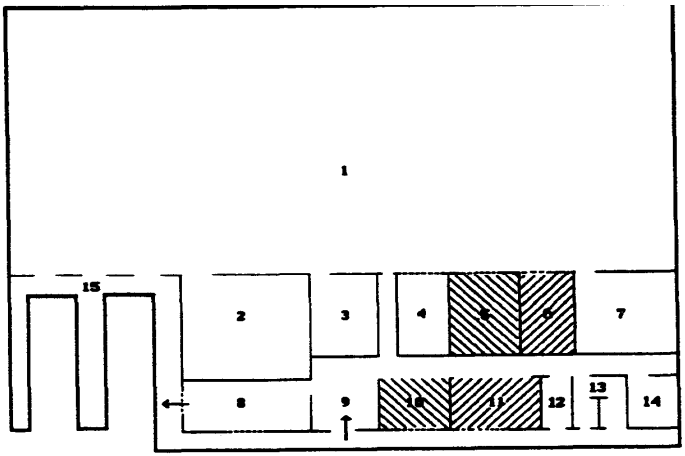

Fig. (1) Sample Warehouse Layout

1. **Main Storage Area.**
2. **Repackaging.**
3. **Cold Room.**
4. **Warehouse Director.**
5. **Procurement Office.**
6. **Director of Supply (Logistics).**
7. **Flammable Substances.**
8. **Shipping and Receiving.**
9. **Reception Area.**
10. **Records and Inventory Control.**
11. **Stenography Clerks.**
12. **Coffee Room.**
13. **Toilets.**
14. **Controlled Substances.**
15. **Main Entrance and Loading Docks.**

Sanitation

GMP Regulations require:

1. Any building used in the manufacture, processing, packing, or holding of a drug product shall be maintained in a clean and sanitary condition. Any such building shall be free of infestation by rodents, birds, insects, and other vermin. Trash and organic waste matter shall be held and disposed in a timely and sanitary manner.

2. There shall be written procedures assigning responsibility for sanitation and describing in sufficient detail the cleaning schedules, methods, equipment, and materials to be used in cleaning the buildings and facilities. Such written procedures shall be followed.

3. There shall be written procedures for use of suitable rodenticides, insecticides, fungicides, fumigating agents, and cleaning and sanitizing agents. Such written procedures shall be designed to prevent the contamination of equipment, components, drug product containers, closures, packaging, labeling materials, or drug products, and shall be followed.

4. Sanitation procedures shall apply to work performed by contractors or temporary employees as well as work performed by full-rime employees during the ordinary course of operations.

Housekeeping

1. Premises and surrounding areas should be in a good appearance, be well maintained and must be kept in an orderly, clean and hygienic conditions free from accumulated waste.

2. Buildings must be kept free of vermin, insects, birds and other pests. Control treatments should be carried out according to written procedures by trained personnel using proven effective and safe procedures which do not contaminate the goods being held and should cover both the interior and exterior of the building.

3. Precautions must be taken to minimize the contamination of the store by dirty, damaged or unsuitable containers.

4. Waste materials should be collected in suitable receptacles for removal to collection points outside the building and disposed of at regular and frequent intervals.

5. Floor surface should be sealed to minimize the generation of dust and to facilitate cleaning.

Fire Prevention

Accumulation of flammable trash, such as cartons and boxes, must not occur. Smokes alarms are inexpensive to install and provide warning in case fire does break out. For fire extinguishing, sprinkler systems are most effective. Their principal drawback is that if accidentally set off they may ruin some stock. A cheaper alternative is to place extinguishers suitable for chemical

fires at frequent intervals throughout storage areas, although they offer no protection unless someone is around to use them. Employing night watchmen serves the dual purpose of responding to fire alarms and protecting against theft.

Warehouse Size

The average takeoff of all clinical facilities for a given delivery interval will determine the volume to be delivered down through the system. Assume that 200 clinical facilities consume a total of 1,000 m3 during a three months interval, and that they are served by few district warehouses, each of these must be capable of holding an average of 250 m3 a piece plus room for safety stock; the central warehouse must hold at least 1,000 m3 plus safety stock.

Warehouse Site Selection

In selecting the site of the warehouse, the following points should be considered:

1. Accessibility: Road is open the year round.
2. Utilities: Site served by water and electricity.
3. Communications: Reliable telephone service.
4. Drainage: Neither site nor surrounding area subject to flooding due to direct runoff or high water table.
5. Size: Unimpaired entry and exit for large vehicles.
6. Security: Area not likely to invite intrusion or vandalism.
7. Proximity: Good access to transport links, railways, highways.

Warehouse Design

Certain points should be considered in designing warehouse (Fig. 1.), the most important are the following:

1. Easy Movement: Use one-floor layouts. Interior partitioning limits stock arrangement; if partitions are used, position walls and doors to promote easy movement.
2. Air Circulation: Use of fans and forced ventilation prolongs shelf-life and improves working conditions.
3. Bulk Storage on Pallets: This improves efficiency of stock handling; pallets are cheaper to construct than shelves and hold more stock for the amount of space they occupy; they facilitate air circulation and allow easier access to stock for cleaning.
4. Easy Maintenance: Floors should be graded and drains placed to catch runoff; provide well-spaced faucets.
5. Systematic Arrangement of Stock: Frequently used arrangements are by therapeutic/pharmacological class, clinical indications, level of service, and alphabetic sequence. Array stock in the same order that products appear on standard requisitions
6. Cold Chain Maintained: Vaccines require special cold storage arrangements. Cold rooms, refrigerators, and freezers should be protected from power cuts by backup generators.

7. Secure Storage Area for Controlled Substances: Narcotics must be stored in areas with restricted access.

8. Protected Storage Area for Flammable Substances: Ether, alcohol, and fuels are best stored in out-buildings. Otherwise the storage room should seal tightly, be well ventilated and be insulated with fireproof material.

9. Fire Prevention Measures: Do not allow trash to accumulate; provide smoke alarms, fire extinguishers and a night watchman.

Fig. (2) Temperature Requirements for vaccine storage

VACCINE	Level:	Central	Regional	Local
	Storage Time:	6-18 months	3 months	1 month
Measles **Oral Polio**		-15 °C to -25 °C		
DPT * **Tetanus *** **BCG**		+4 °C to +8 °C		

*** Never Freeze DPT or Tetanus**

III. PERSONNEL

1. Personnel who carry out supervision and/or controlling functions should possess the necessary integrity, knowledge, experience and qualification.
2. Each store should employ sufficient staff of a quality and experience appropriate with their individual responsibilities and the operations carried out.
3. Staff must be given specific authority, facilities and training to discharge their responsibilities effectively.
4. Staff should be medically examined before being employed and at such subsequent times as may be required by national authorities.
5. Before being employed an applicant's background should be investigated. Staff with convictions for theft or drug abuse should not be employed.
6. Protective clothing must be worn by persons working in warehousing areas. Safety-hats must be provided for people working within racking areas. Where staff have to work under extremes of temperature (e.g. cold room) appropriate clothing should be provided.
7. Drinking, eating and smoking must not be permitted in any part of the premises except those designated for that purpose and adequately separated from storage areas.

8. Staff must maintain high standards of personal hygiene and cleanliness. Direct contact between raw materials or products and operators hands must be avoided whenever possible.

9. The personnel should have the basic knowledge concerning.

    a. Types of materials and dosage forms to be handled.

    b. Materials that require specific storage conditions.

    c. Types of storage conditions.

    d. Types of stability (physical, chemical, microbiological, toxicological and therapeutic).

    e. Expiration date.

    f. Stress storage conditions.

    g. Sampling.

    h. Quality control and quality assurance

IV. SECURITY AND SAFETY

1. The cost of security precautions should be related to the social environment in which the facility is situated and the value and nature of the goods used. Where large or significant quantities of valuable materials are held or where theft is prevalent, 24 hour security coverage should be provided.

2. Security arrangements with respect of poisons and habit-forming drugs should at least meet the standards laid down in the relevant legislation.

3. Stock control procedures should be sufficiently tight to ensure that significant loss by theft can be detected.

4. Arrival and departure of visitors to the warehouse must be controlled. The right to inspect all persons including employees, contractor staff and visitors entering or leaving the site should be reserved and random searches should be cashed out.

5. Safety and risk reduction measures, which must include procedures for the handling, transportation, usage and disposal of highly flammable liquids, toxic and corrosive materials, must comply with the appropriate guide to be safe working.

6. Fire fighting precautions must include:

a. The training of selected staff to form a fire fighting team capable of using effectively the equipment available in the site.

b. The routine maintenance and testing of fire fighting alarms, detection systems, and sprinkler alarms.

7. Fire exits, corridors, walk-ways, doorways and other points requiring immediate access must be clearly defined and kept free from obstruction and litter. Regular fire evacuation drills must be carried out.

8. Walk-in refrigerators and similar facilities must be equipped with safety devices for operators and must not be fitted with self locking doors which cannot be opened from within. The internal light must be manually operated from within the refrigerator.

Safety controls for flammable storage areas include:

a. Electrically conductive floor.

b. Raised door sill.

c. Explosion-proof light fixtures.

d. Blow-out wall.

e. Forced draft vapor take-off.

   i. At floor level.

   ii. Near the ceiling.

f. Rate-of-temperature-rise fire alarm.

g. Fire alarm monitored at fire station or continuously manned control board.

h. Switches for lights and vapor take-off fans located outside the room.

i. Supply of safety cans for dispensing fluids.

j. Alcohol storage located in this area meets Treasury regulations.

k. Heavy safe for storage of nitro compounds and other explosives.

Operations relating to the manufacture, processing, and packing of penicillin shall be performed in facilities separate from those used for other drug products for human use.

V. STORAGE PROCEDURES AND INSTRUCTIONS

General Principles

1. Factors to be taken in consideration for proper storage
    a. Sanitation.
    b. Temperature.
    c. Light.
    d. Moisture.
    e. Ventilation.
    f. Segregation.
2. Materials must be stored under conditions which minimize deterioration, contamination, or damage. They must be stored under conditions compatible with their recommended storage requirements of temperature and/or humidity and where necessary, to comply with legal requirements, under secure or segregated conditions.
3. Appropriate temperatures are:
    a. For materials labeled *"store in refrigerator"*, they should be stored at temperature between 2° and 8° C.

b. For materials labeled *"store in a cool place"*, they should be stored at a temperature between 8° and 15° C.

c. For materials labeled *"store in freezer"*, they should be stored at a temperature not higher than -10° C.

d. In the absence of more stringent storage requirements pharmaceutical products and raw materials should be stored at an average over any month of below 25° C with the maximum usually below 30° C and above 4° C. Materials should be protected from direct sunlight.

4. Temperature or humidity controlled environments must be equipped with suitable indicators, recorders and/or failure warning devices which must be checked at appropriate intervals and the results recorded. Recording thermometers should be used. Temperature in uncontrolled storage areas holding raw materials or products should also be monitored.

5. Temperatures should be measured at different levels in the warehouse and if necessary storage of sensitive materials should be restricted to locations in the warehouse where they will be protected from extreme conditions.

6. There must be an appropriate formal stock control system which record the receipt, location and issue of materials and facilitate proper stock rotation and reconciliation. The stock control procedure should ensure that materials with the shortest life are used first unless there is a conscious

decision that for a special reason an alternative priority has to be applied.

7. Materials and products should be inspected at specified intervals to ensure that containers are properly closed, labeled, and that there is no evidence of serious damage or deterioration in the containers or their contents and that the stock rotation system is functioning correctly.

Receipt of Incoming Materials

See figure 3

1. Upon receipt, each incoming delivery should be checked against the relevant documentation and physically verified by label description, type and quantity, against the relevant purchase order information.

2. The consignment should be examined for uniformity and if necessary should be subdivided according to supplier's lot numbers especially if the delivery comprise more than one batch.

3. All containers should be carefully inspected for contamination and damage and if necessary they should be cleaned or set aside for further investigation.

4. Records should be retained for each delivery. They should include the description of the goods, quality, quantity, supplier, supplier's batch number, the date of receipt.

5. Samples should be taken only by appropriately trained and qualified personnel strictly in accordance with written

sampling instructions. The samples should be representative of the batch from which they were taken.

6. The recommended product related storage conditions, for example, type of container, temperature, humidity, protection from light etc., should be maintained throughout the period of storage.

7. Secure measures should be taken to ensure that rejected materials cannot be used and they should be stored separately form other materials.

8. When necessary, to minimize contamination of the storage area, incoming materials must be cleaned, repacked or over wrapped where large quantities of materials in poor quality containers have to be handled. If it is neither possible to have the material supplied in more suitable containers nor practical to repack the material, it should be held in segregated area.

Fig. (3) Inspection Checklist for Drug Receipts

ALL SHIPMENTS - Compare physical stock with supplier's invoice and original purchase order/contract. Note discrepancies on the Receiving Report

- Number of containers delivered
- Number of packages in each container
- Visible evidence of damages (describe)
- quantity in each package
- Correct drug (don't confuse generic names and brand name), dosage form (tablet, liquid, etc.), dose (milligrams, %, concentration, etc.)
- Take a sample for testing
- Presence of unique identifiers if required (Ministry of Health stamp, etc.)

TABLETS - For each shipment, tablets of the same drug and dose should be consistent. The following characteristics should be checked

- Identical size, shape, color (shade of color may vary from batch to batch)
- Markings (scoring, lettering, etc.) should be identical on all tablets
- No evidence of spots, pits, chips, breaks, uneven edges, cracks, embedded or adherent foreign matter, stickiness.
- No odor upon opening a sealed bottle (except flavored tablets and those with active ingredients normally having a characteristic odor) and no odor after being exposed to room air for 20-30 minutes.

CAPSULES - Capsules should be inspected for the same characteristics as tablets. In addition, the following should be checked:

- No evidence of holes in the capsule
- No empty capsules
- No open or broken capsules

PARENTERALS (Injectables) - All products for injection (IV liquids, ampoules, dry solids for reconstitution, suspensions for injection, etc.) should be checked for the following:

- Clarity of solution (solutions should be free from undissolved particles, within permitted limits).
- Dry solids intended for use in injectable solutions should be entirely free from visible foreign particles
- Evidence of leakage from the immediate container (bottle, ampoule, etc.)

Storage of Approved Products

1. All stored products should be accurately documented particularly with respect to product name, batch number, expiry date and quantity.
2. Comprehensive records should be maintained of the receipt and issue of all products.
3. Products should be protected from excessive climatic conditions during storage and transit, such as heat, frost, moisture and direct sunlight.
4. Products should not be distributed if they are approaching the end of their life. There must be a written policy laying down the remaining shelf-life after which products must not be distributed other than under exceptional circumstances.
5. Picking stock should be stored to facilitate stock security, rotation, order assembly and dispatch.
6. The picking and assembly areas should be organized to minimize the distance traveled by operators. The general environment should be of a high standard and well lit.
7. Handling of goods should be kept to a minimum on grounds of high efficiency and safety. In large facilities the provision of mechanized order assembly system should be considered.
8. There should be a laid down procedure for the checking of assembled orders.

Storage at Clinical Facilities

The basic characteristics of good storage space at clinical facilities are the same as for warehouses. Storerooms require ready access, good circulation, dryness, and security. In most cases, the smaller quantities of drugs stored will permit use of shelving. Products are arranged in convenient manner and in the order they appear on requisitions. Large labels placed on the shelves with each product facilitate recognition.

The Storekeeper and assistant storekeeper alone have access to the storeroom. A *"Dutch Door"* arrangement, in which the top half of the door opens, while the bottom remains closed, keeps out unauthorized persons and permits easy communication.

At lower level facilities such as rural health posts, clinical personnel frequently perform all supply management activities. It is seldom the case, however, that medical auxiliaries or community-based workers receive specific training for this. The result is that the quality of supply handling and storage conditions deteriorates as one move to the periphery of the delivery system.

Training programs for clinical personnel who will handle supplies should include specific courses of instruction in the following subjects:

- Setting up a storeroom and good storage practices
- Use of stock control forms including requisitions, stock records, and prescriptions
- Cold chain procedures, including the use and preventive maintenance of refrigerators.

Special Storage Conditions

Some categories of supplies require special storage conditions. These include vaccines, narcotics, and combustibles. Vaccines require both refrigerators and freezers.

Narcotics and other controlled substances should be kept in secure locking rooms with only one entrance. The keys should be kept in a secure place, preferably a safe. Only the warehouse director and one other person should have access to them.

Combustibles such as alcohol, ether, and fuels must be stored in special rooms. A small, separate out-building is preferable since it virtually guarantees that fire will not spread throughout the warehouse. If a special building is not available, the room used to store these supplies must be fireproof and well-ventilated.

VI. STOCK ARRANGEMENT ROTATION AND CONTROL

Stock Rotation and Control

1. Comprehensive records should be maintained showing all receipts and issues of materials according to batch number.
2. Periodic stock reconciliations should be performed comparing the actual and recorded socks. In any event this should be performed when each batch is totally used up.
3. All significant stock discrepancies should be subjected to investigation as a check against inadvertent mix-ups and wrong issues.
4. Issues should normally observe the principle of stock rotation (first-in first-out) especially where expiry dated materials are concerned.
5. Partly used containers of materials should be securely re-closed to prevent spoilage and/or contamination during subsequent storage. Damaged containers should not be issued but should be brought to the attention of the organization responsible for quality control.

Arrangement of Stock

Within warehouses and storerooms, drugs are arranged according to a specified organizational principle. Therapeutic/pharmacological class, clinical indication, alphabetic order, and level-of-use are commonly used. Within the warehouse itself as well as in clinical facilities, use of the therapeutic/pharmacological classification produces good results, perhaps because it provides a frame of reference within which workers can easily recognize individual products. Level-of-use can be combined with this approach by using preprinted Requisition/Issue Tickets for each type of facility. With this system, drugs are arranged in the warehouse by their classes in the same order as they appear on the Requisition/Issue Ticket. Workers move along the rows of pallets packing only the type and quantity of drugs shown on the Ticket - a greater range of products for hospitals, a lesser range for dispensaries. A final check before sealing the boxes assures that auxiliaries have not requested unauthorized drugs (e.g., morphine for backaches).

Control of Obsolescent and Outdated Stock

All stocks should be checked regularly for obsolescent and degraded materials. Materials with an expired shelf life should be destroyed unless an extension of shelf life is granted following the satisfactory results or re-analysis. All due precautions should be observed to preclude issue of outdated materials.

VII. DISPATCH AND ISSUING

1. The allocation and shipping of products should be made only after the receipt of a written sale order.
2. Results for dispatch procedures should be established depending on the nature of the product and after taking into account any special precautions to be observed. The shipping container should offer adequate protection from all external influences, and should be indelibly and clearly labeled.
3. Dispatch documents should be retained indicating:
    - Date of dispatch.
    - Customer name and address.
    - Product name and quantity sent.

All documentary records should be readily accessible and be kept in a secure place.

In Medical Stores:

1. When requisition/issue tickets (R/I) arrive, shipping clerks review them to see that the types and quantities of supplies correspond to the needs of the warehouse or clinical facility requesting them. The clerks initial approval and send the R/I to the Inventory Control Unit. There, stock clerks review the availability of the supplies requested. They note any

low inventory levels and send the R/I to the Director. The Director reviews the document, taking into account the stock clerks' notations. He may delete items, modify quantities, or approve the R/I as it is. He then returns the document to the Inventory Control Unit. There, the clerks post the Stock Record Cards and send all copies of the R/I to the Pharmaceutical Store Room. Eventually, when Shipping and Receiving provides a signed copy of the R/I verifying that the shipment has been made the stock clerks change the pencil entries to ink.

2. The Chief Storekeeper supervises preparation of shipments. As a clinical pharmacist, he is the only person authorized to make substitutions. Within the store room, supplies are arranged in the order that they appear on the Requisition/Issue. Ticket. The store men loose-pack supplies in cartons. When issuing drugs, an important principle is to issue those drugs with the nearest expiration date first. The Assistant Storekeeper is responsible for this and for posting the Bin Card.

VIII. STABILITY FOLLOW-UP THROUGH CURRENT CHECK-UP AND INSPECTION OF PHARMACEUTICAL PRODUCTS

The stability of a pharmaceutical product can be defined as the ability of its formulation, in a specific container-closure system, to remain within the defined physical, chemical, microbiological, therapeutic, and toxicological specifications till the end of the stated dating, under defined storage conditions. Protection of a pharmaceutical product may be viewed from two perspectives:

1. It is necessary to provide protection for the dosage form from the environment, by controlling product's storage and distribution conditions.

2. Products should be well packaged to protect the end user from the product itself. In this sense security packaging or temperature resistant packaging exhibits a dual protection role. The protection function of packaging provided the major vehicle for optimization of the elements of storage and security. The cGMP include two acts controlling drug stability and Good Storage Practice (GSP).

Act 5.53:

Drug storage should be regularly checked for cleanliness and good order, and for misplaced, deteriorated, or out-dated stock.

Act 5.54:

Drug products should be stored under conditions which minimize deterioration, contamination, spillage, or breakage.

Accordingly, current inspection at appropriate time intervals should be done to verify:

1. Proper selection of storage conditions according to that stated on products label.

   The following world-wide climatic zones are assigned.

   Zone 1: Temperate climate

   Zone II: Mediterranean-like and subtropical climate

   Zone III: Hot, dry climate, dry regions

   Zone IV: Hot, humid climate, tropics.

   In Egypt the climate, varies with season and place, roughly corresponding to climates of zones II, and IV round the year.

Both temperature and relative humidity (RH) determine the exact climate for drug storage.

2. Current recording and occasionally validation of monitoring equipment (thermometers, hygrometers, etc.) to insure proper climate adjustment.

3. Pharmacist should be aware that deterioration of drug products may happen even before their expiration. This may occur perhaps due to improper storage or the fact that the product may require critical storage conditions not stated on the label e.g.:

    - Sorbitol discolors rapidly when stored in metal containers.
    - Sodium metabisulfite gets oxidized rapidly by frequent container opening

Hence, inspection should include frequent product examination to detect signs of product deterioration which differ according to the dosage form, where deterioration may be physically detected as follows:

I- Parenteral Solutions and Oral Solutions:

a. Slight gradual discoloration.

b. Swirly precipitation.

c. Whiskering: pinhole at ampoule tip that leaks solution which precipitates or crystallizes solid matter.

d. Clouding

e. Fading of color

II- Disperse Systems:

a. Cake sedimentation (suspension).

b. Creaming and cracking (emulsions)

c. Discoloration.

III. Semi-Solids (Ointments, creams, gels and suppositories)

a. Change in consistency and feel to touch

b. Syneresis.

c. Phase-separation.

d. Discoloration.

e. Surface crystal growth.

f. Hardness.

IV Solid Dosage Forms:

a. Surface chipping or pitting (plain tablets).

b. Deformation (Capsules).

c. Increased hardness.

d. Discoloration.

e. Color fading (colored tablets).

f. Chipping of coat.

4. In this respect the trained pharmacist, should be aware (during inspection) that drugs mostly susceptible to hydrolytic, oxidative, or photolytic decomposition should be carefully examined for deterioration. Drugs susceptible to hydrolysis are those containing, -COO-CONH-, lactone or lactame group. Most vitamins, hormones, enzymes are highly sensitive to oxidation and photodecomposition.

5. The integrity of packing and packaging of dosage form is one of the important tacks of inspection pharmacist as these protect the drug in a tailored fashion.

6. After each inspection, products showing any signs of instability should be subjected to sample analysis to insure product activity.

IX. MATERIALS AND DRUGS REQUIRING SPECIAL STORAGE CONDITIONS

1. Medical Gases

Gas cylinders should be stored under cover, and not subjected to extremes of temperature. Areas where they are stored should be clean, dry, well ventilated and free of combustible materials. They should be stored vertically and secured to prevent falling. Storage arrangements should permit segregation of different gases and of full/empty cylinders and permit rotation of the stock. Flammable gases should be segregated from oxygen and other oxidizing gases. Storage arrangement for gas-mixture should be such as to avoid separation of the mixture into its component gases.

2. Aerosols

Aerosols should be stored in a clean separate area away from heat and sunlight. Because the container contents are under pressure, filled containers must be checked for weight loss over the expiration dating period. For contents under pressure, the label should carry out do not expose to heat or store at a temperature above 49° C. Keep out of children reach.

3. Creams

Creams can be destroyed under extreme temperature fluctuations; hence they should be stored at temperature above 10° C and not exceeding 30° C. If the creams are opened and diluted, they should not be kept more than 14 days to avoid microbial contamination.

4. Ophthalmic Solutions and Drops

They should be stored according to the conditions specified on the label. After opening they should not be used for more than one month at home and not more than 15 days in hospitals.

5. Capsules

Extremes of humidity and temperature should be avoided. High humidity (>60% RH at 21° C to 24° C) produce more lasting effects on the capsule shell, since as moisture is absorbed, the capsules become softer, tackier and bloated. If temperature is increased the capsule shells may melt and fuse together. High temp > 40° in a dry place may cause cracking of the capsule shell. Therefore, capsules should be stored in an air-conditioned area in which the humidity does not exceed 45% RH at 21° C to 24° C.

Empty hard gelatin capsules, generally range in moisture content between 12 to 15%. Below 10% moisture content, they become brittle and may shrink to the point of not fitting in the filling equipment. Above 16%, size problems in the filling equipment, plus a loss of mechanical strength, may be encountered. Exposure to either heat or moisture extremes can distort empty capsules to the extent that they can not be handled by automatic filling machines.

6. Suppositories

Suppositories should be protected from heat, preferably stored in the refrigerator. Polyethylene glycol suppositories and suppositories enclosed in a solid shell are less prone to distortion at temperature slightly above body temperature. Glycerinated gelatin suppositories should be protected from heat, moisture, and dry air by packaging in well sealed containers and stored in a cold place.

7. Emulsions and Suspensions

Emulsions and suspensions should be stored at a temperature between 15° C and 30° C. High and low temperature may destroy the system and cause separation.

8. Vaccines

DPT and Tetanus should not be stored in a freezer .They should be stored at cold place (3-8° C). Also BCG should be stored in a cold place (3-8° C). Measles and oral polio should be stored in a freezer (-25° C to -15° C).

9. Radiopharmaceuticals

Storage of radiopharmaceuticals must take into consideration the chemical state of the radioactive drug, the quantity and type of radiation involved, and any special storage and stability requirements. For example, gaseous or volatile radiopharmaceutical should be kept in specially vented areas, whereas certain other radioactive drugs require refrigeration. Storage conditions are normally specified in product package inserts. In addition, appropriate shielding must be used for storage areas to minimize personnel exposure.

10. Drugs Requiring Special Storage Condition

a. Aminophyline Injection: Protected from light, discolored product not to be used.

b. Aspirin Tablets: In moisture proof containers, avoid moist conditions.

c. Epinephrine Solution: Protected from light, ophthalmic solutions should be in small volumes, discolored products not used.

d. Idoxuridine Solution: Protected from light, in completely filled containers.

e. Ergometrine and Ergotamine Solutions: Filled containers with minimum headspace, protected from light.

f. Glyceryl Trinitrate Tablets: In water proof non-plastic containers.

g. Heparin Injections: At temp not exceeding 25° C, in refrigerators (2-8° C), freezing is avoided.

h. Insulin Injections: In refrigerators (2-8° C), freezing should be avoided.

i. Carbamazipine Tablets: In cool dry place in tightly closed containers. Tablets readily lose as much one third of their activity when stored in humid environment and the tablet become harder and dissolution is impaired.

j. Nystatin Preparations: In dark cool place, in tightly closed containers.

k. Phenothiazine Preparations: Protected from light in tightly closed containers.

l. Riboflavin Tablets: Protected from light in tightly closed containers.

m. Sulfacetamide Solution: In dark tight containers with minimum headspace.

n. Oxytocin Injections: In amber colored containers with minimum headspace in refrigerator (2-8° C).

o. Noradrenaline Injections: In dark filled containers, if color change to brown the preparation is not to be used.

p. Vegetable and Animal Drugs: Protected from insect infestations or microbiological contaminations by means of suitable agents or processes that leave no harmful residues. Mycotoxin detection such as aflatoxins B_1 and B_2 should be performed on crude drugs before use, because of the carcinogenicity of these mycotoxins.

q. Mannitol Injections: Should be stored at a temperature not less than 20° C. If crystallization occur, heat to dissolve before use.