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From Old Drugs to New Therapies: The Role of Drug Repurposing in Veterinary Pharmacology

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The relationship between animals and humans has always been closely tied to the progress of veterinary science. Among the many scientific branches that support this field, veterinary pharmacology holds a particularly important position because it investigates how medicinal substances interact with the biological systems of animals. Through the study of drug actions, therapeutic applications, pharmacokinetic behaviour, pharmacodynamic responses, and potential toxicological outcomes, veterinary pharmacology provides the scientific framework that allows veterinarians to treat diseases effectively. Its significance extends beyond clinical treatment; it also contributes to improving livestock productivity, promoting animal welfare, and protecting public health by ensuring the responsible use of veterinary medicines in food-producing animals.

Despite the importance of veterinary pharmacology, the discovery and development of entirely new drugs for animals remains an extremely challenging endeavor. Creating a new pharmaceutical compound is rarely a straightforward process. Scientists must first identify specific biological mechanisms responsible for a disease and then search for chemical substances capable of interacting with those targets. Thousands of compounds may be evaluated before a few promising candidates are selected for further testing. These candidates must then undergo extensive laboratory experiments, safety assessments, and controlled trials before they can be considered suitable for clinical application. The entire journey from discovery to approval often requires many years of research and considerable financial investment. For veterinary medicine, where the commercial market is smaller than that of

human pharmaceuticals, such lengthy and expensive processes can present substantial obstacles.

In recent years, researchers have begun to explore alternative strategies that could accelerate the development of veterinary treatments while reducing costs and time. One of the most promising approaches is drug repurposing. Instead of starting from the beginning with the discovery of completely new molecules, drug repurposing focuses on identifying new therapeutic roles for medications that already exist. Many drugs that were originally designed to treat one disease may possess additional biological properties that make them useful for managing entirely different conditions. Because these drugs have already been studied extensively for safety, toxicity, and pharmacokinetic characteristics, the process of adapting them for new uses can be significantly faster and more economical than conventional drug development.

The concept behind drug repurposing is both simple and scientifically compelling. Biological systems often share common molecular pathways, receptors, and metabolic mechanisms across different species. As a result, drugs that interact with specific targets in one organism may produce comparable effects in another. This biological overlap creates opportunities to examine existing pharmaceuticals and determine whether they might offer benefits for treating diseases in animals. By studying how drugs influence cellular pathways and physiological processes, scientists can uncover unexpected therapeutic possibilities that might otherwise remain unnoticed.

Over time, drug repurposing has begun to demonstrate considerable potential in various areas of veterinary medicine. One field where this strategy has attracted significant attention is veterinary oncology. As veterinary healthcare improves and companion animals live longer, the incidence of cancer in dogs and cats has risen substantially. Although several anticancer therapies are currently available for veterinary patients, treatment options remain more limited compared with those available in human medicine. This has encouraged researchers to investigate whether medications originally developed for other medical conditions might possess anticancer properties. Interestingly, certain drugs including some anti-inflammatory agents, metabolic regulators, and antiparasitic compounds have shown the ability to influence tumour growth, suppress cancer cell proliferation, or improve the effectiveness of established chemotherapy treatments. Such findings demonstrate how medicines designed for entirely different purposes can sometimes reveal unexpected potential in cancer therapy for animals.

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Beyond oncology, drug repurposing has also shown promise in addressing neurological and endocrine disorders in veterinary patients. Animals may experience neurological conditions that affect cognition, behaviour, and motor function, particularly as they age. Some pharmaceuticals originally created for the treatment of neurological diseases in humans have been adapted successfully for veterinary use. By influencing neurotransmitter activity or hormonal pathways, these medications can help improve cognitive function and behavioural stability in animals. For instance, certain drugs initially developed for human neurodegenerative disorders have been applied in the management of cognitive dysfunction in aging dogs. As improvements in veterinary care continue to extend the lifespan of companion animals, health conditions associated with aging are becoming more prevalent, further increasing the need for effective therapeutic strategies.

Another area where drug repurposing can offer valuable advantages is the control of infectious diseases. Livestock and companion animals are frequently exposed to numerous bacterial, viral, and parasitic pathogens that can severely affect animal health and agricultural productivity. When new or emerging pathogens appear, the development of entirely new medications may not be possible within a short timeframe. In such situations, repurposing existing antiviral, antiparasitic, or antimicrobial drugs can provide a faster response. Since the pharmacological properties of these drugs have already been studied, scientists can more rapidly evaluate whether they might be effective against newly identified infectious agents. This rapid adaptability is particularly important for managing disease outbreaks that could threaten both animal populations and food security.

Advancements in modern scientific technology have further strengthened the potential of drug repurposing. The development of computational biology, bioinformatics, and systems biology has made it possible to analyse complex biological data with unprecedented efficiency. By examining large datasets that include information on genes, proteins, and metabolic pathways, researchers can identify hidden relationships between drugs and diseases. These analytical approaches allow scientists to predict new therapeutic applications for existing pharmaceuticals by observing how they interact with biological systems at the molecular level.

In addition, computational methods enable comparisons of biological processes across different animal species. Many physiological and molecular mechanisms are conserved among mammals, meaning that drugs affecting certain pathways in humans may produce similar effects in animals. By integrating pharmacological data with genomic and proteomic

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information, researchers can identify promising candidates for veterinary drug repurposing. This interdisciplinary approach brings together veterinary pharmacology, molecular biology, and data science to accelerate the discovery of new treatment possibilities.

Drug repurposing may also contribute to addressing the growing global concern of antimicrobial resistance. The widespread and sometimes inappropriate use of antibiotics in both human and veterinary medicine has encouraged the emergence of resistant microbial strains. These resistant organisms make the treatment of infectious diseases increasingly difficult. Developing new antibiotics from scratch is both time-consuming and expensive, which has encouraged scientists to explore alternative solutions. Some existing medications that were not originally designed as antimicrobial agents have demonstrated the ability to inhibit microbial growth or enhance the effectiveness of conventional antibiotics. Such drugs may act as supportive therapies that improve the performance of existing antimicrobial treatments.

Apart from expanding treatment possibilities, drug repurposing also offers benefits related to animal welfare. Because repurposed drugs have typically undergone extensive safety evaluations during their original development, veterinarians often have more information regarding their toxicological profiles. This reduces the risk of unexpected adverse effects and allows clinicians to make more informed therapeutic decisions. Furthermore, many repurposed drugs are available as generic medications, making them more affordable than newly developed pharmaceuticals. This economic advantage is particularly important in livestock production systems, where treatment costs must remain financially sustainable.

Nevertheless, the successful application of drug repurposing in veterinary pharmacology requires careful consideration of several challenges. One of the most significant factors involves species-specific differences in drug metabolism. Animals differ widely in their physiology, digestive systems, metabolic enzyme activity, and organ function. Consequently, a medication that is safe and effective in humans may produce different pharmacological responses in animals. Thorough pharmacokinetic and pharmacodynamic studies are therefore essential to determine appropriate dosing regimens and ensure safety across different species.

Regulatory approval processes also present potential barriers. Even when a drug has already been approved for one purpose, additional evidence is usually required before it can be authorized for use in a different disease or animal species. These regulatory requirements

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are necessary to guarantee safety and therapeutic effectiveness, although they may delay the clinical adoption of repurposed drugs.

Economic considerations may further influence the development of repurposed pharmaceuticals. Many older medications are no longer protected by patents and are available as inexpensive generic products. While this improves accessibility for veterinarians, it may reduce the financial motivation for pharmaceutical companies to invest in research aimed at discovering new veterinary uses for these drugs. Consequently, much of the research in this field is conducted by academic institutions, research laboratories, and government-supported organizations.

Looking toward the future, scientific progress is expected to expand the possibilities for drug repurposing in veterinary medicine. Emerging technologies such as genomics, proteomics, metabolomics, and artificial intelligence are providing deeper insights into the molecular mechanisms underlying diseases in animals. By integrating these advanced technologies with pharmacological knowledge, researchers can identify novel therapeutic opportunities for existing drugs with greater precision.

The increasing recognition of the One Health concept further emphasizes the value of drug repurposing. This approach acknowledges the close connections between human health, animal health, and environmental health. Many diseases affect both humans and animals, and discoveries made in one field can often contribute to advances in the other. Collaborative research involving veterinarians, physicians, pharmacologists, and data scientists will therefore play a crucial role in identifying new applications for established drugs.

In summary, drug repurposing represents a creative and practical strategy for advancing veterinary pharmacology. By exploring new therapeutic uses for already existing pharmaceuticals, this approach provides an efficient pathway for expanding treatment options without the lengthy and expensive processes associated with traditional drug discovery. Repurposed medications have shown promising potential in areas such as cancer therapy, neurological disorders, infectious disease management, and antimicrobial resistance control. Although challenges related to species differences, regulatory requirements, and economic incentives remain, ongoing scientific and technological progress is expected to strengthen the role of drug repurposing in veterinary medicine. Ultimately, this strategy has the potential to improve animal health, enhance welfare, and support the sustainable development of veterinary therapeutics.

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