Life Sci. Res. Commn., 2026; 2(1):40-43.
https://lifesci.com.sg

Review Article

Drug Repositioning as an Innovative Approach in Pharmaceutical Development

Swarnim Swati*

Trinity Educational Institute, Ramgarh, Jharkhand, INDIA.

ABSTRACT

Drug repurposing, also called drug repositioning, has become a new and effective way to find and develop new drugs. It means finding new ways to use existing or already approved drugs that were made for other diseases. It usually takes more than 10 to 15 years and a lot of money to get a drug to market using the traditional drug development process. Many drug candidates also fail during clinical trials because of problems with safety, effectiveness, or toxicity. Drug repurposing is a promising new way to find drugs that can cut down on the cost, time, and risk of traditional drug discovery by a lot. One of the best things about drug repurposing is that researchers can skip some of the early steps in drug development because they already have safety, pharmacokinetics, and toxicity information about existing drugs. Because of this, repurposed drugs can move through clinical trials and regulatory approval processes more quickly. In the last few years, improvements in computational biology, bioinformatics, artificial intelligence, and high-throughput screening technologies have made it much easier to find possible drug candidates for repurposing. Researchers can now more easily look at large biological datasets and guess new drug-target interactions thanks to these modern methods. Numerous successful instances underscore the potential of drug repurposing in contemporary medicine. Sildenafil was first made to treat high blood pressure, but it was later used to treat erectile dysfunction. Thalidomide was first used as a sedative, but it is now used to treat multiple myeloma. Remdesivir has been studied for the treatment of viral infections. Drug repurposing has demonstrated significant potential in the treatment of various diseases, including cancer, infectious diseases, neurological disorders, cardiovascular diseases, and rare genetic conditions. This review article focuses on the concept and importance of drug repositioning in modern pharmaceutical development. It includes a detailed discussion on the introduction and basic concept of drug repositioning, highlighting its significance as an alternative strategy to traditional drug discovery. The review further describes the major types of drug repositioning and the various approaches used for identifying new therapeutic uses of existing drugs. In addition, the advantages and challenges associated with drug repositioning are critically discussed. Finally, the article outlines future perspectives and emerging opportunities in this field, emphasizing the potential of drug repositioning to accelerate drug discovery and improve therapeutic outcomes.

Keywords: Drug discovery, Drug repositioning, Drug Repositioning, Drug Repurposing, Pharmaceutical Development.

Correspondence:
Swarnim Swati
Trinity Educational Institute, Ramgarh-829122, Jharkhand, INDIA.
Email: swarnimswati721@gmail.com

Received: 23-01-2026;
Revised: 06-03-2026;
Accepted: 18-05-2026.

INTRODUCTION

The development of new drugs is a long, complex, and expensive process that plays a crucial role in improving global healthcare. Traditionally, the process of discovering and developing a new pharmaceutical drug involves several stages, including target identification, drug design, preclinical testing, clinical trials, and regulatory approval. This entire process often takes 10–15 years and requires significant financial investment. Despite these extensive efforts, many drug candidates fail during clinical trials due to safety concerns, lack of efficacy, or unexpected side effects. As a result, pharmaceutical researchers and industries are continuously searching for more efficient strategies to accelerate drug development while reducing cost and risk (Xue *et al*., 2018).

In recent years, drug repositioning, also known as drug repurposing, has emerged as a promising and innovative approach in pharmaceutical research. Drug repositioning refers to the identification of new therapeutic uses for existing drugs that are already approved or have previously undergone clinical testing. Since these drugs already possess established pharmacokinetic, pharmacodynamic, and toxicity profiles, their development for new indications can be significantly faster and safer compared to developing entirely new drugs from scratch (Ashburn and Thor, 2004). This strategy not only saves time and resources but also

DOI: 10.5530/lsrc.2.1.4

increases the success rate of drug development. Drug repositioning has gained considerable attention due to advancements in biomedical research, computational biology, and data analysis techniques. Modern technologies such as bioinformatics, artificial intelligence, and systems biology have enabled scientists to analyze large datasets of drug–target interactions, disease pathways, and genetic information. These tools help researchers identify potential new therapeutic applications for existing drugs more efficiently. In addition, the growing availability of genomic and proteomic data has further supported the discovery of novel drug-disease relationships (Jarada *et al*., 2020).

Several successful examples of drug repositioning demonstrate the practical significance of this approach. One widely known example is sildenafil, which was originally developed for the treatment of angina but later repurposed for erectile dysfunction and pulmonary hypertension after researchers observed unexpected physiological effects during clinical trials (Cruz *et al*., 2021). Another well-known case is thalidomide, which was initially introduced as a sedative but later repositioned for the treatment of multiple myeloma and complications associated with leprosy (Rehman *et al*., 2011). Similarly, minoxidil, originally used as an antihypertensive drug, was later discovered to stimulate hair growth and is now widely used for treating alopecia. These examples highlight how existing drugs can provide new therapeutic benefits when studied from different scientific perspectives (Oliveira *et al*., 2026). Another important factor driving the popularity of drug repositioning is the increasing need to develop treatments for rare, neglected, and emerging diseases. Traditional drug development is often not economically feasible for diseases with small patient populations. However, repositioning existing drugs offers a practical solution because much of the safety and pharmacological data is already available This approach has been particularly valuable in addressing urgent public health challenges and accelerating the development of therapies for conditions that lack effective treatments.

Although drug repositioning offers numerous advantages, it also faces several challenges. Issues related to intellectual property rights, regulatory approval processes, and limited commercial incentives may hinder the widespread adoption of this strategy by pharmaceutical companies. Nevertheless, with continuous advancements in computational tools, molecular biology, and clinical research, drug repositioning is expected to play an increasingly important role in modern pharmaceutical development (Almulhim *et al*., 2025).

Concept of Drug Repositioning

Drug repositioning is defined as the process of discovering new therapeutic indications for existing drugs beyond their original medical use. This strategy involves studying the pharmacological properties, molecular targets, and biological pathways associated with existing drugs to identify potential new applications. The basic concept of drug repositioning is based on the understanding that many drugs interact with multiple biological targets in the human body. While a drug may have been originally developed to treat a specific disease, it may also influence other biological pathways that could be beneficial in treating different diseases. By identifying these additional effects, researchers can repurpose existing drugs for new therapeutic purposes (Langedijk *et al*., 2015).

One of the major advantages of drug repositioning is that it significantly reduces the risk associated with drug development. Since the safety, toxicity, and pharmacokinetic properties of these drugs are already known, the chances of failure during clinical trials are much lower compared to newly developed drug candidates. Additionally, drug repositioning can help reduce research and development costs and shorten the overall drug development timeline. Another important aspect of drug repositioning is its ability to improve the efficiency of pharmaceutical research. Instead of starting from scratch, scientists can build upon existing knowledge and clinical data related to approved drugs. This allows researchers to focus on identifying new disease targets and therapeutic applications rather than developing entirely new chemical compounds (Parisi *et al*., 2020).

Drug repositioning has become particularly important in the era of precision medicine and personalized healthcare. Advances in genomics, proteomics, and molecular biology have made it possible to better understand the underlying mechanisms of diseases. This knowledge enables researchers to identify drugs that may be effective for specific patient populations based on their genetic and molecular characteristics.

Types of Drug Repositioning

Drug repositioning can be broadly classified into different types depending on the mechanism through which the drug is repurposed for a new therapeutic indication.

On-Target Drug Repositioning

On-target drug repositioning occurs when a drug acts on the same biological target but is used to treat a different disease. In this case, the mechanism of action remains the same, but the therapeutic application changes. This type of repositioning is often discovered when researchers realize that the biological pathway targeted by the drug is involved in multiple diseases. For example, aspirin was initially developed and widely used as an analgesic and anti-inflammatory drug. However, later studies revealed that aspirin also has antiplatelet properties that help prevent blood clot formation. As a result, it is now commonly used in the prevention of cardiovascular diseases such as heart attacks and strokes (Parisi *et al*., 2020).

Off-Target Drug Repositioning

Off-target drug repositioning occurs when a drug interacts with a completely different biological target than originally intended. This type of repositioning often results from unexpected pharmacological effects observed during clinical trials or post-marketing studies. A well-known example is minoxidil, which was originally developed to treat high blood pressure. During its clinical use, researchers observed that patients taking the drug experienced increased hair growth. This unexpected effect led to its repositioning as a treatment for hair loss and alopecia (Oliveira *et al*., 2026).

Approaches Used in Drug Repositioning

Several scientific approaches are used to identify potential drug repositioning opportunities.

Computational Approach

Computational methods play an important role in modern drug repositioning. These approaches involve the use of bioinformatics tools, molecular modeling, and machine learning algorithms to analyze large datasets related to drugs, genes, and diseases. By studying drug-target interactions, protein structures, and genetic pathways, researchers can predict potential new therapeutic uses for existing drugs. Computational approaches are highly efficient because they allow scientists to screen thousands of drugs and disease targets simultaneously (Vogrinc and Kunej, 2017).

Experimental Approach

Experimental approaches involve laboratory-based techniques such as high-throughput screening, cell-based assays, and animal studies. In this method, researchers test existing drugs against different biological targets or disease models to observe potential therapeutic effects. High-throughput screening is particularly useful because it allows scientists to test a large number of drug compounds in a relatively short period of time. This approach helps identify promising drug candidates that can be further evaluated in clinical trials (Mohammad *et al*., 2018).

Clinical Observation

Sometimes drug repositioning occurs through clinical observations made by physicians and researchers during clinical trials or routine medical practice. Unexpected therapeutic effects observed in patients may indicate potential new uses for a drug.

For instance, during the clinical trials of sildenafil, researchers noticed its ability to improve erectile function in male patients. This observation eventually led to the development of the drug as a treatment for erectile dysfunction (Cruz *et al*., 2021).

Advantages of Drug Repositioning

Drug repositioning offers several important advantages compared to traditional drug development. First, it significantly reduces the time required to bring a drug to market. Since the drug has already undergone extensive safety testing, researchers can skip several early stages of drug development. Second, drug repositioning reduces the overall cost of pharmaceutical research and development. Developing a new drug from scratch requires substantial investment, whereas repurposing an existing drug is much more economical. Third, the risk of failure in clinical trials is lower because the safety and pharmacological properties of the drug are already well understood. Another advantage is that drug repositioning allows researchers to address unmet medical needs, particularly in the treatment of rare and neglected diseases (Figure 1).

Challenges in Drug Repositioning

Despite its advantages, drug repositioning also faces several challenges. One of the major challenges is related to intellectual property rights and patent protection. Since many repositioned drugs are already approved, obtaining new patents for their additional uses can be difficult. Another challenge is regulatory approval. Even though the drug has been previously approved for a different indication, it still needs to undergo clinical trials to demonstrate its safety and effectiveness for the new therapeutic use. In addition, pharmaceutical companies may have limited financial incentives to invest in repositioning existing drugs if the potential profit margins are low (Pushpakom *et al*., 2018).

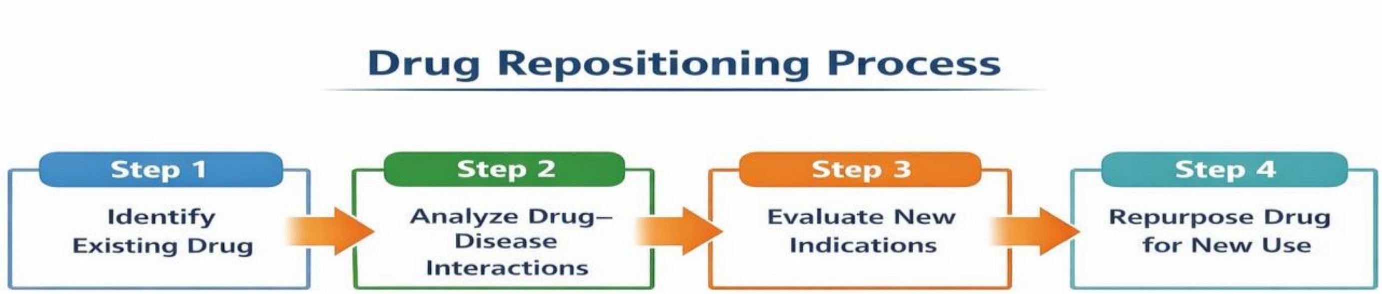

Figure 1: Step-by-Step Process of Identifying and Repurposing Existing Drug.

FUTURE PERSPECTIVES

The future of drug repositioning looks promising due to rapid advancements in biomedical technologies and data science. Emerging fields such as artificial intelligence, systems biology, and network pharmacology are expected to further enhance the identification of new therapeutic uses for existing drugs. Large-scale biomedical databases and genomic research are also providing valuable insights into disease mechanisms and drug interactions. By integrating these datasets, researchers can develop more accurate models for predicting drug-disease relationships (Almulhim *et al*., 2025).

In the coming years, drug repositioning is likely to play a crucial role in accelerating drug discovery and improving treatment options for complex diseases such as cancer, neurological disorders, and infectious diseases.

CONCLUSION

Drug repositioning has emerged as an innovative and efficient strategy in pharmaceutical development. By identifying new therapeutic applications for existing drugs, this approach helps overcome many challenges associated with traditional drug discovery.

The ability to reduce development time, lower research costs, and improve the success rate of clinical trials makes drug repositioning an attractive option for both researchers and pharmaceutical companies. With the continuous advancement of computational technologies and biomedical research, drug repositioning is expected to become an increasingly important tool in modern medicine.

ACKNOWLEDGEMENT

I would like to thank Trinity Educational Institute for providing the resources necessary for this research.

ABBREVIATIONS

AI: Artificial Intelligence; **ADME:** Absorption, Distribution, Metabolism, and Excretion; **HTS:** High-Throughput Screening; **PK:** Pharmacokinetic; **PD:** Pharmacodynamic; **R&D:** Research and Development; **DR:** Drug Repositioning; **DP:** Drug Repurposing; **IPR:** Intellectual Property Rights; **OMICS:** Genomics, Proteomics, and Related High-Throughput Biological Sciences; **ML:** Machine Learning; **DL:** Drug–Disease Relationship; **DTI:** Drug–Target Interaction; **PM:** Precision Medicine.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest.

REFERENCES

Almulhim, M., Ghasemian, A., Memariani, M., Karami, F., Yassen, A. S. A., Alexiou, A., Papadakis, M., C Batiha, G. E. S. (2025). Drug repositioning as a promising approach for the eradication of emerging and re-emerging viral agents. *Molecular Diversity 2025 25:c*, *25*(6), 5465–5485. https://doi.org/10.1007/S11030-025-11131-8

Ashburn, T. T., C Thor, K. B. (2004). Drug repositioning: identifying and developing new uses for existing drugs. *Nature Reviews Drug Discovery 2004 3:8*, *3*(8), 673–683. https://doi.org/10.1038/nrd1468

Cruz-Burgos, M., Losada-Garcia, A., Cruz-Hernández, C. D., Cortés-Ramírez, S. A., Camacho-Arroyo, I., Gonzalez-Covarrubias, V., Morales-Pacheco, M., Trujillo-Bornios, S. I., C Rodríguez-Dorantes, M. (2021). New Approaches in Oncology for Repositioning Drugs: The Case of PDE5 Inhibitor Sildenafil. *Frontiers in Oncology*, *11*, 627229. https://doi.org/10.3389/FONC.2021.627229/XML

Jarada, T. N., Rokne, J. G., C Alhajj, R. (2020). A review of computational drug repositioning: Strategies, approaches, opportunities, challenges, and directions. *Journal of Cheminformatics*, *12*(1), 46-. https://doi.org/10.1186/S13321-020-00450-7/TABLES/3

Langedijk, J., Mantel-Teeuwisse, A. K., Slijkerman, D. S., C Schutjens, M. H. D. B. (2015). Drug repositioning and repurposing: terminology and definitions in literature. *Drug Discovery Today*, *20*(8), 1027–1034. https://doi.org/10.1016/j.drudis.2015.05.001

Li, Y. Y., C Jones, S. J. M. (2012). Drug repositioning for personalized medicine. *Genome Medicine*, *4*(3), 27-. https://doi.org/10.1186/GM326/FIGURES/2

Mohammad Jafari, R., Sheibani, M., Nezamoleslami, S., Shayesteh, S., Jand, Y., C Dehpour, A. R. (2018). Drug Repositioning: A Review. *Journal of Iranian Medical Council*, *1*(1), 7–10. https://www.jimc.ir/article_66203.html

Oliveira, G. T. de, Ikegaki, A. B. K. B., Souza, I. L. I. de, Agostini, S. B. N., Marques, M. B. de F., C Araújo, M. B. de. (2026). Minoxidil as a Prodrug: Review of Chemical, Pharmacological, and Technological Aspects in Alopecia Therapeutics. *Mini-Reviews in Medicinal Chemistry*, *2c*. https://doi.org/10.2174/011389557543311826011521230 7

Parisi, D., Adasme, M. F., Sveshnikova, A., Bolz, S. N., Moreau, Y., C Schroeder, M. (2020). Drug repositioning or target repositioning: A structural perspective of drug-target-indication relationship for available repurposed drugs. *Computational and Structural Biotechnology Journal*, *18*, 1043–1055. https://doi.org/10.1016/j.csbj.2020.04.004

Pushpakom, S., Iorio, F., Eyers, P. A., Escott, K. J., Hopper, S., Wells, A., Doig, A., Guilliams, T., Latimer, J., McNamee, C., Norris, A., Sanseau, P., Cavalla, D., C Pirmohamed, M. (2018). Drug repurposing: progress, challenges and

Recommendations. *Nature Reviews Drug Discovery 2018 18:1*, *18*(1), 41–58. https://doi.org/10.1038/nrd.2018.168

Rehman, W., Arfons, L. M., C Lazarus, H. M. (2011). The rise, fall and subsequent triumph of thalidomide: Lessons learned in drug development. *Therapeutic Advances in Hematology*, *2*(5), 291–308.https://doi.org/10.1177/2040620711413165

Vogrinc, D., C Kunej, T. (2017). Drug repositioning: computational approaches and research examples classified according to the evidence level. *Discoveries*, *5*(2), e75. https://doi.org/10.15190/D.2017.5

Xue, H., Li, J., Xie, H., C Wang, Y. (2018). Review of Drug Repositioning Approaches and Resources. *International Journal of Biological Sciences*, *14*(10), 1232.https://doi.org/10.7150/IJBS.24612

Cite this article: Swati S. Drug Repositioning as an Innovative Approach in Pharmaceutical Development. Life Sci Res Commn. 2026;2(1):40-3.