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Role of Repurposing in COVID 19 Infections

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Abstract

The COVID-19 pandemic caused a significant impact on healthcare systems, economies, and societies worldwide. The disease has led to unprecedented increase in the demand for medical supplies, including personal protective equipment (PPE), ventilators, and medications. This caused shortages essential medical supplies in many regions. Repurposing of drugs, devices, and other medical supplies has emerged as a potential solution to the shortage of essential resources. Repurposing involves the identification and use of existing drugs, devices, and other medical supplies for new indications, including COVID-19 infection.

Keywords: COVID 19, repurposing, drugs, devices, medical supplies

Introduction

Repurposing of drugs and medical supplies has played a critical role in addressing the urgent need for treatments and protective equipment during the pandemic. Given the urgency of the situation, repurposing has been seen as a quick and potentially effective solution to address the shortages of critical medical supplies and the lack of effective treatments for COVID-19 (Liu *et al*, 2021). Repurposing has also been seen as a potential way to fast-track the development of treatments and vaccines. Repurposing existing drugs, allows researchers to bypass the lengthy process of developing a new drug from scratch, potentially allowing for a quicker response to the pandemic (Pushpakom *et al*, 2019).This review discusses the role of repurposing in COVID-19 infection. The review will provide valuable insights into how repurposing can be used in public health emergencies.

Repurposing of Drugs

Repurposing of drugs essentially involves identification and use of previously approved formulations for new disease or novel pathways of cure (Singh *et al*, 2020). Regulatory agencies have the authority to approve the use of existing drugs for medical conditions that differ from their previously approved indications (Pushpakom *et al*, 2019). This process is also known as drug repositioning. Several existing drugs have shown potential in the treatment of COVID-19 infection. Some of these have been summarized in Table 1. This table is not comprehensive and there are many other drugs that have been repurposed or are being studied for use in COVID-19 treatment (Marrazzo *et al*, 2020; Cortegiani *et al*, 2020).

Table 1: Some drugs that have been repurposed for the treatment of COVID-19

Drug	Original Indication	Repurposed Indication	Status/Stage of Clinical Trials	References
Remdesivir	Antiviral for Ebola	COVID-19	FDA-approved, Emergency Use Authorization (EUA)	Chakraborty *et al*, 2021; Chatterjee *et al*, 2020
Dexamethasone	Anti-inflammatory for various conditions	COVID-19	FDA-approved, EUA	Chakraborty *et al*, 2021; Gozzo *et al*, 2020.
Tocilizumab	Anti-inflammatory for rheumatoid arthritis	COVID-19	FDA-approved, EUA	Chakraborty *et al*, 2021; Banerjee & Mahapatra 2021; Tian *et al*, 2021
Baricitinib	Immunomodulator for rheumatoid arthritis	COVID-19	FDA-approved, EUA	Chakraborty *et al*, 2021
Ivermectin	Antiparasitic for various conditions	COVID-19	Investigational, some countries have approved for emergency use	Chakraborty *et al*, 2021; Shirazi *et al*, 2020

Hydroxychloroquine	Antimalarial and immunomodulatory for various conditions	COVID-19	Investigational, no longer recommended by most health organizations	Chakraborty *et al*, 2021; Singh *et al*, 2020
Favipiravir	Antiviral for influenza	COVID-19	Investigational, emergency use approved in some countries	Chakraborty *et al*, 2021; Singh *et al*, 2020

Repositioning approach offers advantages over traditional drug development, including reduced costs, shorter development timelines, and lower risks. However, the status of clinical trials and regulatory approvals can vary by country and region. Repurposing of drugs can be carried out in several ways, including:

Serendipitous discovery: This is the accidental discovery of a drug's new therapeutic use during clinical trials or observations of patients with different conditions.

Data-driven discovery: This is *in silico* approach which depends on the analysis of large datasets, such as electronic health records, drug profiles, solubility of drugs etc to identify drugs that may have potential for a new indication based on their known pharmacological properties (Kumari *et al*, 2020).

Mechanism-driven discovery: This approach involves the identification of new targets or pathways that are relevant to a disease and then screening existing drugs to identify those that can modulate these targets or pathways. This involves already indicated drug in a disease, but a different mechanism of action. Repurposing of drugs has several advantages, including:

- Repurposed drugs have already been approved for safety and efficacy for another indication, which significantly reduces the costs and development time required for clinical trials.
- Repurposed drugs have a well-established safety profile and are typically associated with fewer side effects. This reduces the risk of adverse events during clinical trials (Pilkington *et al*, 2015).
- Repurposed drugs can be brought to market more quickly than new drugs, which mean that patients can gain access to new treatments more rapidly.
- Repurposing of drugs reduces the need for new drug discovery and development, which has significant environmental and economic benefits. The process of drug development becomes environmentally sustainable.

Repurposing or repositioning of drugs is a promising approach for developing new therapeutic options for various diseases. The advantages outweigh over traditional drug development process and have the potential to significantly impact the healthcare industry by providing new treatments to patients at a lower cost and with a reduced risk profile (Rajkumar, 2020).

Repurposing of Devices:

Repurposing of devices refers to the process of taking an existing device that was designed for one purpose and modifying it for a new use. Repurposed devices provide significant benefits in terms of cost, efficiency, and patient outcomes (Li *et al*, 2020). The COVID-19 pandemic led to a shortage of several medical devices, including ventilators (Paik *et al*, 2019). Several groups developed low-cost ventilators using readily available materials, including automotive parts, in response to the shortage of traditional ventilators. Some of the important repurposed devices have been summarized in table 2.

Table 2: Some repurposed medical devices for COVID-19 management

Device	Original Use	Repurposed Use	References
CT Scans	Imaging for lung cancer and other conditions	Diagnosis and monitoring of COVID-19 pneumonia	Gaur *et al*, 2020
Nasal Cannulas	Supplemental oxygen therapy for respiratory conditions	Alternative to mechanical ventilation in COVID-19 patients with mild-to-moderate respiratory distress	Gershengorn *et al*, 2021

Continuous Positive Airway Pressure (CPAP) machines	Treatment of sleep apnea and other respiratory conditions	Alternative to mechanical ventilation in COVID-19 patients with moderate-to-severe respiratory distress	Nguyen *et al*, 2021
Extracorporeal Membrane Oxygenation (ECMO) machines	Treatment of severe respiratory failure	Treatment of COVID-19 patients with severe respiratory distress	Akhtar *et al*, 2021
Negative Pressure Rooms	Containment of airborne infections	Isolation of COVID-19 patients to prevent spread of the virus	Shetty *et al*, 2020.
Ventilators	Treatment of respiratory failure	Treatment of COVID-19 patients with severe respiratory distress	Bottiroli *et al*, 2021
Pulse Oximeters	Monitoring of oxygen saturation in patients with respiratory conditions	Monitoring of oxygen saturation in COVID-19 patients	Alboksmaty *et al*, 2020

The process of repurposing a device typically involves modifications to the device's hardware, software, or both. For example, a device designed for monitoring vital signs in a hospital setting may be repurposed for remote patient monitoring in a home setting (Jang *et al*, 2018). This may involve modifications to the device's software to enable remote data transmission, as well as hardware modifications to make the device more portable and easy to use at home. It's important to note that while repurposing medical devices can help alleviate shortages of critical equipment and provide alternative treatment options for COVID-19 patients, it is still essential to ensure that these devices are used safely and effectively in the context of COVID-19 treatment.

The advantages of device repurposing are enormous. Repurposing of devices can be much less expensive than designing and building a new device from scratch(Bayleyegn *et al*, 2019).Repurposed devices can be designed and modified more quickly than new devices, allowing healthcare providers to respond more rapidly to changing patient needs.Improved patient outcomes can be obtained by use of repurposed devices. New treatment options for patients that were not previously available, may be found leading to improved quality of life. Repurposing of devices reduces waste and promotes sustainability in the healthcare industry by extending the service life of existing devices.As technology continues to advance; the potential for repurposing of devices is only expected to grow, providing new opportunities for innovation and improved healthcare delivery (Roberts *et al*, 2019).

Repurposing of Other Medical Supplies:

The COVID-19 pandemic was a shock for even the best medical systems throughout the world. An urgent need for large stocks of several medical supplies, including PPE was felt. Repurposing of other medical supplies for management of COVID 19 was possible solution that emerged out of necessity. For example, several groups have developed methods to disinfect and reuse N95 masks, which were in short supply. Medical supplies, such as personal protective equipment (PPE), diagnostic equipment, and surgical instruments, were repurposed for uses other than their original intended use (Huh & Na, 2020; Schoeny *et al*, 2020). This approach has gained attention in recent years, particularly during the COVID-19 pandemic, as healthcare providers were forced to find creative solutions to address shortages of critical medical supplies. PPE such as masks and gowns were used as a protective barrier against infections. Diagnostic equipment such as CT scanner was utilized in the diagnosis and monitoring of COVID-19 patients. Surgical instruments, such as forceps and scissors, may also be repurposed for use in procedures beyond their original intended use (Medeiros da Silva *et al*, 2020).

Repurposing of medical supplies has several benefits. Repurposing increases availability of critical supplies, particularly during times of high demand. It reduces the cost of purchasing new equipments and allows for redirecting funds to maintain more important facilities. Repurposed medical supplies can be adapted to meet specific patient needs or to address unique healthcare challenges, improving efficiency and reducing waste (Bhatraju *et al*, 2020). Repurposed medical supplies can be used in a variety of settings, including emergency and disaster response situations, where safety considerations are paramount. Repurposing of medical supplies may not be appropriate for all situations. Yet, it can provide

an effective solution for many healthcare challenges, particularly during times of crisis or limited resources.

Repurposing promoted innovation during pandemic

The COVID-19 pandemic created an urgent need for effective treatments and vaccines to combat the virus. In response, repurposing emerged as a strategy to accelerate the development of COVID-19 therapeutics reducing the time and costs required for traditional drug discovery.

Repurposing has also promoted innovation by spurring collaboration between the public and private sectors, accelerating research on new uses for existing drugs and devices, and fostering creative solutions to supply chain disruptions and shortages of essential medical supplies (Schulman & Lee, 2020; Hanisch & Rake, 2021; Ho *et al*, 2020). For example, the repurposing of antiviral drugs such as remdesivir and favipiravir for COVID-19 treatment was made possible by the availability of prior research on their antiviral activity against other viruses. Similarly, the repurposing of medical supplies such as nasal cannulas and oxygen concentrators for COVID-19 treatment allowed for more efficient use of limited resources and helped alleviate shortages of critical medical equipment.

Furthermore, repurposing has spurred the development of new technologies and approaches to drug discovery and clinical trials. For instance, the use of artificial intelligence and machine learning algorithms to identify potential drug candidates for repurposing has emerged as a promising tool for accelerating drug development. The development of new technologies and approaches to drug discovery accelerated (Omezzine *et al*, 2020).

Conclusion

The COVID-19 pandemic has led to understanding that emergencies may arise anytime. These emergencies may out blow the available resources and essentials may fall short. This was observed as a shortage of several essential medical resources, including drugs, devices, and other medical supplies. Thus, we need to be prepared to handle the pandemic like situations. Repurposing of existing resources emerged as a potential solution to this shortage. Repurposing opened ways for the identification and use of existing drugs, devices, and other medical supplies for new indications. Several existing drugs have shown potential in the treatment of COVID-19 infection, and several low-cost devices have been developed to address the shortage of traditional medical devices. Repurposing of other medical supplies, including PPE, also emerged as a game changer to meet the demands of essential resources. Repurposing significantly helped the humankind to manage the impact of the COVID-19 pandemic.

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