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Pharmaceutical Platform Technology: Devising of New Modalities and Drug Delivery Systems

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Abstract:- By advancing drug delivery science, one can obtain medicines that are easier to use, require less frequent dosing, and are more convenient, allowing patients to spend less time managing their disease. In the near future, novel drug delivery tools and platform technologies have the potential to change the way we develop medicines. In addition to internal platforms and technologies, enhancement of targeting and specificity of novel delivery systems, as well as expansion of routes of administration, may be accomplished in the coming years, with the potential patient benefit always in mind. This review is a summative report of various evolutions in platform technology that share the same base drug delivery.

Keywords:- *Platform, Drug Discovery, Technology Transfer, Microfluidic Systems, Biological Targets.*

I. INTRODUCTION

A platform is typically defined as a collection of technologies that may be utilised as a foundation upon which additional technologies, processes, and applications can be developed. In layman's words, a platform is a foundation over which additional infrastructure, layers, and processes are built in order to have innovations, newest methods, and process sophistication. The base is an example of a mobile that we use on a daily basis, onto which new apps are created, but the mobile remains the same. Mobile simply serves as a platform for many applications to run on. Platform technology[1] provides a common technique, common procedure, and common procedure that may be improved in research, development, and manufacturing. In this scenario, we are developing a standard protocol that will allow us to design more strategies that will lead to the product's continuing development. Pharmaceutical platform technologies provide a substantial contribution to improving product efficiency and quality. Platform technology's conceptual development is a wonderful combination of a risk-based method to gaining previous information for a particular new molecule. Platform technology is becoming increasingly popular in the bioprocessing business.

II. PLATFORM TECHNOLOGY'S IMPORTANCE

Platform technology establishes a ground or foundation on which new applications may be constructed so that any changes that occur can be easily absorbed by people or organisations. Computing platforms, database platforms, storage platforms, application platforms, mobile platforms, and web platforms are examples of platform technology. In the pharmaceutical industry, we employ all of these platforms, as well as some of these applications and technology. In terms of pilot batches, we go through a number of validation procedures and optimization methods before developing commercialization batches. Technologies are critical in terms of drug research and development platforms. They are extremely valuable and crucial instruments for on-going development and improvement. When we talk about drug research and development, we split it into five major stages:

- Target selection - If we have a uniform approach that is followed for all new drug discovery, the process becomes simple and rapid. Protein expression and engineering are involved in this case.
- Lead generation - An automated high-throughput screening method is used.
- Medicinal chemistry, structure biology, and computational drug design and modelling are all involved. Drug metabolism and pharmacokinetics are engaged in optimization and in vivo research.
- Optimized drug candidate - This is the early stage of development. The drug development project management team is involved. When we see an early product development phase or a new molecule development phase, we need to thoroughly analyse the new drug substance, optimise with different excipients, and carry out various pre-formulation studies. In order to carry out all of these studies, we need to develop a standard protocol or standard platform that can be used for several other products.

➢ *Audit*

It will greatly assist us in the right selection of dose form, formulations, toxicity, and selection of acceptable excipients. It will also define the standards for active pharmaceutical ingredients (API) and drug products in the dosage form of choice.

Can a platform technology be applied in the following areas? such is in vivo / ex vivo pharmacology, as seen below

- To develop suitable in vivo / in vivo pharmacology models to assess the biological actions of drugs with promising in vitro results (cancer, diabetes, infectious disease).
- To assess the liability of lead compounds in terms of toxicokinetics and safety pharmacology.
- Identifying drug leads and potential development candidates.
- Drug Discovery Platform: There are several platforms accessible these days that are widely used in high content

screening, hybrid multi-modelled pharmaceuticals, and microplate readers. Aside from these technologies, we also need data management and quality control, which are employed by databases. Platform technology is used in biotechnology and molecular biology to identify novel disease / targets, in vitro / in vivo screening, protein expression, and engineering. Platform technology may also be used to research medication metabolism and pharmacokinetics. Platform technology can help us find new medication leads.

III. ADVANTAGES OF PLATFORM TECHNOLOGY

- Less work, time, and money spent on process development.
- Failure rates are being reduced.
- Risk assessments can be carried out.
- Documentation simplicity.
- Product performance consistency.
- Technology transfer activities are being simplified (from R and D to manufacturing plant).
- Personal training strain is reduced.

IV. COMMERCIAL DRUG DELIVERY SYSTEMS EVOLUTION

Many pharmaceutical treatments have been developed as a result of drug delivery methods, which enhance patient health by improving therapeutic delivery to the target location[2], decreasing off-target accumulation, and increasing patient compliance. To be effective, medications must reach the site of action in the patient in the proper concentration and at the right timing. As researchers strive to make every target drug gable and build the next generation of drug delivery methods, the most promising compounds will be transformed into the medications of the future. And, as treatment modalities evolved, drug delivery systems adapted to meet the new obstacles. The effective therapeutic items that formed the foundation of modern medication delivery[3,4] are mentioned here.

➢ *Nano technology based drug delivery systems*

Conventional drug delivery methods include drawbacks such as a lack of selectivity, a faster rate of drug metabolism, cytotoxicity, a high dosage required, poor patient compliance, and so on. These can be overcome by medication delivery devices designed employing pharmaceutical nanotechnology concepts[5]. Metal nanoparticles have been utilised in a variety of biomedical applications such as electron microscopy probes to examine biological components, drug delivery (carrier for delivering medicines, proteins, peptides, plasmids, DNAs, and so on), detection, diagnosis, and treatment. When combined with affinity ligands, these nanoparticles have found crucial uses as chemical sensors. Silver nanoparticles have been frequently used to prevent the assault of a wide range of microorganisms on prostheses, catheters, vasculargrafts, and human skin; they are also utilised in medicine to minimise infection in burn therapy, arthroplasty, and other procedures. They are, however, not harmful to mammalian cells. Magnetic nanoparticles (MNPs) have sparked significant interest in recent years due to their unique magnetic properties and ability to function at the cellular and molecular level of biological interactions, making them an appealing platform as contrast agents for magnetic resonance imaging (MRI) and drug delivery carriers. Mesoporous silica systems appear to be ideal for drug encapsulation, protein encapsulation, and the encapsulation of other biogenic molecules. Currently, mesoporous materials are being used for hosting and delivering a variety of molecules. Bioactivity is a key aspect for the possible application of mesoporous silica materials-based therapeutic systems. Polymers are used in medicine delivery systems. Because of their unique features and huge potential in drug delivery, engineering polymeric nanostructures such as hyperbranched polymers, dendrimers, and polymeric micelles is a burgeoning topic of modern biomaterials science. In addition to drug diffusion through the polymeric material, they can contribute to drug release as a result of their erosion/degradation. Carbon Nano Tubes have gotten a lot of interest because of their exceptional mechanical, electrical, and surface characteristics, which make them perfect candidates for a wide variety of applications such as structural materials. These have been shown to provide significant benefits in biosensors, biomedical devices, and drug delivery systems. Liposomes, which are minuscule phospholipid bubbles with a bilayered membrane structure, have attracted a lot of interest in the last 30 years as prospective medicinal carriers. Recently, several new discoveries in the field of liposomal medications have been witnessed, ranging from clinically authorised pharmaceuticals to novel experimental uses, with gene delivery and cancer therapy being the primary areas of focus. Figure 1 depicts novel medication delivery systems based on a nanotechnological approach.

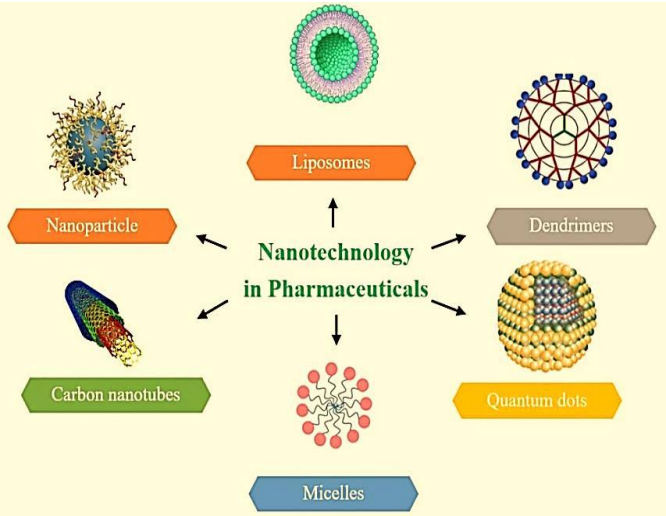

Fig 1: Novel drug delivery systems employing nanotechnology

➢ *Microfluidic systems*

Reducing the so-called "drug route," or the distance from the point of administration to the region of interest, is one of the most difficult tasks in drug research today. Indeed, significant advances in medication discovery have been

achieved in recent years, with more and more powerful chemicals found each year, but the procedures used to test these treatments have not progressed as far. Microfluidics can assist the pharmaceutical sector in both medication development and administration. Indeed, innovative lab-on-chip designs are giving researchers access to novel platforms for drug manufacturing and delivery. Furthermore, microfluidics permits the creation of medicine delivery devices that are low-cost, simple to use, less painful, and devoid of side effects.

➢ *Microneedles*

MN technology[6, 7] is an active transdermal medication delivery mechanism that is intended to be used as an alternative to standard syringe injections. The MN array is utilised to penetrate the stratum corneum and administer the medicine in a non-invasive manner. These arrays are made up of micro-sized needles with heights ranging from 25 to 2000 m. MNs have been used in a variety of applications, including drug and vaccine delivery, cosmetics, and disease diagnostics.

➢ *Gelling Drug Delivery Systems in Situ*

These have gotten a lot of attention in the recent decade. They are in a sol-state before to delivery and can form gels in response to endogenous cues such as temperature rise, pH change, and the presence of ions. Such systems can be given in a variety of ways to accomplish local or systemic drug administration and they can also be employed as carriers for drug-loaded Nano- and micro particles. For the development of such systems, natural, synthetic, and/or semi-synthetic polymers with in situ gelling activity[8] can be utilised alone or in combination; association with mucoadhesive polymers is very desired in order to further prolong the residence duration at the site of action/absorption. In situ gelling systems also include solid polymeric formulations, which are typically generated by freeze-drying and, when in contact with biological fluids, undergo rapid hydration, resulting in the development of a gel capable of releasing the drug loaded in a controlled manner. Various in situ gelling drug delivery systems for non-parenteral administration routes, such as ocular, nasal, buccal, gastrointestinal, vaginal, and intravesical, have been developed in the last ten years, with a special focus on formulation composition, polymer gelation mechanism, and in vitro release studies.

➢ *Polylactic Co Glycolic Acid Micro Particles*

Among the few polymers authorised for clinical usage are poly(glycolic acid) or poly(glycolide) (PGA), poly(lactic acid) or poly(lactide) (PLA), and poly(lactic-co-glycolic acid) or poly(lactide-co-glycolic acid) (PLGA). PLA and PLGA quickly became the standard materials for the development of injectable controlled release systems, particularly microparticles, after their approval as materials for the creation of bioresorbable surgical sutures. More than 15 products based on this technology have been approved and commercialised since the 1986 approval of Decapeptyl® SR, the first product based on PLGA microspheres. Today, there is a resurgence of interest in PLA/PLGA microparticulate systems research. With several licenced products on the market, injectable PLA/PLGA microparticles are regarded as a reliable drug delivery technology and offer particular promise for the administration of therapeutic peptides, a field of research that is rapidly expanding. Furthermore, when the first patents expire, pharmaceutical firms have expressed interest in developing generic PLA/PLGA-based pharmaceuticals, a complex process that will need significant academic, industry, and regulatory research. Indeed, demonstrating pharmacological equivalence and bioequivalence for PLA/PLGA microparticulate products is far more difficult than for medical goods based on traditional oral dosage forms, such as quick release tablets or capsules. Last but not least, as part of the medication delivery device business area, PLA/PLGA microparticulate devices may be profitable for pharmaceutical enterprises. Indeed, the worldwide medication delivery device market was valued at more than 330 billion USD in 2016 and is predicted to reach over 930 billion by 2024. Compared to traditional oral or parenteral dose forms, implantable medication delivery systems have various benefits. For starters, implanted devices enable medicine delivery at the location of greatest need. Implants used to treat brain tumours or prostate cancer are two examples. This may also allow for substantially lower medication dosages, reducing possible adverse effects. Second, as seen in the following figure, implanted devices enable the prolonged delivery of a therapeutic substance (Figure 2). The last, and possibly most crucial, advantage is improved patient compliance, as the treatment regimen associated with an implanted device is often less onerous than tablets or injections.

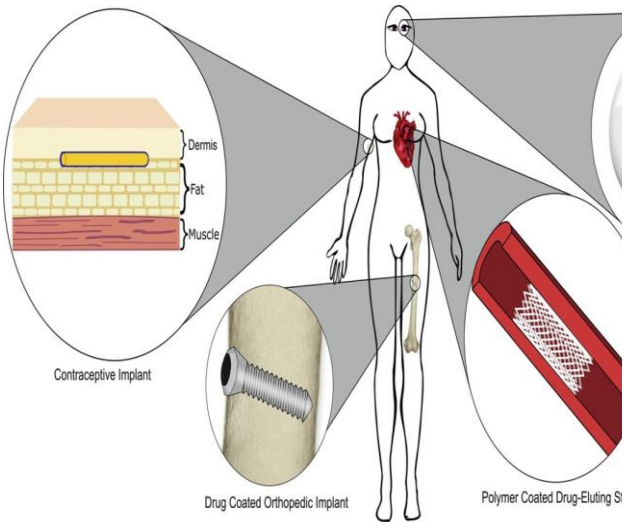

Fig: 2 Types of Implants

Implantable drug pumps[9, 10] are used to provide insulin to diabetic patients and to give pain medicines directly to the spine. These are primarily programmed "active" devices that require drug refill on a regular basis via an access port. Subcutaneous solid implants, on the other hand, give long-term, "passive" release that does not require replenishment. These delivery devices, which are often found as tiny flexible rods or "matchsticks," are particularly useful for the administration of very strong medications such as hormones. Histrelin implants for the palliative treatment of prostate cancer and uterine fibroids as well as early puberty in children, levonorgestrel implants for family planning, and

buprenorphine for the treatment of opioid addiction are commercial examples. Subcutaneous implants for the treatment of schizophrenia, breast cancer, photosensitivity, and Parkinson's disease are also in the works. Under ophthalmology, there are a number of potential solid implant applications for the treatment of macular edoema and retinal vein blockage with corticosteroids, as well as products in development for the treatment of glaucoma and age-related macular degeneration.

- *The Use of Liquid Crystalline Systems[11-13] as A Drug Carrier:*

Its applications in medication delivery are highlighted. Drug distribution to targeted biological targets may be accomplished efficiently utilising liquid crystals techniques since they respond to both pH and temperature depending on the type of liquid crystal systems used for drug molecule administration. It may be used to formulate any type of formulation intended for distribution via multiple routes of administration due to its wide range of drug loading, regardless of its hydrophobicity or hydrophilicity. Because of their outstanding potential as drug carriers, hexagonal and cubic mesophases are of great interest. This drug loading approach is quickly becoming one of the most promising, but it requires significant study to broaden its spectral range in the formulation development arena.

V. CONCLUSION

In general, advanced drug delivery technologies enable drug reformulation and administration methods, all of which contribute to life-cycle management and allow the innovator to keep the product exclusivity. Over the years, there has been a continuous transition from simple life-cycle management to drug repurposing, which involves using delivery technologies to address solubility and permeability difficulties in the early stages of drug development processes or safety and effectiveness issues in the late stages. As a result, the goal of this analysis is to take stock of recent improvements in drug delivery technologies that may be used to improve the risk-benefit profiles of existing systems and employ them in the early discovery phase to reduce drug attrition rates.

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REFERENCES

[1]. Robert A. Good now, JR, Annual reports in medicinal chemistry, platform technologies in drug discovery and validation, volume 5.
[2]. Langer, R. Drug delivery and targeting. Nature 392, 5–10 (1998).
[3]. Chien, Y. Novel Drug Delivery Systems (CRC Press, 1991).
[4]. Langer, R. New methods of drug delivery. Science 249, 1527–1533 (1990).
[5]. Pratibha Muntha*, Pharmaceutical Nanotechnology - Applications of Nanotechnology in Pharmaceutics, Research and Reviews: Journal of Pharmaceutics and Nanotechnology, Volume 4 | Special Issue 2, 2016.
[6]. Ava M. Vargason l, Aaron C. Anselmo l and Samir Mitragotri, The evolution of commercial drug delivery technologies, Nature Biomedical Engineering | VOL 5, September 2021, 951–967.
[7]. Vladimir P. Torchilin , Recent advances with liposomes as pharmaceutical carriers, Nature Reviews Drug Discovery volume 4, pages145–160 (2005)
[8]. Deepak Kaushik, Harish Dureja, Recent patents and patented technology platforms for pharmaceutical taste masking, 2014 Apr; 8(1):37-45.
[9]. G P Belyakov, N T Avramchikova, G Y Belyakova, M N Chuvashova, Technology platforms: opportunities and development perspectives, IOP Conf. Series: Materials Science and Engineering 155 (2016) 01 2003.
[10]. D. M.*, chaudhari p. D and more s. D designing a platform technology for age appropriate pediatric dosage form, 2019 | volume no. 56 | issue no.05 | page no. 14-23.
[11]. Dr. Deanna Mudie, Dr. Kimberly Shepard, Dr. Michael Morgen, John Baumann, An Engineered Platform For High-Loaded Dosage Forms Of Amorphous Solid Dispersions.
[12]. Dongyang Fang[1], Yining Yang[1], Mengsuo Cui[1], Hao Pan[2], Lijie Wang[1], Pingfei Li[1], Wenjing Wu[1], Sen Qiao[1] & Weisan Pan[1] Three-Dimensional (3D)–Printed Zero-Order Released Platform: a Novel Method of Personalized Dosage Form Design and Manufacturing, *AAPS PharmSciTech* volume 22, Article number: 37 (2021)
[13]. Ava M. Vargason, Aaron C. Anselmo & Samir Mitragotri, The evolution of commercial drug delivery technologies, *Nature Biomedical Engineering* volume 5, pages951–967 (2021).