"A RECENT REVIEW ON INHALER DEVICE"

[1]Snehal S. Salghante, [2]Balaji S. Wakure, [3]Khalil K.Shaikh, [4]Aditya V. Patil, [5]Ashwini R. Pawar

[1,4,5]M Pharmacy, [2]Principal, [3]Assistant Professor
Department of Pharmaceutics
Vilasrao Deshmukh Foundation, Group Of Institions, VDF School Of Pharmacy
Latur, Maharashtra, India

Abstract: **For the local, systemic, and central nervous system medication distribution, intranasal administration is the preferred approach. Nasal spray dosage forms have several advantages over other nasal drug delivery methods, including being affordable, convenient to use and carry, and self-administrable. The local and systemic delivery of various medications and biopharmaceuticals for the treatment of pulmonary and non-pulmonary disorders has shown to be successful when administered via the pulmonary route of administration.In this review we have discussed the aerosol delivery devices with respect to mechnism, classification and there proper use of device.**

Keywords: **Inhaler, Meter Dose Inhaler, Dry powder Inhaler, Nebulizers.**

1. Introduction:

Today, a variety of formulations, including nasal spray, nasal drops, nasal powder, nasal gels, and nasal inserts, are utilised to give medications via the nasal route. A non-invasive approach that produces a rapid onset of drug activity is administering medications through the nose in spray dose form. The nasal spray dosage form has a good patient compliance rate since it is economical, convenient to use and carry, and self-administrable. As a result, nasal medication delivery has gained popularity and presents a significant potential prospect. With inhalation aerosol therapy, it is simple to target the pharmacologically active chemicals for the treatment of respiratory disorders. Due to its large surface area, wide vasculature, and thin air-blood barrier, the administration of drugs through the respiratory tract is becoming more significant in the present era of non-invasive novel drug delivery technologies. The formulation and delivery mechanism have a large role in determining the deposition pattern of the delivered aerosol. Nebulizers, pressurised metered-dose inhalers (pMDI), and dry powder inhalers (DPIs) are the three platforms on which aerosol medicinal chemicals are delivered by devices. This review describes the traditional and current state-of-the-art designs for inhaler devices and how these have enhanced their functionality. When using inhalation therapy, aerosolized drugs are used. An aerosol is a suspension of a liquid or solid as tiny particles in a gaseous medium. For an aerosolized medication to be therapeutically effective, it must be able to reach peripheral airways. It is difficult to predict the degree of aerosol deposition in the lungs since airways differ in size and structure from person to person and are affected by pathological abnormalities. Where the medication is deposited, however, can be affected by modifications in local airflow brought on by lung diseases. Different mechanisms are involved in the deposition of aerosolized particles depending on the size, shape, density, charge, and hygroscopicity of the particle. Deposition is influenced by the geometry of the airway as well as physiological factors such breathing patterns, respiratory tract airflow dynamics, variations in relative humidity, and airway temperature. Relative humidity in the trachea for oral inhalation is estimated to be 90%; it increases incrementally by 1% for each downstream bronchial transit, reaching 99.5% saturation in the tenth generation. Drugs are absorbed into the circulation via the lung mucous membrane when patients use an inhaler to inhale their medications via the pulmonary drug delivery route. Treatment for lung conditions like asthma and chronic obstructive pulmonary disease (COPD) most frequently employs this method. Metered-dose inhalers (MDI), dry powder inhalers (DPI), soft mist inhalers (SMI), and nebulizers are some of the several types of inhalers. medication particle characteristics, breathing habits, and the geometry of the respiratory tract all have an impact on the speed and effectiveness of pulmonary medication administration.

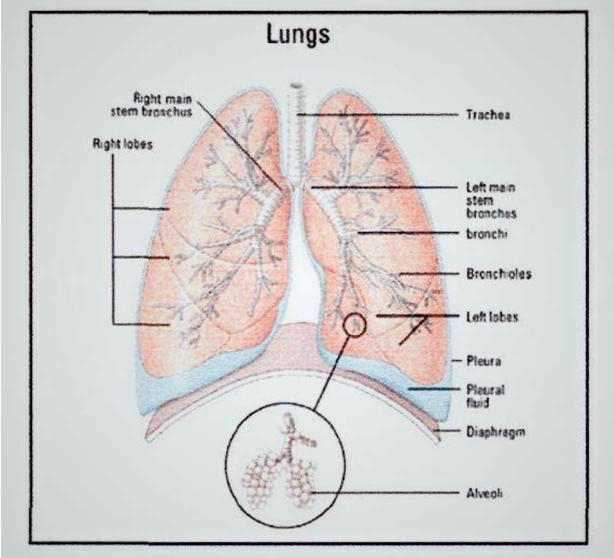


Fig: Structure and anatomy of respiratory tract

2. Drug absorption in the lung: Drug accumulation in the respiratory system does not always indicate effective treatment. A major aspect in deciding a drug's fate after inhalation is its permeability characteristics and how they affect the distribution and absorption of molecules. The lung's physiological properties, such as its large surface area, rapid tissue perfusion, and thin alveolar blood barrier, enable rapid medication absorption through the solvent. The molecular size, lipophilicity, and hydrophilicity of an agent determine its absorption by the alveolar epithelium. Lipophilic drugs easily pass through endothelium, interstitium, and alveolar epithelial cells to enter the circulation. The molecular size of the hydrophilic molecule, which applies to hydrophilic molecules with low molecular weight, is the rate limiting factor in diffusion. The rate of absorption varies significantly depending on the physiochemical properties of the substance and whether it happens via diffusion or a carrier-mediated process.

3. Pulmonary metabolism and elimination: The blood, the lymphatic system, or the mucociliary activity may ultimately eliminate any particulate matter that has built up in the respiratory tract. The physicochemical characteristics of aerosols, site of deposition, and respiratory physiology are significant determinants influencing clearance. Solvents are removed from the body by absorption into the blood stream. Insoluble particles deposited on the ciliated region of the respiratory tract are primarily cleared via mucociliary transport as opposed to those deposited on the non-ciliated surfaces of the pulmonary region, where they may be phagocytized by macrophages or may leak into the interstitium and then be transported to a lymph node.

4. Examples of inhalers:

a)NEBULIZERS: Liquids are turned into aerosols of a size that can be breathed into the lower respiratory tract using nebulizers.Atomization is the pneumatic breakdown of a large liquid into minute droplets. Electricity is used by ultrasonic nebulizers to transform a liquid into inhalable droplets. A nebulizer is the quickest and most effective means to deliver droplets to the outer region of the lungs. Due to the fact that the solutions are aerosolized and inhaled through a mouthpiece or ventilation mask during typical tidal breathing, they are used by small children and elderly hospital patients. In order to treat and identify respiratory infections, nebulizers are widely employed. Because the mass transported by the droplet, which has an approximate size of 1-2 m, is low, the dose is given over a period of 10-15 minutes. With the advent of high output nebulizers, drug administration to patients is now more efficient and may be done in shorter therapy sessions. Compressed air or ultrasonic aerosol generation can be used to nebulize aqueous droplets.

- **Compressed air nebulisers:** Using pressurised air, this technique creates a spray out of a liquid. The high-velocity gas jet is tangentially passed via a skinny venturi nozzle. An area of negative pressure where the air jet emerges causes a liquid to be drawn up a feed tube from a fluid reservoir as a result of the Bernolli effect. Larger, non-respirable droplets strike baffles or the chamber wall and fall back into the reservoir fluid, while smaller droplets exit the nebulizer as the liquid exits as a fine filament that breaks down into a droplet due to surface tension.

OMRON®
Compressed air nebuliser

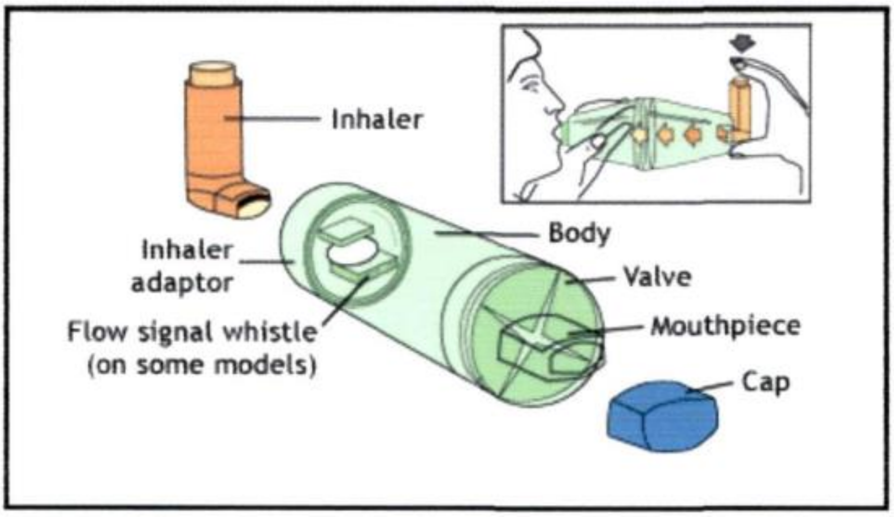
- **Ultrasonic aerosol nebuliser:** A rapid oscillating waveform is imposed onto a liquid by vibrating an electromechanical surface in order for this to work. The waveform becomes unstable at a specific amplitude, which causes the liquid film to rupture and discharge small droplets. The biggest drawback of nebulizers was their immobility because they required an electrical power source. The Citizen® Uhrasonic nebuliser, Omron® compressed air nebuliser, and Devilbiss® nebuliser are three of the more useful, portable, battery-operated hand-held nebulizers on the market right now.

Fig : Ultrasonic aerosol nebulizer

Nebulising Solutions: Purified water is mixed with co-solvents such glycerine, propylene glycol, and ethanol to make nebulizing solutions. It's crucial to take into account variables including tonicity, solubility, pH, isoelectric pH (for proteins and peptides), ionic strength, buffer levels, and cosolvent concentrations while making nebulizing solutions. Stabilisers and antioxidants are added to the solution. Nebulizing solutions are aseptically packaged as unit dosages in glass or plastic containers.

b) PRESSURIZED METER DOSE INHALER: growing interest in altering metered dosage inhalers (MDIs) to reduce administration errors and enhance the distribution of aerosolized medication particles into the respiratory tract and nasal passages. An actuator, canister, and occasionally a spacer make up the MDI device. A measuring dose valve with an actuating stem makes up the canister itself. The pressurised metered dosage inhalers (pMDI) are the most practical, flexible, and cost-effective way to administer aerosol medications currently available. The apparatus is designed to release an inhalable, finely distributed pharmaceutical spray. MDIs are used to give formulations, which are solid drug particles suspended in a liquid propellant and aerosolized as a solution or suspension. The starting particle size of the suspended powder is significant since it affects the particle size produced by the device. As a result, the powders used range in size from 1 to 5 m. The powder is kept suspended in the propellants by the employment of surfactants. MDIs have historically contained combinations of C-12, C-11, and C-114 chlorofluorocarbons as propellants. Vapour pressure, particle surface area, and mouthpiece design all have an impact on the inhaler devices' spray patterns. Inappropriate inhaling techniques that involve breathing and actuation coordination are the root of the administration problems with the MDI's aerosol delivery.

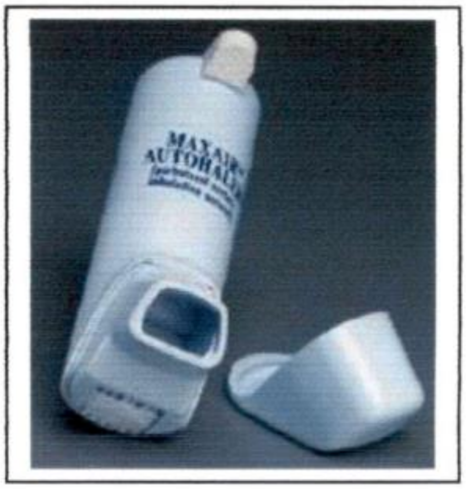
- **Spacer**



Aerosol plumes from metered dosage inhalers can be seen up to 40 cm away from the actuator's departure. huge particles can be collected while giving time for huge droplets to evaporate to respirable size when a spacer is placed between the patient and the MDI. As a result, less substance is deposited in the mouth and more is deposited in the lungs as compared to what is deposited by standard MDIs. To regulate the flow of aerosol and maintain the aerosol cloud until the patient inhales, simple tubes, small and large chambers with inspiratory valves, and other spacers are available.

- **Breath actuated devices:** Young and senior patients are particularly susceptible to the problem of device coordination. The creation of breath-activated technology like the Autohaler contributes to the resolution of this issue. The pMDI is activated by this device's diaphragm at a set inspiratory pressure, so the patient doesn't have to coordinate actuation and inspiration.

Autohaler



- **Non-breath actuated device:** These gadgets, which reduce the patient's need to exert extra effort when inhaling to disperse the medication, are currently under development. This inspiratory effort may fluctuate depending on the patient's age or clinical condition. Inhale Therapeutic Systems uses compressed air to release the medication from a unit dose container into a significant holding chamber, where the patient inhales it.

c)Dry powder inhalers: DPIs are an alternative to metered-dose inhalers (or MDIs), which are aerosol-based inhalers. The DPIs might need to go through a process before the patient can take a measured dose of powder. Commonly, the drug is kept inside the inhaler in a unique form or in a capsule for manual loading. The user inserts the inhaler's mouthpiece into their mouth after it has been loaded or activated, inhales sharply and deeply (ensuring that the drug reaches the lower portions of the lungs), and holds their breath for five to ten seconds. Due to their numerous benefits over MDIs and nebulizers, dry powder inhalers (DPIs) have grown in popularity. The DPIs include no volatile propellant. The patient's breathing alone causes the medicine particles to disperse and entrain in DPIs. DPIs are portable and inexpensive in compared to other distribution systems. A unit dose DPI like the Rotahaler®, a breath-actuated inhaler, is more feasible for people with poor coordination than the Asthalin pMDI. During the design and engineering of a DPI, the formulation of the powder containing the pharmaceutical component must have chemical stability and dispersibility. The metering mechanism of the inhaler must be designed to deliver consistent doses under a range of inhaling conditions. The powder inhaler itself ought to be created in a way that makes it a useful tool that the user can use without difficulty or discomfort. Uncomplicated unit-dose A metered dose of the medicine formulation is contained in a gelatin capsule called a "spinhaler."
Twisthaler® is one brand of dry powder inhaler.
Flexhaler®.
Diskus®.
HandiHaler®.
Ellipta®.
Breezhaler®.

- Spinhaler: Disodium cromoglycate (Intal), both alone and in combination with isoprenaline sulphate (Intal Compound), is frequently administered via spinhalers. The Aventis-created Spinhaler rotates the capsule before it is breathed, releasing the sodium cromoglycate by simply activating a mechanism that punctures the capsule with metal needles. Through perforations bored onto the sides of the capsule walls, the powder diffuses via a "friction whirl" into a sizable air channel during inhalation as the capsule spins within the rotor. An aerosol is created when the powder is propelled through a passageway. The fluidized powder combination must be sufficiently dispersed by an air flow of at least 351/min.

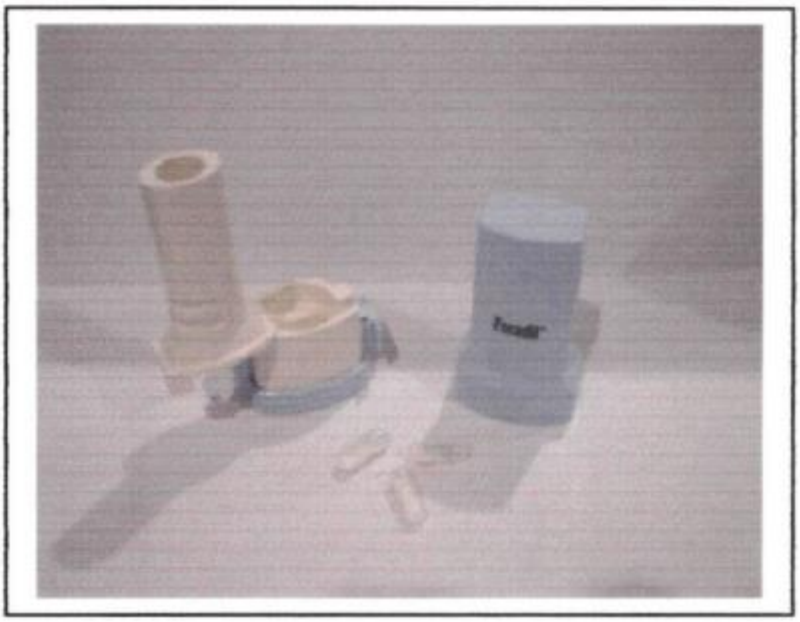


Fig: Spinhaler

- Diskus: Galxo Wellcome's Diskus® is an improvement on the diskhaler method, with the pre-metered doses packaged in blister on a foil strip. Since a coiled strip is utilised in place of a disc in this device, it can carry 60 doses of salmeterol.

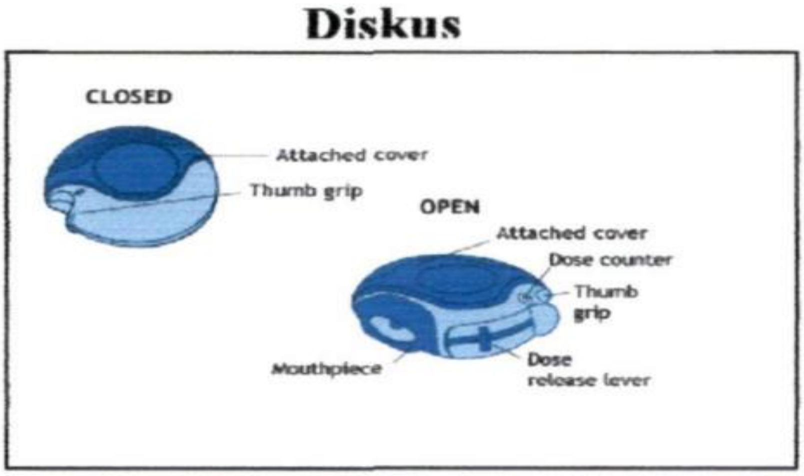


Fig: Diskus

5. Proper use of nebulizer: Put the mask over your face or place the mouthpiece in your mouth in the space between your teeth, then firmly seal it with your lips. Start the compressor. To avoid spills and make sure the medication is properly dispensed, hold the nebulizer upright.

6. Proper use of metered-dose inhalers (MDIs): Without realising it, MDI misuse is simple. If you don't timing your inhalation appropriately with the inhaler releasing the medication, not all of it will reach your lungs.

It's crucial to carefully follow the instructions for utilising your MDI. Request a demonstration from your provider. If a spacer is appropriate for you, you can also inquire. It is a tube that fastens to the mouthpiece and makes it simpler to time when you should inhale the medicine.

7. Proper use of Dry powder inhaler: To pull the drug out, you must be able to breathe in deeply and swiftly. This implies that certain individuals might not be able to use DPIs. Request a usage demonstration from your doctor for the equipment they have prescribed. If you have any concerns about your capacity to use it, talk to them.

8. Conclusion: In this review we have discussed the aerosol delivery devices like Nebulizers,meter dose inhaler, and dry powder inhaler with respect to mechnism, classification and there proper use of device.

REFERENCES:

1. Grossman J. "The evolution of inhaler technology." J Asthma, 31, 55-64, 1994.
2. Hickey A. "Pharmaceutical inhalation aerosol technology." Factors governing aerosol deposition and targeting in the lungs, Marcel Dekker Inc publication, 1-83, 1992.
3. Dale Meisner, “Liposomes as a Pulmonary Drug Delivery System," Fundamental of Controlled Release Drug Delivery, 2nd Edition, 29, 31-59, 1990.
4. Y.W.Chien, "Novel Drug Delivery System", Marcel Dekker publication, 50, 124- 125, 1992.
5. Aulton. "Pharmaceuticals: The science of dosage form design", Gonda, "Therapeutic aerosols", 341-354, 1996.
6. Cyr T, Graham A, Li K, Lovering E, "Low first spray drug content in albuterol metered dose inhaler," Pharmaceut. Res, 8, 658-660,
7. Sears H.R, Talyor D.R, Print G.C, et al, "Regular Inhaled Beta agonist Treatment in Bronchial Asthma," Lancet; 336, 1391-1396, 1990.
8. Stephen P. Newman, "Optimizing delivery of drugs to the lungs". Clinical Asthma Reviews; 2, 123-128,1998.
9. Hill M. "Characteristics of an active multidose dry powder inhaler. Resp Drug Deliv IV, Interpharm Press, Buffalo, Grove, IL, 109-116.
10. www.elandrugdelivery.com
11. Vidgren M, Silvasti M, Vidgren P, Sormunen H. "Easyhaler multi dose powder inhaler-practical and effective alternative to the pressurized MDI." Aerosol Sci Technol, 22, 335-345, 1995.
12. Schultz R, Miller N, Smith D, Ross D. " Powder aerosol with auxiliary means of dispersion, J Biopharm Sci, 3, 115-121, 1992.
13. Cole R, Mackay A. "Essential of respiratory diseases." Edinburgh, Churchill, hvingstone, 1990.
14. Persson G, Olsson B, Soliman S. "The impact of inspiratory effort on inspiratory flow through a Turbuhaler in asthmatic patients." Eur Resp J, 10, 681-684, 1997.
15. Timsina M, Martin G, Marriott C, Lee K, Suen K. " Studies on the measurement of peak expiratory flow rate (PIF) with dry powder inhaler devices in healthy volunteers." Thorax, 48, 433-435, 1993.

16. Meakin B, Caincy J, Woodcock P. "Drug delivery characteristics of Bricanyl Turbuhaler dry powder inhaler". Int J Pharm, 119, 91-102, 1995.
17. Clark A, Hollingworth A. "The relationship between powder inhaler resistance and peak expiratory conditioning in healthy volunteers-Implications for in- vitro testing." J Aerosol Med, 66, 99-110, 1993.
18. Boer D, Winter A, Lerk C. "Inhalation characteristics and their effects on in-vitro drug slivery from dry powder inhalers. Part I Inhalation characteristic, work of breathing and volunteers preference in dependence of the inhaler resistance." Int J Pharm 130, 231-244, 1996.
19. Shah S, Ganesh S, Misra A. "Factor affecting development of dry powder inhalers." Ind J Pharm Sci, 65, 336-345, 2003.
20. Hickey A, Gonda I, Irwin W, Fildes F. "Factors influencing the dispersion of dry powder as aerosol." J Pharm Sci, 79, 1009-1004, 1990.
21. Chawla A, Taylor K, Newton J, Johnson M. “Production of spray dried Salbutamol Sulphate for use in dry powder aerosol formulation." Int J Pharm, 108, 233-240, 1994.
22. Phillips E, Stella V. "Rapid expansion from supercritical solutions: application to pharmaceutical process." Int J Pharm, 62, 65-73, 1990.
23. Ward G, Schultz R. "process-induced crystallinity changes of albuterol sulphate and its effect on powder physical stability." Pharm Res, 12, 773-779, 1995.
24. Ree P, Clark T, Moren F. "the importance of particle size response to inhaled bronchodilators." Eur J Respir Dis, (suppl 119), 73-78, 1982.