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A TRANSDERMAL PATCH REVIEW AND EVALUATION

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ABSTRACT:

One of the novel drug delivery approaches that overcome limitations of traditional dosage is the transdermal drug delivery system. Currently, 74% of medicines are taken orally, which may not provide the necessary effectiveness. The delivery of drugs through transdermal route has the advantage of being always painless. A transdermal patch is an adhesive patch that has been medicated and is applied to the skin to allow a prescribed dosage of medication to pass through the skin and enter the bloodstream. The topical delivery of therapeutic agents presents several benefits in comparison to traditional oral and invasive drug delivery techniques. Transdermal drug administration has a number of significant benefits, including limiting hepatic first pass metabolism, improving therapeutic efficacy, and preserving a constant medication plasma level. The advantages and disadvantages of transdermal drug delivery systems (TDDS), drug permeation pathways, transdermal drug delivery systems and their components, transdermal patch methods of preparation, formulation factors, and evaluation parameters are all thoroughly discussed in this review article. The future prospects for transdermal drugs delivery systems and recent advancements in the area are also included in the study.

KEYWORDS: Transdermal Patches, Skin, Permeation Pathways, Polymer Matrix, Permeation Enhancers.

INTRODUCTION:

When drugs are taken in conventional dose forms, their plasma drug concentrations fluctuate a lot, which may lead to unintended toxicity or poor efficacy.^{1, 2} TDDS stands for transdermal drug delivery system. Another name for it is patches. The Food and Drug Administration authorized the first transdermal patches in 1981. This approach is now more widely used, simpler, and boosts the therapeutic advantages of the medicine applied to the patient. This is the more effective way of delivering the medication to the body.³ Transdermal drug delivery is the term used to describe self-contained, discrete dosage forms that, when applied to undamaged skin, allow the medication to enter the systemic circulation through the skin at a regulated rate. Ensuring patient compliance, enhancing therapeutic efficacy, and ensuring safety are the main goals of controlled drug delivery. Better management of plasma drug levels and fewer doses are needed to achieve this.⁴ A transdermal patch is made up of various components that are essential to the medicine's skin release, such as adherents, liners, drug reservoirs, and drug release membranes. To distribute the medication from the transdermal patch, several kinds of patches and application techniques have been found.⁵

A patch is one of the transdermal drug delivery system's dosage forms.⁶ The skin's stratum corneum acts as a barrier to the transdermal patch, making it difficult for larger molecules to get through. However, this barrier can be removed by including enhancers.⁷ Transdermal patches are a very easy, painless, user-friendly method of multiday dosage, and their primary goal is to administer drugs via the systemic circulation through skin at a pace with inpatient variation and low inter.⁸

Many medications are currently offered as transdermal patches, such as nicotine, fentanyl, clonidine, scopolamine (hyoscine), and estradiol combined with norethisterone acetate. The application location may change based on the drug's therapeutic category. For instance, one can apply estradiol to the abdomen or buttocks and nitroglycerin to the chest. Moreover, the length of the drug's release also dependent upon consumption, ranging from the shortest (up to 9 hours) to the longest (up to 9 days).⁹

ADVANTAGES:

1. There is no hepatic first pass metabolism, salivary metabolism, or intestinal metabolism.
2. Because of the systems' simplicity of use, patients can self-administer them.
3. The medication can be immediately stopped in an emergency by taking off the patch at any moment during therapy.
4. There is little inter- and intra-patient variance since practically all individuals have the same structure and biochemical makeup of skin.
5. Skin application is a suitable route of administration for medications that exhibit stomach discomfort and absorption.
6. Drugs having short biological half-lives that would usually require frequent administration can be provided by continuous, non-invasive infusion.
7. Patient compliance is improved as a result of lower dosage frequency.
8. It is possible to prevent therapeutic failures brought on by uneven dosage administration of traditional treatments.
9. Because the blood concentration time profile is constant and optimal, the negative effects are reduced.
10. You avoid the hazards, discomfort, and inconvenience that come with parenteral treatment.

DISADVANTAGES:

1. For a medicine to pass through the stratum corneum, it must possess certain desired physicochemical qualities. Transdermal administration will be extremely challenging if the drug dosage needed for therapeutic benefit exceeds 10 mg/day.
2. Due to the skin's intrinsic impermeability, only reasonably powerful medicines are appropriate candidates for TDDS.
3. Restarting the system is necessary because some patients have contact dermatitis at the application site for one or more system components.
4. Another aspect that must be thoroughly considered before deciding to manufacture a transdermal medicine is clinical necessity.
5. The skin's barrier function varies with age, from person to person, and from one place to another on the same individual. 11, 12

THE DRUG APPROVED BY FDA FOR TDDS: 13-17

Sr. No.	Approved Year	Drug Products	Indication
1.	1979	Scopolamine	Motion sickness
2.	1982	Nitroglycerine	Angina pectoris
3.	1984	Clonidine	Hypertension
4.	1986	Estradiol	Menopausal symptoms
5.	1990	Fentanyl	Chronic pain
6.	1991	Nicotine	Smoking cessation
7.	1993	Testosterone	Testosterone deficiency
8.	1995	Lidocaine	Local analgesic
9.	1999	Lidocaine	Post hepatic pain
10.	2001	Ethinyl estradiol	Contraceptive
11.	2003	Oxybutynin	Overactive bladder
12.	2006	Fentanyl	Acute postoperative pain
13.	2007	Rotigotine	Parkinson's disease
14.	2008	Granisetron	Chemo induced emesis
15.	2010	Buprenorphine	Chronic pain
16.	2022	Donepezil	Alzheimer's disease

STRUCTURE OF SKIN:

With a surface area of 1.7 m², the skin is the biggest and most accessible organ in the body, making up 16% of an average person's total body mass.¹⁸⁻²⁰ The primary purpose of the skin is to act as a barrier that shields the body from germs, UV radiation, toxins, allergies, and water loss while also acting as a barrier against the external environment.²¹ The viable dermis, hypodermis, viable epidermis, and non-viable epidermis are the four separate tissue layers that make up the skin. The skin's outermost layer, the epidermis, is robust and relatively thin. Keratinocytes are found in the epidermis. They are derived from cells in the basal layer, which is the deepest layer of the epidermis. New keratinocytes gradually advance toward the epidermis' surface. When it is intact, the stratum corneum, the outermost layer of the epidermis, keeps the majority of germs, viruses, and other foreign objects out of the body. It is also somewhat waterproof. The blood vessels, muscles, nerves, and internal organs are all shielded from injury by the epidermis. The epidermis's outermost layer of keratin is much thicker.²² It is estimated that for every square centimeter of skin on humans, there are

between 10 and 70 hair follicles and 200 and 250 sweat ducts. It is among the human body's most easily accessible organs.

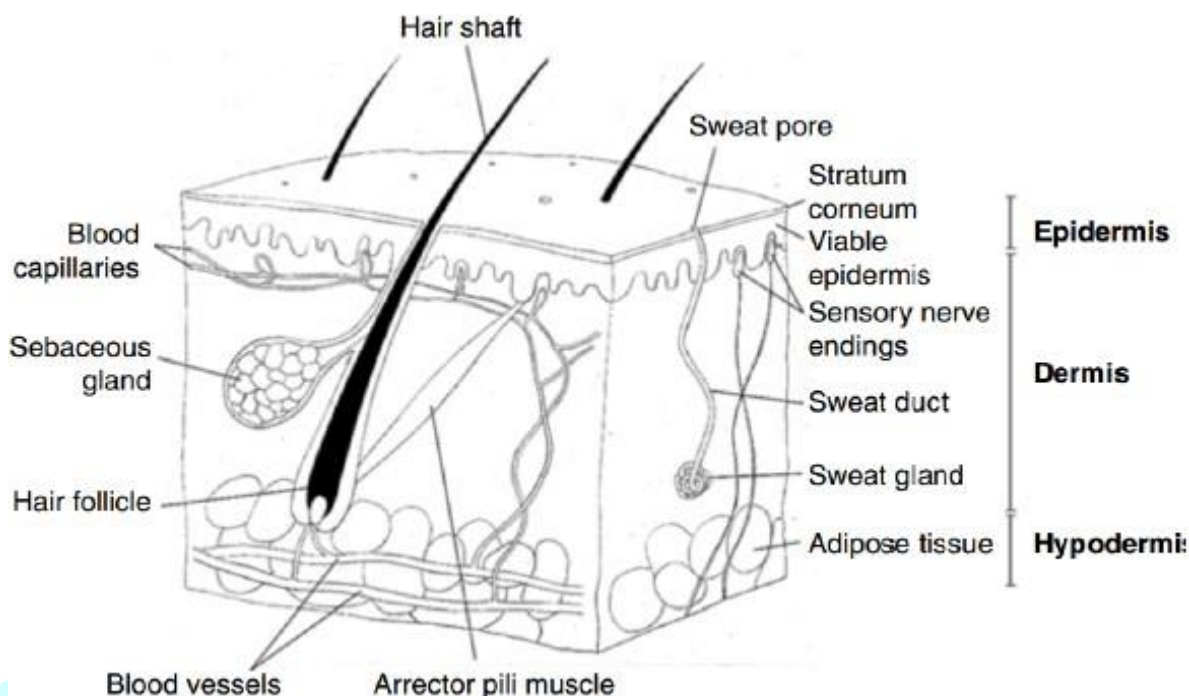


Fig no: 1

DRUG ACROSS HUMAN SKIN:

There are a number of ways that medications can penetrate the skin and enter the body after being administered topically. Medications can enter the body through the appendages (transappendageal) or the stratum corneum (transepidermal). There are two distinct pathways that may be identified for penetration into the stratum corneum: the transcellular pathway, which alternates between passing through the lipid lamellae and corneocytes, and the tortuous pathway, which passes along the lipid lamellae (intercellular route). 23

It is generally accepted that the intercellular pathway is the main way of penetration into the stratum corneum. The heavily cross-linked cornified membrane that covers the keratinocytes is the primary source of this. It is impossible to fully rule out transcellular transport for tiny hydrophilic molecules like water. Either the follicular duct or the duct of the eccrine sweat glands is included in the appendage route, also known as the shunt route. The follicular duct's contents are lipophilic, whereas the eccrine sweat glands' contents are mostly hydrophilic. The primary cause of this is sebum released into the follicular duct aperture. It is commonly acknowledged that intact stratum corneum is the primary route via which passive skin permeation occurs because of its huge surface area. 24-27

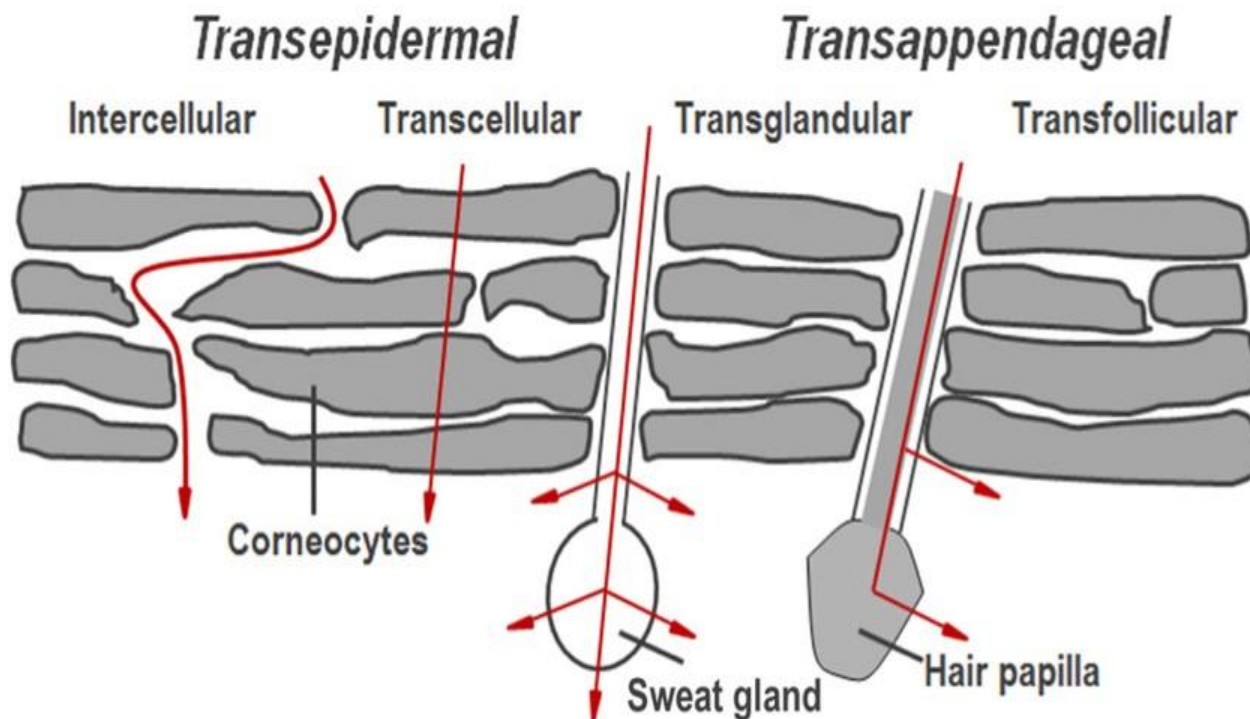


Fig no: 2

TRANSDERMAL PATCHES:

A specified dose of therapy can be administered by directly delivering pharmaceuticals via the skin into the bloodstream with the use of a transdermal patch, which is a transdermal carrier system. The patch can minimize systemic side effects and increase a treatment's therapeutic efficacy since it may control the medication's release. One benefit of this approach over oral, intravenous, and intramuscular medication delivery routes is this. Transdermal drug delivery systems aim to deliver medication into the bloodstream through the skin at a consistent rate that is least variable from patient to patient. 28

The U.S. Food and Drug Administration authorized the first commercially accessible prescription patch containing scopolamine for motion sickness in December 1979. The nicotine patch, which distributes nicotine to aid in quitting tobacco use, was the most popular transdermal patch in the US. In 2007, Europe authorized the first vapor patch to be sold commercially to help people quit smoking. Furthermore, there are several additional patches on the market that ease the peripheral pain associated with shingles, such as lidocaine patches, often known as Lidoderm, nitroglycerine patches for angina, and fentanyl, an analgesic for extreme pain. Bu Trans, a brand name for buprenorphine, is used as an analgesic for moderate to severe chronic pain. 29

COMPONENTS OF TRANSDERMAL PATCHES:

Transdermal patches consist of a polymer matrix/drug reservoir, active ingredient (drug), permeation enhancers, pressure-sensitive adhesive (PSA), backing laminates, release liner, and excipients such as plasticizers and solvents. 30

1. **Polymer matrix:** The building block of a transdermal delivery system is polymers.

Transdermal delivery systems are made of multilayered polymeric laminates, where a drug reservoir or drug-polymer matrix is positioned between two polymeric layers: an inner polymeric layer that serves as a rate-

controlling membrane and/or adhesive, and an outer polymeric layer that is impervious to drugs and prevents drug loss through the backing surface. In order to fabricate transdermal delivery systems that effectively satisfy the various requirements, careful consideration must be given to the design and selection of polymers.

The primary challenge lies in the creation of a polymer matrix. Subsequently, the drug-loaded matrix must be optimized concerning its release characteristics, adhesion cohesion balance, physicochemical properties, compatibility, and stability with both skin and other system components.

There are several kinds of polymers used in TDDS:

- (1) Natural polymers, which include zein, gelatin, shellac, cellulose derivatives, gums, waxes, and natural rubber.
- (2) Artificial rubbers: butyl rubber, nitrile, acrylonitrile, silicon rubber, hydrin rubber, poly isobutylene, and poly butadiene, among others.
- (3) Synthetic polymers include but are not limited to polyvinyl alcohol, polyvinyl chloride, polyethylene, polypropylene, polyacrylate, polyurea, and polymethyl methacrylate. 31

2. **Drug:** The drug selection is crucial for the effective development of a transdermal medication delivery system. Some of the desired characteristics of a medication for transdermal distribution are as follows:

Physical and Chemical Properties:

- The medication's molecular weight should be less than or equal to 1000 Daltons.
- The medication need to have a preference for both hydrophilic and lipophilic phases.
- Severe partitioning features are incompatible with effective transdermal medication administration.
- The medication's melting point need to be low.

Biological Properties:

- The medication needs to be strong, requiring a daily dosage of a few milligrams or less.
- The medication must to have a brief half-life ($t_{1/2}$).
- The medication must not cause allergic reactions or skin irritation.
- Transdermal administration is a good option for medications that break down in the gastrointestinal system or are rendered inactive by the hepatic first-pass effect.
- Because transdermal administration has a nearly zero-order release profile, tolerance to the medication cannot develop.
- Drugs that must be delivered continuously or that have negative effects on tissues other than the intended target can also be designed for transdermal administration. 32-34

3. **Permeation enhancer:** Enhancers work by raising the permeability of the skin to the appropriate therapeutic level. Enhancers should have the following qualities: they should be odorless and colorless, have a controlled and reversible enhancing action, be non-toxic, non-allergic, and non-irritating; they should also be pharmacologically inert, able to act specifically for a predictable amount of time, and be chemically and physically compatible with drugs and other pharmaceutical excipients. 35

4. **Pressure Sensitive Adhesive (PSA):** It facilitates a transdermal patch's increased adhesion to the skin's surface. It may be removed off the smooth surface with ease and without leaving any trace.
 - a) Silicon-based adhesives
 - b) Polyacrylates
 - c) Polyisobutylene

5. **Backing Laminate:** It's a supporting substance that doesn't let medicines or penetration enhancers pass through. They have to be chemically compatible with the excipients, adhesive, enhancer, and medication.

For example - vinyl, polyester, and polyethylene films. 36

6. **Release linear:** Release linear reduces contamination and medication loss during storage by migrating into the sticky layer. 37 However, because the linear is in close proximity to the delivery system, it must adhere to certain specifications about chemical inertness and water, penetration enhancer, and drug permeation. 38

7. **Other excipients such as plasticizers or solvents:**

(a)**Solvents:** Drug reservoirs are made from methanol, acetone, dichloromethane, chloroform, and isopropanol.

(b)**Plasticizers:** To give the transdermal patch flexibility, additional ingredients such as propylene glycol, triethyl citrate, polyethylene glycol, and dibutyl phthalate are added. 39

TYPE OF TRANSDERMAL PATCHES:

1. **Single-layer Drug in Adhesive:** The adhesive layer in this kind of patch is in charge of both medication release and adhering the system's several layers to the skin. A backing and liner are used as temporary coverings for the adhesive layer.
2. **Multi-layer Drug in Adhesive:** Since both sticky layers in this kind of patch are in charge of medication release, they are comparable to single-layer patches. There is an additional layer in this system that must cling to the medication; often, a membrane separates them, although this isn't always the case. Both permanent and temporary liner layers are included in this patch. 40
3. **Reservoir:** A drug reservoir is positioned in this system between the rate-control membrane and the support layer, and the medication is released across the membrane with micro pore rate control. Within the reservoir compartment, the medication may be distributed across a solid polymer matrix or as a gel, suspension, or solution. 41
4. **Matrix:** The backing layer, which serves as the formulation's outermost layer, and the adhesive make up the majority of the matrix system. To create an adhesive solution, which is subsequently evaporated to create a matrix film, pharmaceuticals and other additives, such as polymers and enhancers, are combined. The matrix film and backing film are then joined together. The transdermal patch that is most often used on the market is the matrix-type patch. This matrix method has the benefit of a thin and elegant preparation formed by the patch, making it easy to use and facilitating a quick, simple, and affordable production process. 42

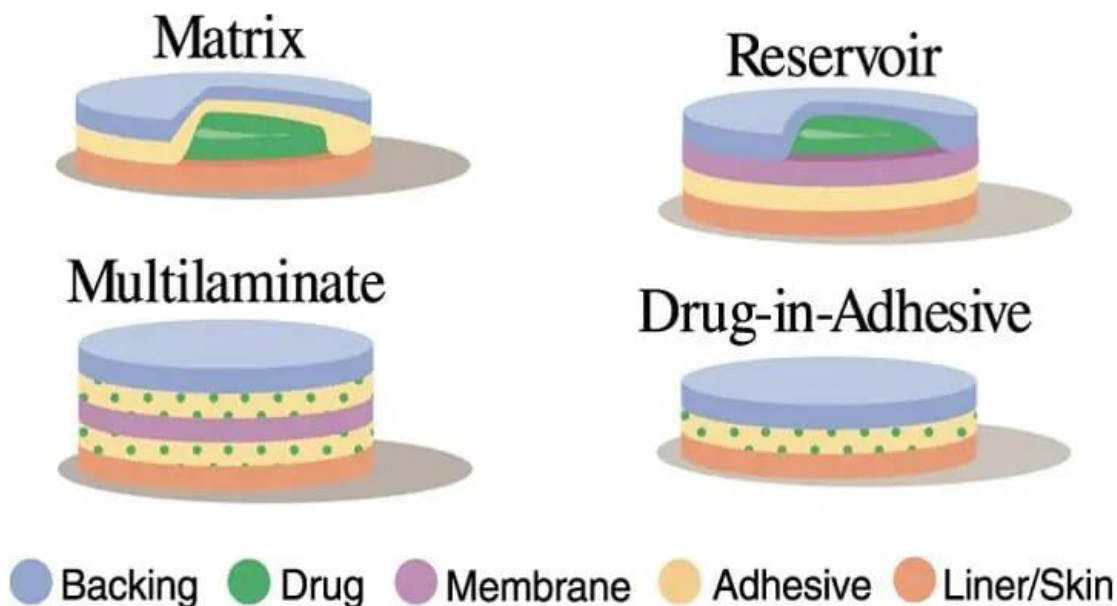


Fig no: 3

VARIOUS METHODS OF PREPARATION OF TDDS:

1. The asymmetric TPX membrane technique :

A heat-sealable polyester sheet (the backing membrane) that is concave and has a diameter of one centimeter can be utilized to create a prototype patch. A concave membrane is filled with the drug sample, sealed with an adhesive, and coated with an asymmetric TPX membrane (poly (4-methyl-1-pentene)). The dry/wet inversion method is used to make them. Polymer solution is created by dissolving TPX in a combination of nonsolvent additives and solvent (cyclohexane) at 60°C. A Gardner knife is used to cast the polymer solution to a specific thickness on a glass plate after it has been held at 40°C for 24 hours. The glass plate must then be submerged right away in a coagulation bath after the casting film has evaporated at 50°C for 30 seconds. The membrane can be removed after 10 minutes of soaking and air-dried for 12 hours at 50°C in a circulation oven. 43

2. Using a circular Teflon mold:

In an organic solvent, solutions with different ratios of polymers are utilized. The medication is dissolved in half as much of the same organic solvent as estimated. After dissolving enhancers in varying quantities in the remaining organic solvent, they are added. The drug-polymer solution is mixed with the plasticizer. After mixing the entire mixture for 12 hours, pour it into a circular Teflon mold. To regulate the vaporization of solvent in a laminar flow hood model, the molds must be positioned on a level surface and covered with an inverted funnel at a speed of 0.5 m/s. For a whole day, the solvent is left to evaporate. To prevent aging effects, the dried films must be kept for a further 24 hours at 25±0.5°C in a desiccator filled with silica gel before examination. These films, which are to be assessed a week after preparation, are ketorolac-containing bioadhesive films. Using a variety of bio adhesive polymers, including sodium carboxymethyl cellulose (Na-CMC), hydroxypropyl cellulose (HPC), hydroxypropylmethyl cellulose

(HPMC), and carbopol 934, films were cast from organic and aqueous solutions. The produced films were investigated for their mechanical and physical characteristics, swelling patterns, bio adhesion in vitro, drug penetration through the buccal mucosa of cows, and drug release in vitro. 44

3. Mercury Substrate Method:

This process involves dissolving the medication and plasticizer in the polymeric solution. After agitating for ten to fifteen minutes to create a uniform dispersion, the mixture is poured onto a leveled mercury surface and covered with an inverted funnel to regulate the evaporation of the solvent.

4. By Using “IPM Membranes” Method:

Drug is distributed and swirled in a magnetic stirrer for 12 hours with a combination of water and polymer (propylene glycol with Carbomer 940 polymer). Triethanolamine is added to the dispersion to neutralize it and give it viscosity. For very low drug solubility in aqueous solution, pH 7.4 buffer is used to create a solution gel. Incorporating the gel into the IPM membrane is the plan.

5. By Using “EVAC Membranes” Method:

Polyethelene (PE), 1% carbopol reservoir gel, and ethylene vinyl acetate copolymer (EVAC) membrane are required as rate-control membranes for the manufacture of TDS. If the medication cannot be dissolved in water, prepare the gel using propylene glycol. The medication is dissolved in propylene glycol, and then the mixture is mixed with carbopol resin and neutralized using a 5% w/w sodium hydroxide solution. The medication (in gel form) is applied to a backing layer sheet that covers the designated region. To create a leak-proof device, a rate-regulating membrane will be put over the gel and the edges will be heated to seal. 45, 46

APPROACHES USED IN DEVELOPMENT OF TRANSDERMAL PATCHES:

1. Adhesive diffusion-controlled system
2. Membrane moderated systems
3. Matrix dispersion system
4. Micro reservoir systems 47

IDEAL PROPERTIES OF DRUG FOR TDDS: 48

S.NO	PARAMETERS	PROPERTIES
1	Dose	Should be low
2	Molecular weight	Less than 500
3	Partition coefficient	Log P (-1 and 3)
4	Half-life in hr.	Should be 10 or less
5	Skin reaction	Should be non-irritating
6	Skin permeability	Less than 0.5×10^{-3} cm/hr.
7	Oral bioavailability	Should be low
8	Therapeutic index	Should be low
9	Concentration	Minute
10	Dose deliverable	Greater than 10mg/day

FACTORS AFFECTING TRANSDERMAL PATCHES:

Transdermal patches work differently depending on a number of parameters.

These are listed below:

Physicochemical properties:

1. Solubility/melting point;
2. Partition coefficient;
3. Molecular size
4. Ionization

Skin Physiological and Pathological Conditions

1. Horny layer reservoir effect
2. Lipid film
3. Skin hydration
4. Skin temperature
5. Regional variation
6. Pathological skin injuries
7. Cutaneous self-metabolism
8. Skin barrier properties in the neonate and early infant
9. Age-related changes in the skin's barrier qualities
10. Race

11. Body site and
12. The usage of penetration enhancers. 49

EVALUATION OF TRANSDERMAL PATCHES:

Transdermal drug delivery systems, which produce a smaller and longer release of the medication at a predefined pace, have been created to increase the therapeutic effectiveness of the medicine and patches to boost patient compliance.

1. **Physical Appearance:** The color, clarity, opacity, translucency, flexibility, and smoothness of each created patch were examined visually. 50
2. **Thickness of Patch:** Digital micrometers, traveling microscopes, micrometer screw gauges, or vernier calipers were used to measure different spots on each patch to estimate its thickness. Every patch had its dimensions collected at various points. We assured accuracy in evaluating the formed patches' thickness by computing the average thickness and standard deviation.
3. **Weight Uniformity:** The made patches were dried for four hours at 60°C before the weight uniformity test was performed. Each patch was divided into distinct portions in order to conduct the test, and each section was then weighed using a digital balance. From these individual weight readings, the average weight and standard deviation were computed. 51
4. **Folding Endurance:** The patch is cut consistently in one region and then folded repeatedly at the same location until it breaks. Prior to the patch breaking, the number of folds is recorded. It will provide stability to the folding. 52
5. **Percentage Moisture Loss:** The prepared patches are weighed one at a time and stored for a full day at room temperature in desiccators filled with anhydrous calcium chloride. The patches are weighed after the 24-hour period at predetermined intervals until a consistent weight is achieved. The following formulae are used to determine the % moisture loss:

$$\text{Percentage moisture loss} = \frac{(\text{Initial wt} - \text{final wt})}{(\text{initial wt})} \times 100$$

6. **Percentage Moisture Uptake:** Individually weighted formulated patches are stored in desiccators with saturated potassium chloride or ammonium chloride. RH is kept constant at 84%. The patches are weighed again after a day at predetermined intervals until a steady weight is reached. 50

$$\text{Percentage moisture uptake} = \frac{(\text{final wt.} - \text{initial wt.})}{(\text{initial wt.})} \times 100$$

7. **Water Vapor Permeability Evaluation (WVP):** The flow of air naturally determines it. You may use the following formulas to estimate it:

$$\text{WVP} = W/A.$$

WVP is measured in g/m² every day.

Where W is the volume of vapor that entered the patch (gm/24 hours).

A = exposure samples' surface area (m²) 52

8. **Drug Content Analysis:** Carefully weighted prepared patches are introduced to a solvent capable of completely dissolving the medication. After that, a shaker incubator is used to continuously shake this mixture for a whole day. The solution is then filtered to get rid of unwanted contaminants and subjected to sonication to guarantee adequate mixing. After the required dilution has been applied, the resultant filtrate is next examined using suitable methods like UV spectrophotometry or high-performance liquid chromatography (HPLC). 53
9. **Percentage Elongation Break Test:** The length of the patch immediately before the break point is used to calculate it.
(Final length-Initial length)/Initial length x 100 is the percentage elongation. 50
10. **Flatness:** A transdermal medication patch has to have a flat surface that doesn't get smaller with time. A flatness test can be used to study it. In this test, two strips are cut from the right and left sides, and one strip is cut from the center. Every strip has a measured length. The percentage constriction is used to quantify the variance in length. A percentage of 0% constriction denotes 100% flatness. 53

$$\% \text{ construction} = (\text{initial length} - \text{final length}) / \text{initial length} \times 100$$

11. **Skin Irritation Test:** Testing for skin penetration and sensitization uses healthy rabbits. The dorsal surface of the rabbits' skin is where the specially prepared patches are applied with care. The hair on the rabbits' skin is removed before the patch is attached. The skin is closely monitored and evaluated for any possible indications of irritation or negative responses following a 24-hour period. 54

12. **In vitro drug release studies:**

To evaluate the drug's release from the prepared patches, the paddle over disk method (USP apparatus V) is used. Dry films with a known thickness must be weighed, cut into a specific shape, and adhered to a glass plate using an adhesive. After equilibrating the apparatus to $32 \pm 0.50^\circ\text{C}$, the glass plate is submerged in 500ml of the phosphate buffer (pH 7.4) or dissolution medium. Next, the paddle is moved to a distance of 2.5 cm from the glass plate and is turned at a speed of 50 revolutions per minute. Up to 24 hours can pass between the appropriate time intervals for sample withdrawal (5 ml aliquots), and analysis by UV spectrophotometer or HPLC. 55

13. **In-vitro permeation studies:**

After being released from the polymeric films, the medication enters the skin and travels via the epidermis' cells or between its cells via skin appendages, eventually reaching the dermal microcirculation. For permeation experiments, a Franz diffusion cell or Keshary-Chien diffusion cell is used as a vertical diffusion cell with the artificial transdermal patch made of rat skin or synthetic membrane placed between the donor compartment and receptor. The lipophilic side of the transdermal system is in touch with the receptor fluid after it has been applied to the hydrophilic side of the membrane and placed in the diffusion cell. A steady rate of stirring and a predetermined temperature are maintained in the receiving compartment. At various times, the samples are removed, and the same volume of buffer is added each time. The materials are suitably diluted and quantified using an

appropriate analytical technique. It is computed how much medicine has infiltrated each square centimeter at each time interval. 56

APPLICATION OF TRANSDERMAL PATCHES:

1. The most popular transdermal patch for quitting tobacco use is the nicotine patch. It was authorized in 2007 as a smoking cessation vapor patch.
2. Use of hormones:
 - a. Menopausal symptoms can be treated with estrogen patches.
 - b. Evra or Ortho Evra as a patch for contraception.
3. Motion sickness sufferers utilize scopolamine patches.
4. A nitroglycerine patch is used to treat angina.
5. Vitamin B12 supplements, such as the Cynocobalamine transdermal patch, are also taken.
6. The purpose of caffeine patches is to absorb caffeine via the skin.
7. The UK 5-Hydroxytryptophan patch was also introduced in 2014.
8. Alzheimer's disease is treated with the Exelon brand. 57-59

CONDITION IN WHICH TRANSDERMAL PATCHES ARE USED:

When: The patient is unable to take oral medication due to dysphagia and is asking an alternate mode of drug administration; when the patient has unacceptable side effects, such as constipation.

Where effective administration might lead to better pain management. Patients who are unable of using their analgesics for self-medication due to cognitive impairment or other conditions may find this helpful.

CONDITION IN WHICH TRANSDERMAL PATCHES ARE NOT USED:

When:

- (1) Treating acute pain is necessary; transdermal patches should not be used.
- (2) When a quick dosage titration is necessary.
- (3) When the dosage needed is 30 mg or less per 24 hours or less. 60, 61

RECENT ADVANCES IN THE FIELD OF TRANSDERMAL DRUG DELIVERY SYSTEM:

1. Protein delivery using patch technology
2. Transdermal patches for painless diabetes monitoring
3. In young women experiencing spontaneous premature ovarian failure, the use of testosterone transdermal patches
4. A transdermal oxybutynin patch is used to treat overactive bladder (OAB).
5. Pain management
6. Enhancement technique for molecular absorption. 62,63

CONCLUSION & FUTURE PROSPECTS:

Compared to traditional medication delivery, transdermal patches provide several benefits such as higher bioavailability, avoidance of gastrointestinal side effects, avoidance of first-pass metabolism, preservation of the drug in plasma, and improved patient compliance. The qualities of the patch made of different polymers as well as in vitro penetration and release tests determine if a patch is appropriate for transdermal delivery. The key to effective medication delivery is skin and patch adherence. The drug should be medium in terms of lipophilicity and water solubility, with a specific molecular weight of less than 500 Dalton. If not, the target location cannot be reached by drug penetration and its therapeutic impact. It offers a steady blood flow and a predefined rate of drug release while the medication is being delivered. The lipid barrier is crossed and the drug molecule is pushed into the systemic circulation via enhancing techniques such as iontophoresis, which uses a low voltage, and electrophoresis, which uses a high voltage.

Painless injections may be the way of the future with transdermal medicine administration. It is being looked into as a vaccine delivery option for nanoparticles. Many transdermal devices have previously been successfully introduced to the market, and many more are in the process of doing so. The recent study conducted in this field by researchers has been briefly discussed in this review. The article reports on a number of techniques used as well as the polymers used for the same.

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