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Editorial

A Perspective on Drug Discovery, Development and Delivery

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Editorial

Understanding a disease and bringing an efficacious new treatment to patients is an intricate, costly and long-term process. This entire process from discovering and developing a potential drug candidate to its delivery into the human body takes an average of 10-15 years and costs around $0.8 - 1.0 billion per drug [1,2]. It requires comprehensive knowledge about the root cause of the disease at molecular, cellular and genetic levels, identification of the 'druggable' target to which potential new drugs might be able to interact, validation of the target, discovery of the potential drug that can interact with the desired target, and testing of its safety and efficacy in humans. This is followed by the regulatory review and approval of the drug and subsequent provision to the patients.

Drug discovery: In the drug discovery process, firstly, a good target (which may include, proteins, DNA and RNA) needs to be determined, which should have characteristic features, like effectiveness, safety, ability to meet clinical and commercial standards and, most importantly, be 'druggable'[3]. This step is followed by target validation, which is a multi-functional process, involving various in-vitro and in-vivo validation assays, e.g., antisense technology based probes (RNAi) and alternatively, transgenic animal models as validation tool [4]. After the target has been validated, screening a library of compounds is performed to find the lead compound that may interact with the identified 'druggable' target and alter the pathological path. The lead compound can be identified through various methods, such as isolation from the natural products [5], high-throughput screening [6], NMR based screening [7], and *de novo* synthesis [8].

Drug development: Once the lead compound has been identified, further rigorous testing and optimization is performed on the lead compound, including pre-clinical research on microorganisms/ animals and clinical trials on humans to identify the 'potential drug candidate' which may be most effectual with respect to safety, toxicity, dosage, and efficacy. For the pre-clinical phase, the selected lead compounds are tested in cells of the microorganisms (in vitro) and in animals (in vivo) to elucidate their pharmacodynamic and pharmacokinetic (Absorption, Distribution, Metabolism, Excretion and Toxicity) properties [9]. The successful lead compound is expected to be distributed to the correct action site in the body, should be absorbed into the bloodstream, must be non-toxic and can be metabolized efficiently and excreted properly from the body. In this phase, the drug candidate is cautiously examined so as to prepare it for testing in humans. After the pre-clinical testing is performed, clinical trials [10] are done on humans in 3 phases: *Phase 1* is to perform initial testing on a small group of healthy human volunteers, *phase 2* involves testing in a small group of patients and *phase 3* includes testing a large group of patients to see the effectiveness and safety of the drug candidate since healthy and ill people potentially have different metabolic profiles for the drugs. After passing through this phase, the potential drug candidate is sent for regulatory review and approval [11].

The discovery and development of a potential drug is an expensive and demanding task. However, delivering it to the patients is even more challenging due to various factors [12]. For example, during delivery of the drug to the patient, partial degradation of drug may happen before it reaches a desired target in the body, which will restrict or reduce the potency and therapeutic effects of the drug. Side effects occur due to the off-target interactions of the drug with other parts of the body. Moreover, the presence of blood-brain barrier, which impedes the drug delivery to the brain and spinal cord, also makes delivery of the drug extremely difficult in treating Central Nervous System-related diseases. Cellular defenses are imposed during the transportation of drugs to the targeted intracellular sites. Therefore the approach of delivering the drug in the body plays a crucial rolein diagnosing a disease.

Drug delivery: This process involves methods, formulations and technologies for proper administration of drug through various routes in the body to safely achieve its anticipated therapeutic effect. Drug delivery is usually concerned with the amount and duration of drug present in the human body, which may includeprecise site-targeting within the body or it might involve in assisting systemic pharmacokinetics.

The drug delivery process incorporates the drug's chemical formulation, medical devices or drug-device combination products. The concept of drug delivery is deeply blended with dosage form and route of administration. Medications can be taken through multipleroutes such as non-invasive peroral (through the mouth), topical (skin), transmucosal (nasal, buccal/sublingual, vaginal, ocular and rectal), carrier-based, inhalation or intravenous injection routes. The drug delivery systems are engineered technologies for site-targeted delivery and/or controlled discharge of therapeutic agents [13]. Present-day efforts in the area of drug delivery include (1) the growth of *site-targeted delivery,* in which the drug is only active in the specific target area of the body and (2) *constant release formulations,* in which the drug is discharged over a period of time in a controlled manner from a formulation. Different kinds of constant release formulations exist that include liposomes, proliposomes, microspheres, gels,

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prodrugs, cyclodextrins drug-loaded biodegradable microspheres (nanoparticles) and drug-polymer conjugates [14]. In order to accomplish efficient site-targeted delivery, the designed system must avoid the host's defense mechanisms and circulate to its anticipated site of action [15]. There are also various other methods of drug delivery such as thin film drug delivery (it uses dissolving film or oral drug strip to deliver drugs), self-microemulsifying drug delivery system (uses a microemulsion for drug delivery, e.g.,c yclosporine), acoustic targeted drug delivery (involves ultrasound energy to increase the transference of drug into and/or across specific tissues), neural drug delivery systems, injectable biomaterials, and retrometabolic drug design. However, each method has its own advantages and disadvantages, and therefore each medication needs to be taken in its own specific manner.

Discovering and developing better drugs, designing innovative delivery methods or improving current ones can only advance the usage of existing medications. However, this improvement will only be effective if the methods are developed to safely direct drugs through specific areas of the body, such as the stomach, where low pH can destroy a medication, or around an area where healthy bone and tissue might be adversely affected. Thus the field of drug discovery, development and delivery plays a very significant and critical role in social healthcare and therefore there is a dire need to consistently advance this field so as to provide better medication to the patients and increase their survival rate.

References

1. DiMasi JA, Hansen RW, Grabowski HG. The price of innovation: new estimates of drug development costs. J Health Econ. 2003; 22: 151-185.
2. Adams CP, Brantner VV. Spending on new drug development1. Health Econ. 2010; 19: 130-141.
3. Rask-Andersen M, Almén MS, Schiöth HB. Trends in the exploitation of novel drug targets. Nat Rev Drug Discov. 2011; 10: 579-590.
4. Blake RA. Target validation in drug discovery. Methods Mol Biol. 2007; 356: 367-377.
5. Newman DJ, Cragg GM. Natural products as sources of new drugs over the last 25 years. J Nat Prod. 2007; 70: 461-477.
6. Zhang XHD. Optimal High-Throughput Screening: Practical Experimental Design and Data Analysis for Genome-scale RNAi Research. Cambridge University Press. 2011.
7. Agrawal P. NMR Spectroscopy in Drug Discovery and Development. Mater. Methods. 2014; 4: 599.
8. Schneider G, Fechner U. Computer-based de novo design of drug-like molecules. Nat Rev Drug Discov. 2005; 4: 649-663.
9. Han C, Davis CB, Wang B. Evaluation of Drug Candidates for Preclinical Development: Pharmacokinetics, Metabolism, Pharmaceutics, and Toxicology. John Wiley & Sons. Inc. 2010.
10. Pocock SJ. Clinical Trials: A Practical Approach, John Wiley & Sons. 2004.
11. Meadows M. The FDA's drug review process: ensuring drugs are safe and effective. FDA Consum. 2002; 36: 19-24.
12. Park K. Controlled Drug Delivery: Challenges and Strategies. American Chemical Society: Washington DC. 1997.
13. Ravi Kumar MNV. Handbook of Particulate Drug Delivery (2-Volume Set), American Scientific Publishers. 2008.
14. Tiwari G, Tiwari R, Sriwastawa B, Bhati L, Pandey S, Pandey P, et al. Drug delivery systems: An updated review. Int J Pharm Investig. 2012; 2: 2-11.
15. Bertrand N, Leroux JC. The journey of a drug-carrier in the body: an anatomo-physiological perspective. J Control Release. 2012; 161: 152-163.

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