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Revolutionizing Veterinary Public Health with AI

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Introduction:

Artificial intelligence, known as machine learning, is a primitive concept based on the assumption that human thought and reasoning can be mechanized. AI emulates human intelligence through systems programmed to think like humans and mimic their actions or support human decision-making. The AI systems use algorithms, data, and machine learning techniques to recognize patterns, make decisions, and adapt to new information over time. Artificial intelligence was invented as an academic discipline in 1959 including brain stimulation, modeling human problem-solving, logic, databases of knowledge, and imitation of human behavior. The term "artificial intelligence" was introduced by John McCarthy, with key AI pioneers including Allen Newell (CMU), Herbert Simon (CMU), John McCarthy (MIT), Marvin Minsky (MIT), and Arthur Samuel (IBM).

Currently, AI is utilized in various ways to enhance healthcare, including reducing costs, improving patient outcomes, boosting efficiency, early disease detection, diagnostics, medical imaging, drug discovery development, outbreak prediction and modelling, surveillance monitoring, and response. This predictive power allows healthcare providers to deliver proactive, preventive care, ultimately improving treatment effectiveness and minimizing healthcare expenditures.

Veterinary public health is a specialized field of public health that primarily focuses on preventing and controlling diseases that can affect animals and humans. It also emphasizes food safety and security, antimicrobial resistance, and one health approach which is the interconnectedness of human, animal, and environmental health. So, the application of AI is a vital tool in this sector, helping to improve animal and human health by preventing disease outbreaks and enabling early disease detection.

AI plays a major role in disease surveillance and prediction through data analysis and pattern recognition. It processes large amounts of data from heterogeneous sources like health-related data from veterinary clinics and

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hospitals, farms, and wildlife, as well as weather patterns and global travel data to identify emerging trends that people might neglect. It also identifies contact tracing and outbreaks at an early stage, while predicting the liabilities of disease spread. It analyzes factors like climate, animal movement, and human activity to foretell potential outbreaks of diseases such as avian influenza, rabies, or foot-and-mouth disease.

AI is applicable in the fields of antimicrobial resistance (AMR) research, cancer research, drug design and vaccine development, epidemiology, and genomics. It offers innovative strategies to address antimicrobial resistance by analyzing genomic data to detect resistance markers early on, enabling early interventions. It also supports AI-powered decision systems that can optimize antibiotic use by recommending the most effective treatments based on patient data and local resistance patterns. AI can accelerate drug discovery by predicting the efficacy of new compounds and identifying potential antibacterial agents. For example, National Animal Disease Referral Expert System (NADRES) of ICAR-NIVEDI is a system that works on combining and coordinating the alert and response mechanisms for the stakeholders in the prediction, prevention, and control of animal disease threats (zoonotic ones also) through sharing of data, epidemiological studies and filed missions to asses and prevent outbreak, whenever needed. Combining livestock disease data and Artificial Intelligence techniques provides new opportunities to prevent outbreaks and maintenance in the animal healthcare sector.

AI models have been utilized to study zoonotic pathogens and the factors that influence their spread. By analyzing extensive datasets related to animal populations, environmental factors, and human health, AI enables researchers to predict potential outbreaks, identify risk factors, understand transmission patterns, and create effective mitigation strategies for zoonotic diseases, using advanced techniques such as machine learning and deep learning algorithms. It can also monitor mutations in zoonotic pathogens, assisting in the identification of potential variants that could enhance transmissibility, treatment resistance, or cross-species transmission. This is particularly crucial in studying pathogens such as viruses (e.g., SARS-CoV-2). For example, it predicted the Nipah virus outbreaks by using environmental data and animal movement patterns in fruit bat populations.

With the advancement of time, AI is increasingly being integrated into food inspection systems to detect contaminants in animal-derived food products (meat, dairy, eggs) through computer vision technologies. These systems analyze visual data, such as images or videos captured by cameras, to identify defects, contamination, or irregularities throughout the entire process—from animal slaughtering to post-mortem processing, packaging, and delivery. AI systems offer high accuracy, reducing the heavy reliance on manual inspection and ensuring faster, more effective food safety and quality controls. Additionally, AI can grade food products based on quality parameters like size, color, and texture, enabling automated sorting for various market segments.

Environment and ecological systems are essential segments of the world, supporting diverse species and biodiversity essential for survival. With AI assistance, wildlife tracking, habitat assessment, biodiversity analysis, and natural disaster prediction have become more efficient. AI algorithms analyze camera trap footage, drone imagery, and GPS data to identify and estimate population sizes, preventing the illegal hunting and exploitation of wildlife and refined protection of diverse species. With the help of AI-powered image analysis, it evaluates forest health, detects deforestation, and identifies areas that require restoration. Biodiversity analysis and species identification are achieved through AI algorithms that analyze acoustic recordings, environmental DNA (eDNA), and camera trap footage. These innovations identify different species, assess biodiversity levels, and even discover new or endangered species. Additionally, AI-powered flood prediction systems offer early warnings, helping communities prepare and evacuate more effectively. For example, the Tamil Nadu Forest Department deployed AI-based early warning systems to prevent human-wildlife conflicts and train collisions. Such systems could be adapted to incorporate AI into the veterinary field, particularly in veterinary public health. However, issues like data privacy, ethical concerns, and the need for skilled professionals must be tackled for AI to realize its full potential in this area.

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