CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES
SJIF Impact Factor: 7.187

Available online at: http://www.iajps.com *Research Article*

CURRENT REGULATIONS FOR MARKETING AUTHORIZATION OF PHARMACEUTICAL PACKAGING MATERIALS IN INDIA, USA, AND EUROPE

Ravali Koyi[1*], M V Nagabhushanam[2]

[1]Department of Pharmaceutical Regulatory Affairs, Hindu College of Pharmacy, Amaravathi Road, Guntur, Andhra Pradesh, India-522002.

Article Received: October 2023 Accepted: October 2023 Published: November 2023

Abstract:

Pharmaceutical packaging is one market across the globe which is advancing at constant pace. It is expected that market will grow to worth $78.79 Billion by 2025. Packaging is a key for sale, safety and success. Like other packaged goods, pharmaceuticals packaging need to be in such a manner that it will provide speedy packaging, protection, identification, product quality, patient comfort, display and needs of security. Advancement in research of pharmaceuticals development had always being dependent on the packaging technology. Maintaining integrity of pharmaceuticals during storage, shipment, and delivery is assured by quality of packaging available. This article reviewing current pharmaceutical packaging trends and predicting the packaging outcomes in future and also explains the Current Regulations for Marketing Authorization of Pharmaceutical Packaging Materials in India, USA & Europe.

Keywords: *Pharmaceutical packaging Materials, Marketing Authorization, Current Regulations, India, USA & Europe.*

Corresponding author:

Ravali Koyi,

II/II M.Pharmacy, Department of Pharmaceutical Regulatory Affairs, Hindu College of Pharmacy, Amaravathi Road, Guntur, Andhra Pradesh, India-522002.

QR code

Please cite this article in press ***Ravali Koyi*** *et al,* ***Current Regulations For Marketing Authorization Of Pharmaceutical Packaging Materials In India, Usa, And Europe,*** *Indo Am. J. P. Sci, 2023; 10 (11).*

INTRODUCTION [1-5]:

Packaging can be defined as an economical means of providing presentation, protection, identification information, containment, convenience and compliance for a product during storage, carriage, display and until the product is consumed. Packaging must provide protection against climatic conditions biological, physical and chemical hazards and must be economical. The package must ensure adequate stability of the product throughout the shelf life.

Package should provide adequate information related to the contents including legal requirements, route of administration, storage conditions, batch number, expiry date, manufactures name and address and product license number.

The primary packaging consists of those packaging components which have a direct contact with the product (i.e., bottle, cap, cap liner, label etc). The main functions of the primary package are to contain and to restrict any chemical, climatic or biological or occasionally mechanical hazards that may cause or lead to product deterioration. Packaging must also function as a means of drug administrations.

The packaging external to the primary package is known as the secondary packaging. The secondary packaging mainly provides the additional physical protection necessary to endure the safe warehousing and for refill packaging.

Table-1-Types of primary and secondary packaging material

Material	Type	Example of use
Glass	Primary	Metric medical bottle, ampoule, vial
Plastic	Primary	Ampoule, vial, infusion fluid container, dropper bottle
	Secondary	Wrapper to contain primary pack
Carboard	Secondary	Box to contain primary pack
Paper	Secondary	Labels, patient information leaflet

REGULATORY BODY IN INDIA

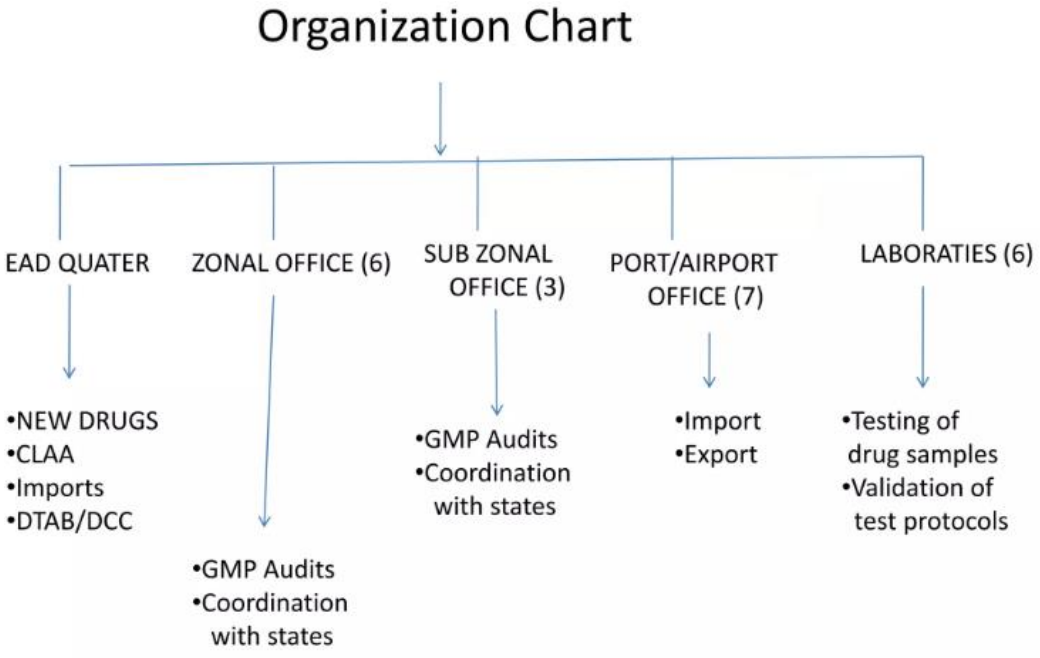
- **CDSCO**: Central Drugs Standard Control Organisation
- **Headquarters**: New Delhi, India

The Central Drugs Standard Control Organisation (CDSCO)under Directorate General of Health Services, Ministry of Health & Family Welfare, Government of India is the National Regulatory Authority (NRA) of India.
It headquarters is located at FDA Bhawan, Kotla Road, New Delhi 110002 and also has six zonal offices, four sub zonal offices, thirteen Port offices and seven laboratories spread across the country.

The Drugs & Cosmetics Act,1940 and rules 1945 have entrusted various responsibilities to central & state regulators for regulation of drugs & cosmetics. It envisages uniform implementation of the provisions of the Act & Rules made there under for ensuring the safety, rights and wellbeing of the patients by regulating the drugs and cosmetics. CDSCO is constantly thriving upon to bring out transparency, accountability and uniformity in its services in order to ensure safety, efficacy and quality of the medical product manufactured, imported and distributed in the country.

Under the Drugs and Cosmetics Act, CDSCO is responsible for approval of Drugs, Conduct of Clinical Trials, laying down the standards for Drugs, control over the quality of imported Drugs in the country and coordination of the activities of State Drug Control Organizations by providing expert advice with a view of bring about the uniformity in the enforcement of the Drugs and Cosmetics Act.

Further CDSCO along with state regulators, is jointly responsible for grant of licenses of certain specialized categories of critical Drugs such as blood and blood products, I. V. Fluids, Vaccine and Sera.



Zonal offices	Sub zonal offices
• Mumbai • Kolkata • Chennai • Ghaziabad • Ahemdabad • Hyderabad	• Chandigarh • Jammu • Benglore

Functions of CDSCO:

- Approval of new drugs and clinical trials
- Import registration and licensing.
- License approving of Blood Banks, LVOs, Vaccines, r-DNA products & some medical devices.
- Amendments to D&C Act and Rules
- Banning of drugs and cosmetics
- Grant of test license, personal license, NOCs for Export
- Testing of new drugs

Currency: Rupee (₹)
Population: 140.76 crores
Pharma market status: The pharmaceutical industry in India is expected to reach $65 Bn by 2024 and to $130 Bn by 2030. The pharmaceutical industry in India is currently valued at $50 Bn. India is a major exporter of Pharmaceuticals, with over 200+ countries served by Indian pharma exports.

Regulatory body of usa:
FDA: Food and Drug Administration
Headquarters: White Oak, Maryland. The agency also had 223 field offices and 13 laboratories located throughout the 50 states, the United states virgin islands and Puerto Rico.

FDA established in 1930 as a part of the US department of Health and Human services (DHHS), regulates products accounting for roughly 25% of the United States gross national product.

FDA is responsible for safety regulation of Drugs, Vaccines, Blood products, medical devusices, Dietary supplements, Biological medical products, Radiation-emitting devices, Veterinary products and Cosmetics.

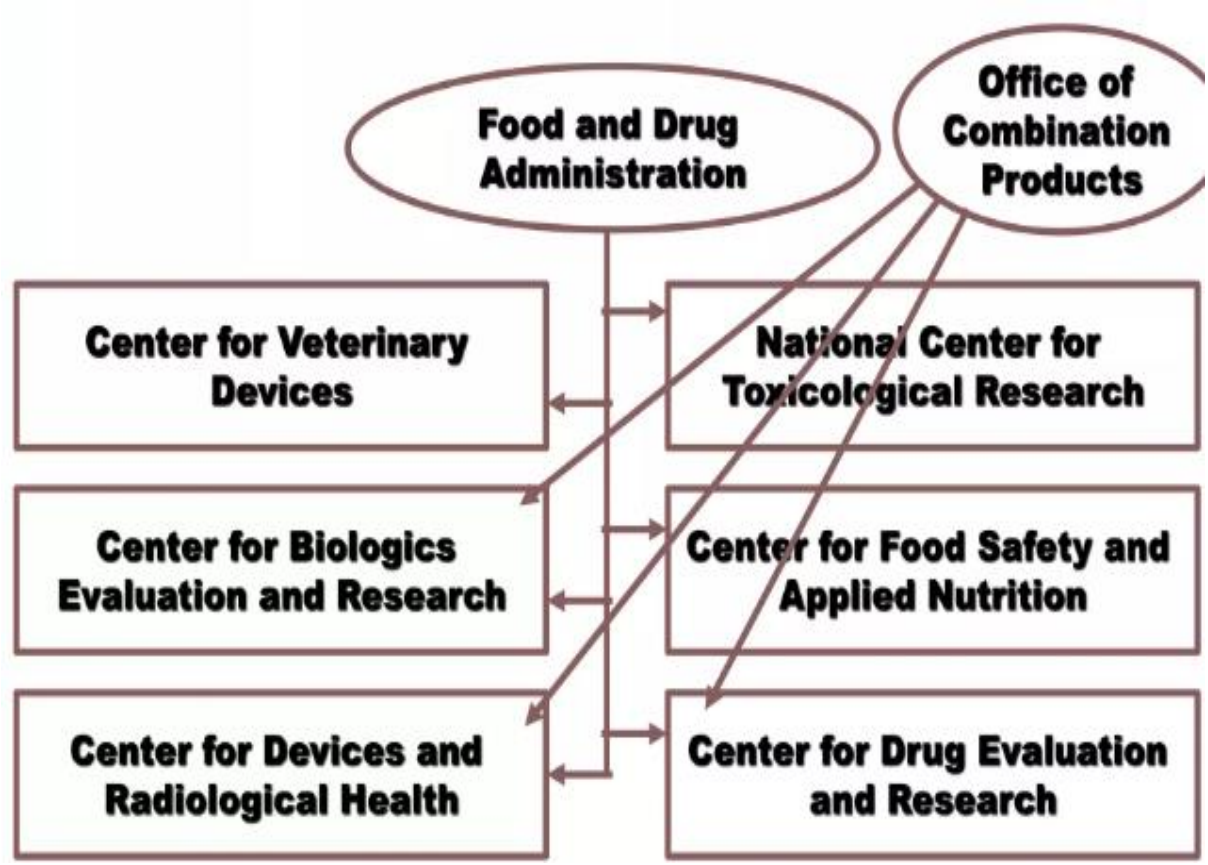
FDA enforces other law, notably section 361 of the Public Health Service Act and associated regulations, many of which are not directly related to food or drugs.

In June 1906, President Theodore Roosevelt signed into law the Food and Drug Act, also Known as the "Wiley Act" after this chief advocate. The act applies penalties to the interstate marketing of adulterated drugs, in which the standard strength, quality or purity of the active ingredient was not either stated clearly on the label or listed in the United State Pharmacopoeia or the National Formulary. The act also banned misbranding of food and drugs. The responsibility for examining food and drugs for such adulteration or misbranding was given to Wiley's USDA Bureau of chemistry. Wiley used these new regulatory powers to pursue an aggressive campaign against the manufactures of foods with chemical additives, but the chemistry bureau's authority was soon checked by judicial decisions, as well as by the creation of the board of Food and Drug Inspection and the Reference Board of Consulting Scientific Experts as separate organizations within the USDA in 1907 and 1908 respectively.

FDA consists of six product centers, one research center and two offices:

- Center for biologics evaluation and research
- Center for devices and radiological health
- Center for drug evaluation and research
- Center for food safety and applied nutrition
- Center for tobacco products
- Center for veterinary medicine
- National center for toxicological research
- Office of regulatory affairs
- Office of commissioner

FDA Structure / Organization



Functions of FDA

- Protecting the public health by assuring that food is safe, sanitary and properly labelled.
- Veterinary drugs and vaccines, biological product, medical devices which are intended for human use are safe and effective.
- Protect the public from electronic product radiation.
- Regulating tobacco products
- Assuring cosmetic products are safe.
- Provide the accurate science-based information.

Currency: Dollar ($)
Population: 33.19 crores
Pharma market status: The U.S. pharmacy market size was USD 534.21 billion in 2020 and is projected to grow from USD 560.00 billion in 2021 to USD 861.67 billion by 2028 at a CAGR of 6.3% in the 2021-2028 period.

EUROPEAN MEDICINES AGENCY
SCIENCE MEDICINES HEALTH

Regulatory body for europe:
EMA: European Medicines Agency
Formed: January 1st, 1995
Headquarters: London
Official Website: www.ema.europa.eu
EMA is the EU regulatory body responsible for the scientific evaluation and supervision of medicines developed by pharmaceutical companies for use in the European Union
EMA protects public and animal health in 27EU member states, as well as the countries of the Economic area, by ensuring that all medicines available on the EU market are safe, effective and of high quality.
EMA has 20 years track record of ensuring efficacy and safety of human and veterinary medicines across Europe and promoting research and innovation in the development of medicines.
In the first two decades, the agency recommended the authorisation of a total 975human and 188 veterinary medicines. Today's EMA success is based on the

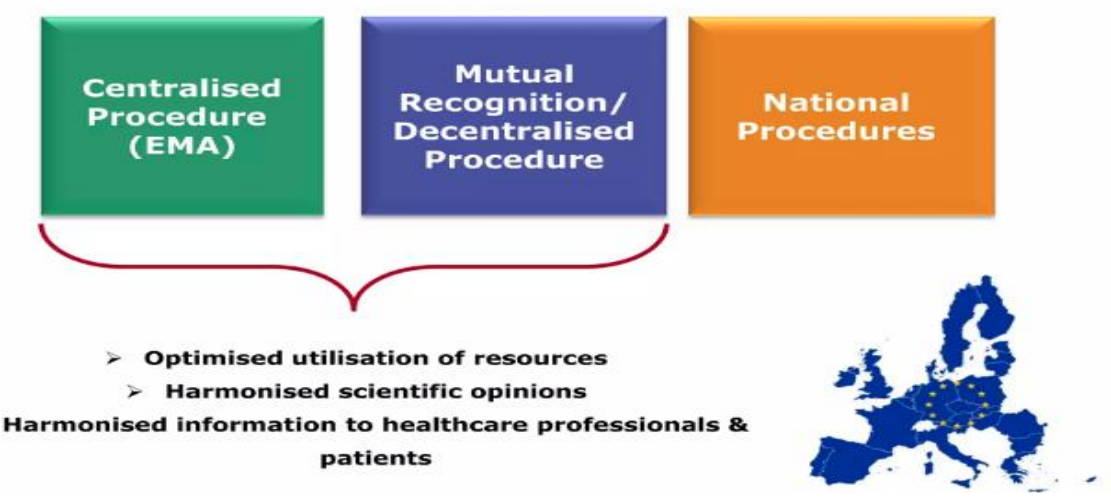
cooperation of European medicines regulatory network, a partnership b/w EC and EEA

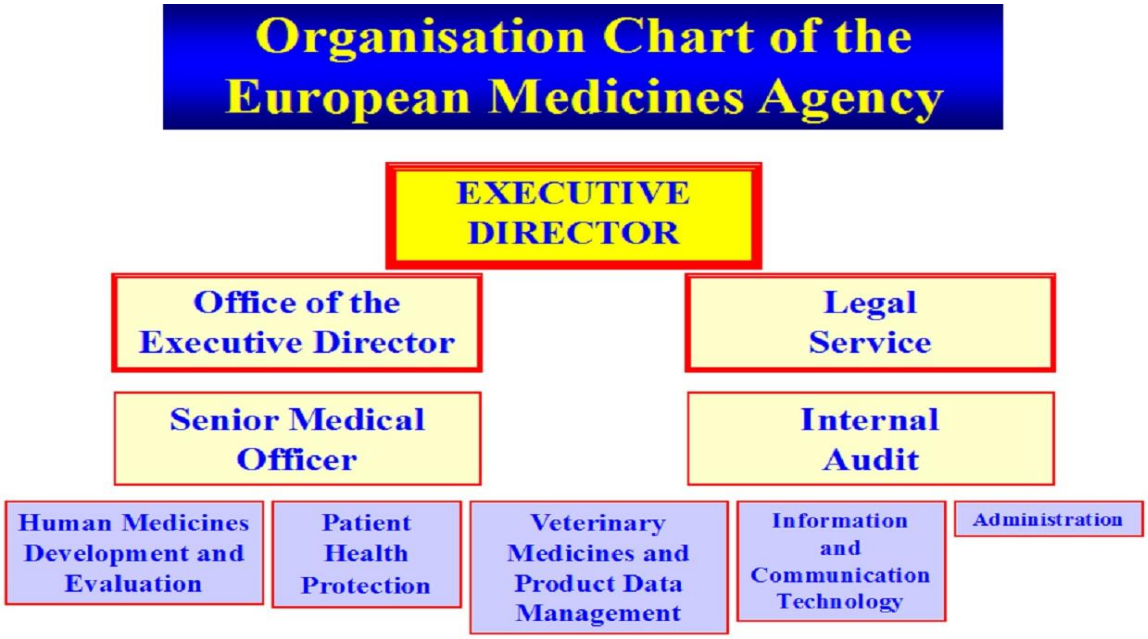
EMA regulate:

- Facilitate development and access to medicines.
- Evaluate applications for marketing authorization.
- Monitor the safety of medicines across their life cycle.
- Provide information on human and veterinary medicines to healthcare professionals and patients.

Committees:

- Committee for medicinal products for human use (CHMP)
- Pharmacovigilance Risk Assessment Committee (PRAC)
- Committee on Herbal Medicinal Products (CHMP)
- Committee for Advanced Therapies (CAT)
- Committee for medicinal products for veterinary use (CVMP)
- Committee on orphan medicinal products (COMP)
- Paediatric committee (PDCO)





European System

Functions of EMA:

- To explore medicinal products
- It works closely to national competent authorities in a regulated network.
- Implements policies and procedures to ensure it works independently, openly, and transparently.
- Maintain the highest standards in its scientific recommendations

Currency: Euro (€)

Population: 74.64 crores

Pharma market status: With 5,951 drugs in active development as of September 2022, European biopharma has a 28% share of the total global pipeline. The proportion of biologics under development (2,268, 27%) is on par, while vaccines remain a strength (31%), although the subset of advanced therapies is notably below average.

2.ASPECTS OF PACKAGING[6-7]

1. General considerations
2. Functions of packaging
   a. Containment
   b. Protection
3. Presentation and information
   a. Labels
   b. Repackaging, relabelling, and dispensing.
   c. Package inserts for patients
4. Compliance
5. Protection of patients
6. Detection of counterfeiting

General considerations:

Packaging may be defined as the collection of different components (e.g. bottle, vial, closure, cap, ampoule, blister) which surround the pharmaceutical product from the time of production until its use.

The aspects of packaging to be considered (4) include:

- The functions of packaging
- the selection of a packaging material
- the testing of the material selected.
- filling and assembling
- sterilization
- storage and stability

Examples of the types of materials used are shown in Table 1.

Table 2: Types of raw materials used in packaging.

Types of materials	Uses
Cardboard	Boxes Display units
Paper	Labels Leaflets
Glass	Ampoules Bottles Vials Syringes Cartridges
Plastic	Closures Bottles Bags Tubes Laminates with paper or foil
Metal, e.g. aluminium	Collapsible tubes Rigid cans Foils Needles Gas cylinders Pressurized containers
Rubber	Closures, including plungers

A distinction must be made between primary and secondary packaging components. The primary packaging components (e.g. bottles, vials, closures, blisters) are in direct physical contact with the product, whereas the secondary components are not (e.g. aluminium caps, cardboard boxes). The choice of primary and/or secondary packaging materials will depend on the degree of protection required, compatibility with the contents, the filling method and cost, but also the presentation for over-the-counter (OTC) drugs and the convenience of the packaging for the user (e.g. size, weight, method of opening/ reclosing (if appropriate), legibility of printing).

Containers may be referred to as primary or secondary, depending on whether they are for immediate use after production of the finished product or not. Both single-dose and multi-dose containers exist. Containers may be well-closed, tightly closed, hermetically closed or light-resistant.

The packaging process, as defined in the glossary, is the process that a bulk material must undergo to become a finished product. The properties and attributes of the product should be as specified by the manufacturer and required by the user. The packaging process consists of the following stages:

- ✓ filling and assembling
- ✓ sterilization in the final container, if applicable.
- ✓ placing labels on the container
- ✓ storage at the manufacturing and shipping sites.

Packaging documentation (1) includes aspects related to:

- ✓ specifications and quality control, including batch records.
- ✓ labels, inks and adhesive materials (e.g. glue).
- ✓ package inserts for patients.

Apart from primary and secondary packaging, two types of special packaging are currently in use, as follows:

- Unit-dose packaging. This packaging guarantees safer medication by reducing medication errors; it is also more practical for the patient. It may be very useful in improving compliance with treatment and may also be useful for less stable products.
- "Device" packaging. Packaging with the aid of an administration device is user-friendly and also improves compliance. This type of packaging permits easier administration by means of devices such as prefilled syringes, droppers, transdermal delivery systems, pumps and aerosol sprays. Such devices ensure that the medicinal product is administered correctly and in the right amount.

Function of packaging:

a. Containment

The containment of the product is the most fundamental function of packaging for medicinal products. The design of high-quality packaging must take into account both the needs of the product and of the manufacturing and distribution system. This requires the packaging:

- ✓ not to leak, nor allow diffusion and permeation of the product.
- ✓ to be strong enough to hold the contents when subjected to normal handling.
- ✓ not to be altered by the ingredients of the formulation in its final dosage form.

b. Protection

The packaging must protect the product against all adverse external influences that may affect its quality or potency, such as:

- ✓ Light
- ✓ Moisture
- ✓ Oxygen
- ✓ biological contamination
- ✓ mechanical damage

The compatibility of the packaging with the active pharmaceutical ingredients is very important in maintaining the integrity of the product.

For primary packaging, it is necessary to know the possible interactions between the container and the contents. Normally, product/ component stability and compatibility are confirmed during the primary research and development stage.

While excluding the effect of external factors on the product, the packaging itself should not interact with it so as to introduce unacceptable changes. There are numerous possibilities of interactions between (primary) packaging materials and pharmaceutical products, such as:

- ✓ the release of chemicals from components of the packaging materials
- ✓ the release of visible and/or subvisible particles
- ✓ the absorption or adsorption of pharmaceutical components by the packaging materials
- ✓ chemical reactions between the pharmaceutical product and the packaging materials
- ✓ the degradation of packaging components in contact with the pharmaceutical products
- ✓ the influence of the manufacturing process (e.g. sterilization) on the container

The active pharmaceutical ingredients should remain within their specification limits over the shelf-life of the pharmaceutical product. The question of whether a packaging will provide the required protection for the pharmaceutical product and the required stability over a certain time period can only be answered by means of real-time stability studies. Such studies must evaluate the changes in the quality of the product, in contact with its packaging, during a period equivalent to its intended shelf-life.

In addition, packaging must meet the following requirements:

- ✓ it must preserve the physical properties of all dosage forms and protect them against damage or breakage.
- ✓ it must not alter the identity of the product.
- ✓ it must preserve the characteristic properties of the product, so that the latter complies with its specifications.
- ✓ it must protect the product against undesirable or adulterating chemical, biological or physical entities.

Storage. Packaging materials should be stored in accordance with GMP for storage areas. The characteristics of the active pharmaceutical ingredients will determine whether different packaging will be needed. For example, the packaging requirements of medicinal products kept at temperatures between 2 and 8°C may differ from those of products intended for tropical countries or light sensitive products. If the contents are sterile, sterility

must be maintained, including that of any unused remaining product.

The shelf-life and utilization period are always determined in relation to storage conditions and the stability of the active pharmaceutical ingredient.

Normal storage conditions are defined as "storage in dry, well-ventilated premises at temperatures of 15–25°C or, depending on climatic conditions, up to 30°C. Extraneous odours, other indications of contamination, and intense light have to be excluded".

Presentation and information:
Packaging is also an essential source of information on medicinal products. Such information is provided by labels and package inserts for patients.
The information provided to the patient may include the following:

- ✓ the name of the patient
- ✓ the identification number for dispensing records
- ✓ the name, strength, quantity and physical description or identification of the medicinal product
- ✓ directions for use and cautionary statements, if applicable
- ✓ the storage instructions
- ✓ the date of dispensing and period of use (related to the expiry date).
- ✓ the name and address of the dispenser

Labels:
Throughout manufacturing, a succession of specific outer labels are applied to the container of the medicinal product. The level of processing is indicated by the following words:

- Quarantine
- Storage
- Distribution

Specifications for labels for finished drug products are defined in the WHO guidelines on GMP for pharmaceutical products.

Written labels on the packaging:

- Permit the identification of each active ingredient by means of its INN, and also give the dosage form and the trade name/trademark. All information concerning the medicinal product, as required by national legislation, must be stated on the packaging.
- Preserve the stability of the medicinal product by giving advice on its storage:

  After the stability of the product has been evaluated, one of the following recommendations as to storage conditions can be prominently indicated on the label:
  — store under normal storage conditions
  — store between 2 and 8 °C (under refrigeration, no freezing).
  — store below 8 °C (under refrigeration).
  — store between -5 and -20 °C (in a freezer).
  — store below -18 °C (in a deep freezer).
- Permit the follow-up of a specific medicinal product by means of the batch number on the labels. It must be possible to follow the route of distribution of a product from the manufacturing process to its administration to the patient with the aim of locating and identifying products that are of potential risk (e.g. blood products, blood-derived products).
- Mask the real identity of the medicinal product in clinical studies. This is extremely important in clinical trials in determining the real efficacy of a medicinal product in blinded studies. If the identity is masked by a code, it must be possible to disclose it at any time in a medical emergency.

National legislation must be followed with regard to the information provided to the patient, as well as the record-keeping and packaging instructions.

Repacking, relabelling, and dispensing:
In some countries, it is common practice not to dispense drugs in the original packaging, but rather in a personalized manner to each patient. This applies especially to solid oral dosage forms and involves the "repacking" and "relabelling" of drugs in small quantities. Different drugs may even be included in "customized" medication packages, also referred to as "patient med packs". The quantities of drugs supplied in this way are usually enough only for a short period of time, i.e. to provide drugs for immediate use. It should be remembered, however, that data obtained in stability studies undertaken by the manufacturer are no longer valid for drugs removed from the original package.
Where repacking and relabelling are necessary, the WHO guidelines on GMP for pharmaceutical products (1) should be followed to avoid any mix-up or contamination of the product, which could place the patients' safety at risk.

Package inserts for patients (patient information leaflets):

Product information must help patients and other users to understand the medication. The patient package inserts, together with the label, provides the patient with key information concerning the proper use of the product, potential adverse drug reactions and interactions, storage conditions and the expiry date.
In OTC medicinal products, the package insert, together with the label.

Compliance:
Packaging and labelling may help to reinforce the instructions given by the physician or the pharmacist and improve compliance with drug therapy. In this respect, packaging becomes a compliance aid.
The design of pharmaceutical packaging should be such that the product can easily be administered in a safe manner to the patient. If the patient feels at ease with the packaging and route of administration, the design of the packaging may become a key factor in increasing compliance. This is also an important factor in clinical trials.

Protection of patients:
Packaging must not only increase compliance through its design but must also protect the patient and indicate the integrity of the product. Packaging equipped with a tamper-evident device protects against incidental and accidental poisoning. To protect children, several child-resistant closures have been developed.

Detection of counterfeiting:
The Forty-first World Health Assembly, after reviewing the report of the Executive Board on the implementation of WHO's revised drug strategy, requested: ". . . governments and pharmaceutical manufacturers to cooperate in the detection and prevention of the increasing 132 incidence of the export or smuggling of falsely labelled, spurious, counterfeited or substandard pharmaceutical preparations".

Several documents (2, 6–9) show that counterfeit pharmaceutical products are in wide circulation. In November 1985, during the WHO Conference of Experts on the Rational Use of Drugs in Nairobi, Kenya, concern was expressed regarding the extent to which counterfeit pharmaceutical products were in circulation in developing countries. In view of the importance of this issue, a text has been drafted to provide model provisions to deal with counterfeit drugs.

The design of the packaging must therefore contribute to preventing tampering with, or the counterfeiting of, certain medicinal products. Such tamper-evident containers can allow the visual inspection of the medicinal product before use, and this may serve as a first stage in detecting counterfeit drugs.

FDA REGULATIONS FOR PHARMACEUTICAL PACKAGING [8-11]:
FDA ensures the quality of drug products by carefully monitoring of drug manufacturers adhere to pharmaceutical regulatory compliance as per the cGMP.
Packaging is also the part of cGMP.
The following characteristics are the most common requirements of most regulatory agencies:

1. Production preparation related requirements
   - Protection of the product
   - Protection of the consumer
   - Control of doses
2. Label requirements
   - Information of the receiver
   - Legal control of the product
3. Environmental aspects
   - Packaging wastage
   - Ozone depletion
4. Consumer protection
   - Child resistance closures
   - Tamper evident packaging.

FDA packaging Guidelines:
FDA packaging guidelines defines the types of containers to be used, dividing them into

- Parenteral containers (glass/plastic)
- Non parenteral containers (glass, plastic& metal)
- Pressurized containers
- Bulk containers of API & drug product

Also listed are closures including child resistant and tamper evident closure, liner, seal & elastomers when used for closure. According to FDA guidelines, for submitting documents for packaging for human drugs and biological the following are required:

PURPOSE:

- ✓ Package must maintain standards, identity, strength, quality & purity for intended shelf life.
- ✓ Full information needed.
- ✓ Type of container/ Closure
- ✓ Suitability for intended use
- ✓ Submission of packaging information & date

ENVIRONMENTAL CONCERN:
With in increase environmental concerns there has been considerable pressure to reduce contamination of environment with particular concern on amount of

packaging & its disposal. Ozone depletion is also of concern with the use of pressurized containers. Regarding these aspects the increase in concerns has led to the European E Commission packaging waste directive which requires:

- ✓ Reduction in quality of waste
- ✓ Reduction in harmfulness of waste
- ✓ Increase in reuse of packaging.
- ✓ Recycling & recovery of packaging waste
- ✓ Reduction of the total; packaging to be disposed of.

FDA issues new packaging guidelines for pharma industry:

The Center For Drug Evaluation and Research of the US Food and Drug Administration (FDA) has issued new guidelines for test batches packaging for abbreviated new drug applications (ANDA), abbreviated antibiotic applications (AADA) and supplements.

According to the agency, the procedures apply to test batches manufactured for ANDAs, AADAs and supplements only, and exclude the batches prepared for new drug and investigational new drug applications reviewed by the Offices of Drug Evaluation (ODE) I or II. The guidance covers test batch of finished drug products manufactured according to current good manufacturing practice regulations in support of ANDA or AADA. Identification applied to a group of filled product containers that are set aside and held in unlabelled condition for future labelling operations will also be covered in the guidance.

Furthermore, the active ingredient blend combined with most of the excipients along with processed material, the unpackaged finished drug products, are also covered. As part of the procedures, the applicant needs to use production filling and packaging equipment for the test batch, and will also have to fill multiple sizes of the proposed market containers from the same test batch.

The packaging and labelling sections of the batch record should contain details including drug product and label reconciliation, and a summary table of packaging information explaining the container or closure system. Details pertaining to the total number of containers packaged, the quantity distributed and the destination of all disbursements of the packaged product should also be mentioned.The guidelines have been considered as processes that are proposed to increase the quality adherence practices, which are critical for the pharma sector.

CONCLUSION:

Packaging should provide protection, identification, information, convenience and compliance for a product during storage, carriage, display and until such time the product is consumed. A thorough background about the product, the market, the distribution system and other facilities available have to be considered while selecting a packaging material. Pharmaceutical packaging should look into concerned issues like child safety, correct dosage, patient traceability, tampering and diversion of pharmaceutical products. Now, major additional concerns of drug counterfeiting and concerns around terrorism bring a new sense of urgency to medical packaging manufacturers and hospitals, clinics, assisted living facilities, doctors' offices and the individual consumer. Considerable steps have to be taken to ensure packaging traceability. Some manufacturers have affixed the use of barcodes to pharmaceutical products. Tracing pharmaceuticals right from their origin at a chemical plant to the patient beside may be attainable when Radio Frequency Identification (RFID) is embedded throughout the pharmaceutical packaging and makes it easier to ensure that the product is authentic and thereby improves the efficiency of drug supply chain.

REFERENCES:

1. European Pharmacopoeia, 4th Ed., Council of Europe, Strasbourg (2001): 242
2. Automating Management Information Systems: Barcode Engineering and Implementation - Harry E. Burke, Thomson Learning, ISBN 0-442-20712-3
3. Automating Management Information Systems: Principles of Barcode Applications - Harry E. Burke, Thomson Learning, ISBN 0442206674
4. Bentley's Text Book of Pharmaceutics edited by E.A.Rawlins,Eighth edition , Page no: 685-709.
5. Center for Drug Evaluation and Research (CDER) compressed Medical Gases Guideline (February 1989).
6. DE Albert, " Materials Characterisation as an integral Part of global Biocompatibility", Med Plastic and Biomat, 4(1997):16-23.
7. Brahmaiah Bonthagarala, Current Regulatory Requirements for Registration of Medicines, Compilation and Submission of Dossier in Australian Therapeutic Goods Administration, International Journal of Advanced Scientific and Technical Research, ISSN 2249-9954, Issue 6 volume 6, November-December 2016, 144-157.

8. Brahmaiah Bonthagarala, Comparison of Regulatory Requirements for Generic Drugs Dossier Submission in United States and Canada, International Journal of Pharmaceutical Science and Health Care, ISSN 2249 – 5738, Issue 6, Vol. 6 (November-December 2016), 1-19.
9. Brahmaiah Bonthagarala, Nanomedicine Clinical Use, Regulatory and Toxicology Issues In Europe, Journal of Drug Delivery and Therapeutics, 2019; 9(4-s):846-848.
10. Brahmaiah Bonthagarala, A Review on global harmonization task force (GHTF) - principles of in vitro diagnostic (IVD) medical devices classification, The Pharma Innovation Journal 2018; 7(7): 667-672, ISSN (E): 2277- 7695.
11. Brahmaiah Bonthagarala, Compilation of Chemistry Manufacturing Controls In Abbreviated New Drug Application, Journal of Pharma Research, Vol-08, Issue 08, 2019.