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Review: Current Opportunities and Challenges in Drug Repurposing

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ABSTRACT :

Background: Drug repurposing, or repositioning existing medications for new therapeutic purposes, has emerged as a compelling strategy in the pharmaceutical landscape. As the pressure to bring new treatments to market grows amidst rising costs and lengthy development timelines, drug repurposing offers a pragmatic alternative that can expedite the availability of therapies while optimizing the vast repository of existing drugs.

Methods: This review explores the new opportunities and challenges associated with this innovative approach. It includes opportunities like Cost-effectiveness, Regulatory advantages, Speeding up drug development, Innovative applications, Addressing healthcare inequities, Existing safety data, Accelerated development timeline, Rare and neglected diseases, Combination therapies. Also recent research findings on drug repurposing, highlighting the challenges faced, and identifying knowledge gaps that warrant further investigation.

Conclusion: For both researchers and pharmaceutical companies, the future of drug repurposing holds both immense promise and significant hurdles that must be navigated thoughtfully and strategically.

Keywords: Drug repurposing, re-profiling, drug discovery, drug development, clinical trial design

1. Introduction :

In simple terms, it is finding a new knife for an old sheath. Drug Repurposing or repositioning is the use of already existing FDA-approved drugs for new therapies and targets [1]. Repurposing makes use of fresh insights into biology to identify novel ways in which already-existing compounds function or to give an established target fresh significance in a novel disease domain. The repurposing strategy can help circumvent some of the difficulties involved in developing a novel chemical entity while simultaneously identifying novel first-in-class pathways to cure disease [2]. Drug repurposing useful, when a cure is desperately needed or conventional de novo drug research is not financially feasible, it is especially helpful. Finding substances with a well-established safety profile and recognized therapeutic benefits that could work well for different indications is the aim of drug repurposing. Pharmaceutical firms are working on drug repurposing initiatives for autoimmune, infectious, and uncommon diseases, cancer, and other conditions [3,4].

1.1. Principle of Drug repurposing

The principles of drug repurposing using current drug knowledge, cutting-edge data analytic technologies, finding possible therapeutic targets, and obtaining mechanistic insights are the cornerstones of drug repurposing [5]. Through the smart and effective use of current medications and data analysis, drug repurposing provides novel therapeutic uses that benefit patients and healthcare systems [6].

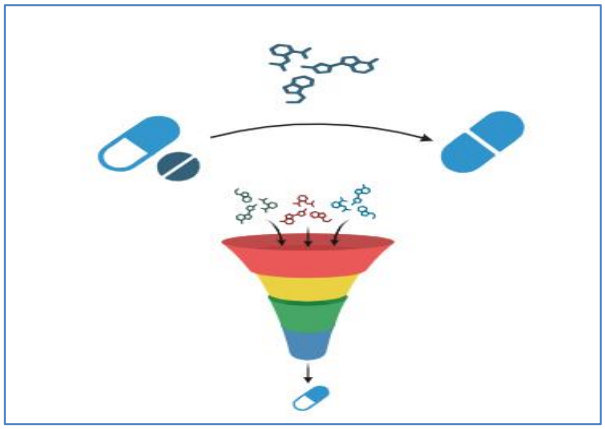

Figure 1. Process of drug repurposing

1.2. Need of drug repurposing

The process of creating a novel medication requires a significant investment of time, funds, and energy, primarily because of obstacles in the therapeutic development pipeline. It is important to identify methods for shortening this duration, cutting expenses, and raising success rates [7]. Drug repurposing is impactful strategy for it. A great deal of the compounds that are licensed for other uses have already undergone human testing, thus comprehensive data regarding their pharmacology, formulation, and possible toxicity are accessible. New candidate therapies may be ready for clinical trials more quickly thanks to repurposing, which draws on earlier research and development efforts. This would expedite the Food and Drug Administration's review process and, if approved, the integration of these therapies into healthcare [8,9].

2. Opportunities in Drug Repurposing

a) Cost-effectiveness
b) Regulatory advantages
c) Speeding up drug development
d) Innovative applications
e) Addressing healthcare inequities
f) Existing safety data
g) Accelerated development timeline
h) Rare and neglected diseases
i) Combination therapies

a) Cost-Effectiveness:
The ability to drastically cut prices is one of the biggest benefits of drug repurposing. There is less need for lengthy preclinical research because the safety characteristics and pharmacokinetics of currently available medications are fully understood, facilitating quicker transitions into clinical trials. Significant savings and the reallocation of resources to more urgent research issues can result from this streamlining [10].

b) Regulatory Advantages:
When it comes to repurposed pharmaceuticals, regulatory processes are typically faster than those for new drug applications [11]. Organizations like the FDA have implemented initiatives like the 505(b) (2) application, which enables sponsors to more easily get approval based on available evidence by utilizing pre-existing data [12].

c) Speeding up Drug Development:
Repurposing current pharmaceuticals might expedite the drug development process, given the urgency of meeting unmet medical requirements, especially in acute diseases or during public health crises [13]. The COVID-19 pandemic illustrated how quickly new applications for already-approved medications may be assessed, highlighting a quick reaction mechanism that may prove essential in the event of future pandemics [14].

d) Innovative Applications:
Technological developments like artificial intelligence and large data analytics have created new opportunities for finding possible drugs that could be repurposed [13]. Researchers can enhance the development of innovative therapeutic applications for known drugs by uncovering unanticipated drug-disease links through the analysis of large datasets [15].

e) Addressing Healthcare Inequities:
Drug repurposing also play crucial role in addressing healthcare systems. Repositioned medications that are already generic and off-patent can be a cost-effective way to ensure that low-income people have increased access to necessary therapies [16].

f) Accelerated Development Timeline:
When opposed to beginning from scratch with new chemical entities, medication repurposing can drastically shorten the time it takes to produce new drugs [17].

g) Existing Safety Data:
Repurposed medications don't require as much safety testing because of the wealth of safety data collected during their prior use [15].

h) Rare and neglected diseases:
Repurposing makes use of medications that are already on the market that might not otherwise be developed, which opens up the possibility of developing treatments for rare and neglected diseases [18].

i) Combination therapies:
Repurposed medications can be added or combined to current therapies to improve the range of medical diseases for which they can be used as treatments [19].

Challenges in Drug Repurposing :

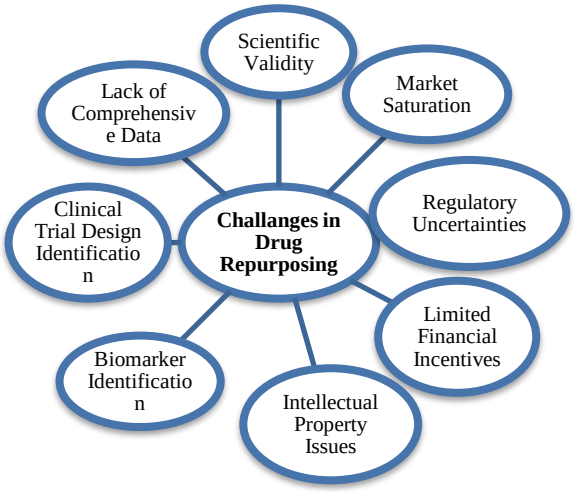

Figure 3: Challenges in drug repurposing

3.1 Scientific Validity:

Validating potential repurposed usage scientifically is one of the main problems. Even with current understanding of a drug's safety profile, thorough clinical trials are necessary to determine a drug's efficacy for a novel application. The procedure can be intricate, and there's a chance it won't provide the expected results, which would mean wasting money [20].

3.2 Market Saturation:

Repurposed agents may find it challenging to achieve momentum due to the overabundance of medications targeting comparable pathways in the pharmaceutical sector [21]. Businesses need to carefully consider how to position their goods and create thorough marketing strategies that highlight the special benefits of the repurposed medications over rivals [22]

3.3 Regulatory Challenges:

Regulatory agencies require substantial evidence of a medication's effectiveness and safety. Meeting these requirements might be difficult, particularly if approved repurposed drugs are used. Depending on the type of new indication, there can be variations in the regulatory environment for pharmacological repurposing. For researchers and developers who are not aware with the procedures involved in repurposing techniques, navigating these restrictions can be difficult [23]

3.4 Limited Financial Incentives:

Developing new treatments may offer a more appealing financial incentive for medication repurposing. Repositioning current pharmaceuticals can be financially hampered by investors who are looking for big returns on breakthrough therapies, particularly if the size of the predicted market is small [22].

3.5 Intellectual Property Issues:

The world of intellectual property pertaining to pharmaceuticals that have been modified can be very complicated. Existing patents may help certain repurposed pharmaceuticals, but others can face difficulties, especially if proprietary modifications or innovative delivery methods are involved. Developers looking to make money out of their research may find it difficult to navigate this field [24].

3.6 Clinical Trail Design and Biomarker Identification:

Effective clinical trial design for repurposed drugs requires the selection of appropriate dosages, patient demographics, and objectives. The approval of repurposed medications is affected by the need for reliable biomarkers to predict therapy effectiveness or sickness response, which is sometimes challenging to find [25].

3.7 Lack of Comprehensive Data:

One of the primary barriers to pharmaceutical repurposing is the absence of centralized, comprehensive databases with detailed information on pharmacological properties, target interactions, and illness correlations [23]. It can be challenging for researchers to find reliable, up-to-date data, which makes it challenging to identify potential targets for repurposing activities [26].

4. Conclusion :

Drug repurposing stands at the intersection of innovation and pragmatism, representing a promising approach to drug development in a rapidly evolving healthcare landscape. While it provides numerous advantages including cost-effectiveness, accelerated development timelines, and innovative therapeutic combinations, it is not without its challenges. Future endeavours must focus on enhancing scientific validation methods, addressing intellectual property constraints, and developing clear regulatory pathways to unlock the full potential of this approach. For both researchers and pharmaceutical companies, the future of drug repurposing holds both immense promise and significant hurdles that must be navigated thoughtfully and strategically

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