



Journal of Frontiers in Multidisciplinary Research

Drug Repurposing for Novel Indications

Dr. Fatima Noor

Department of Microbiology, University of Dhaka, Bangladesh

* Corresponding Author: **Dr. Fatima Noor**

Article Info

E-ISSN: 3050-9726

P-ISSN: 3050-9718

Volume: 01

Issue: 02

July-December 2020

Received: 15-07-2020

Accepted: 30-08-2020

Published: 17-09-2020

Page No: 06-08

Abstract

Drug repurposing, also known as drug repositioning, is a strategy for identifying new therapeutic uses for existing drugs. This approach offers a cost-effective and time-efficient alternative to traditional drug discovery, as it leverages existing safety and efficacy data. The present article explores the concept of drug repurposing, its methodologies, and its potential to address unmet medical needs. We discuss various computational and experimental approaches used in drug repurposing, highlight successful case studies, and examine the challenges and opportunities in this field. The article concludes with a discussion on the future directions of drug repurposing and its implications for personalized medicine.

Keywords: Drug repurposing, drug repositioning, computational biology, personalized medicine, drug discovery, therapeutic innovation

Introduction

The process of developing a new drug from scratch is a time-consuming, expensive, and risky endeavor. On average, it takes 10-15 years and costs over \$2.6 billion to bring a new drug to market, with a high likelihood of failure during clinical trials. In contrast, drug repurposing offers a promising alternative by identifying new therapeutic applications for existing drugs. This approach not only reduces the time and cost associated with drug development but also minimizes the risks, as the safety profiles of repurposed drugs are already well-established.

Drug repurposing has gained significant attention in recent years due to its potential to address unmet medical needs, particularly in areas such as rare diseases, oncology, and infectious diseases. The COVID-19 pandemic, for instance, highlighted the importance of drug repurposing as researchers rapidly identified existing drugs that could be used to treat the novel coronavirus. This article provides a comprehensive overview of drug repurposing, including its methodologies, applications, and future prospects.

Materials and Methods

1. Data Sources for Drug Repurposing

- **Pharmacological Databases:** Databases such as Drug Bank, ChEMBL, and PubChem provide comprehensive information on drug structures, targets, and biological activities.
- **Clinical Trial Data:** Repositories like ClinicalTrials.gov offer insights into ongoing and completed clinical trials, which can be mined for potential repurposing opportunities.
- **Omics Data:** Genomic, transcriptomic, and proteomic data can be used to identify novel drug-disease associations.
- **Literature Mining:** Text mining tools can extract relevant information from scientific literature to identify potential drug repurposing candidates.

2. Computational Approaches

Network-Based Methods: These methods use biological networks (e.g., protein-protein interaction networks) to identify drug-disease associations.

- **Machine Learning:** Algorithms such as random forests, support vector machines, and deep learning models can predict drug repurposing opportunities based on large datasets.
- **Molecular Docking:** This technique predicts how a drug interacts with a target protein, helping to identify new therapeutic uses.
- **Signature-Based Methods:** These methods compare gene expression profiles of drugs and diseases to identify potential matches.

3. Experimental Approaches

- **High-Throughput Screening:** This involves testing large libraries of existing drugs against new targets or disease models.
- **Phenotypic Screening:** This approach assesses the effects of drugs on cellular or organismal phenotypes, without prior knowledge of the target.
- **Animal Models:** Preclinical studies in animal models can validate the efficacy of repurposed drugs for new indications.

4. Case Studies

- **Thalidomide:** Originally developed as a sedative, thalidomide was repurposed for the treatment of multiple myeloma and leprosy.
- **Sildenafil:** Initially developed for hypertension, sildenafil (Viagra) was repurposed for erectile dysfunction and pulmonary arterial hypertension.
- **Raloxifene:** Originally approved for osteoporosis, raloxifene was repurposed for breast cancer prevention.

Results

1. Success Stories in Drug Repurposing

- **COVID-19:** Drugs like remdesivir and dexamethasone were repurposed for the treatment of COVID-19, demonstrating the potential of this approach in addressing emerging infectious diseases.
- **Oncology:** Several drugs, including metformin and aspirin, have shown promise in cancer prevention and treatment.
- **Rare Diseases:** Drug repurposing has been particularly impactful in rare diseases, where traditional drug development is often not economically viable.

2. Computational Predictions

- **Network-Based Predictions:** Studies have successfully identified novel drug-disease associations using protein-protein interaction networks.
- **Machine Learning Models:** These models have demonstrated high accuracy in predicting drug repurposing opportunities, particularly when trained on large, diverse datasets.

3. Experimental Validation

- **High-Throughput Screening:** This approach has led to the identification of several repurposed drugs for cancer, neurodegenerative diseases, and infectious diseases.
- **Animal Models:** Preclinical studies have validated the efficacy of repurposed drugs in various disease models,

paving the way for clinical trials.

Discussion

1. Advantages of Drug Repurposing

- **Cost-Effectiveness:** Drug repurposing significantly reduces the cost of drug development by leveraging existing safety and efficacy data.
- **Time Efficiency:** The repurposing process is faster than traditional drug discovery, as it bypasses early-stage preclinical testing.
- **Reduced Risk:** Since repurposed drugs have already been tested in humans, the risk of adverse effects is lower.

2. Challenges and Limitations

- **Intellectual Property Issues:** Repurposing existing drugs may raise patent-related challenges, as the original patents may have expired.
- **Regulatory Hurdles:** Regulatory agencies may require additional clinical trials to approve repurposed drugs for new indications.
- **Scientific Complexity:** Identifying the right drug-disease pair requires a deep understanding of both the drug's mechanism of action and the disease's pathophysiology.

3. Future Directions

- **Integration of Multi-Omics Data:** Combining genomic, transcriptomic, and proteomic data can enhance the accuracy of drug repurposing predictions.
- **Personalized Medicine:** Drug repurposing can be tailored to individual patients based on their genetic makeup, leading to more effective and targeted therapies.
- **Collaborative Efforts:** Public-private partnerships and collaborative research initiatives can accelerate the discovery of repurposed drugs.

Conclusion

Drug repurposing represents a paradigm shift in drug discovery, offering a cost-effective, time-efficient, and low-risk alternative to traditional approaches. By leveraging existing drugs for new therapeutic applications, this strategy has the potential to address unmet medical needs and improve patient outcomes. While challenges remain, advances in computational biology, experimental techniques, and collaborative research are paving the way for the future of drug repurposing. As we move towards an era of personalized medicine, drug repurposing will undoubtedly play a crucial role in shaping the landscape of therapeutic innovation.

References

1. Ashburn TT, Thor KB. Drug repositioning: Identifying and developing new uses for existing drugs. *Nature Reviews Drug Discovery*. 2004;3(8):673-83.
2. Pushpakom S, et al. Drug repurposing: Progress, challenges and recommendations. *Nature Reviews Drug Discovery*. 2019;18(1):41-58.
3. Oprea TI, Overington JP. Computational and practical aspects of drug repositioning. *Assay and Drug Development Technologies*. 2015;13(6):299-306.
4. Li J, Zheng S. Drug repositioning for personalized medicine. *Genome Medicine*. 2015;7(1):1-10.

5. Corsello SM, *et al.* The Drug Repurposing Hub: A next-generation drug library and information resource. *Nature Medicine*. 2017;23(4):405-8.
6. Novac N. Challenges and opportunities of drug repositioning. *Trends in Pharmacological Sciences*. 2013;34(5):267-72.
7. Dudley JT, *et al.* Computational repositioning of the anticonvulsant topiramate for inflammatory bowel disease. *Science Translational Medicine*. 2011;3(96):96ra76.
8. Jin G, Wong ST. Toward better drug repositioning: Prioritizing and integrating existing methods into efficient pipelines. *Drug Discovery Today*. 2014;19(5):637-44.
9. Hurle MR, *et al.* Computational drug repositioning: From data to therapeutics. *Clinical Pharmacology & Therapeutics*. 2013;93(4):335-41.
10. Pantziarka P, *et al.* The Repurposing Drugs in Oncology (ReDO) Project. *ecancermedicalscience*. 2018;12:886.