Applications of Artificial Intelligence in Veterinary Medicine

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Abstract

Artificial Intelligence (AI) is the facility of automated systems or computer-controlled robots to perform tasks that are often associated with human intelligence. More precisely, AI could employ itself in a range of tasks for medical practice, thus promoting the well-being of patients. Similarly, now a days AI is more efficiently used in the field of veterinary medicine, ultimately promoting the animal's health through the diagnosis, and treatment of disease. Furthermore, it is also noticed that the emergence of AI has recently been observed in veterinary research, particularly clinical studies, with remarkable promising potential for future scientific revolutions. The potential fields of using AI include antimicrobial resistance, pharmacology, drug discovery & vaccine, disease diagnostics, and genomic data analysis. In this chapter, we explained and responded to the potential effects of AI on veterinary research and clinical practice suggesting this technology as a viable solution to many of the contemporary health issues in nearly all domains.

Keywords: Artificial Intelligence, Machine Learning, Biomedical Research, Veterinary Clinical Practice

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Introduction

Artificial intelligence (AI) is an emerging field of computer science that is capable of performing tasks similar to human intelligence. AI (a digital brain) is a very complex computer program that mimics human learning and problem-solving seen in both humans and primates (Konar, 2018). AI is a revolutionary technology in the contemporary world that is making life easier. AI is capable of inspiring potential to enhance our daily and professional lives, but it also poses virtuous trepidations (Xu et al., 2021).

AI as a scientific field evolved in 1956 and has advanced a row of methods, such as simulation, imitation of human reasoning, logical methods, and knowledge representation models as well as behaviour mimicry, etc. The formal inception of AI as a distinct scholarly field can be dated back to June 1956 when John McCarthy coined the term AI. It was for a long time a relatively small-scale scientific undertaking that started offering a relatively small number of real-world solutions for a long time not too long ago (Lu, 2019).

Veterinary science is a very broad field that involves areas such as animal health, especially for companion animals, and public or population health regarding zoonotic diseases. On the other hand, AI has an impact on as many scientific topics as philosophy, neuroscience, cybernetics, control theory, data sciences, and computer engineering. Although the intersection of these two (2) identified areas are both vast and growing, the amalgam of the two may contain the possibility of mutual collaboration (Abdulrazaq et al., 2024). The tremendous and promising achievements and possible previews in the area of AI progressions in healthcare, both for people and animals are heartening. AI's entrance into animal healthcare introduces new prospects, which aim to advance the pets and healthcare worker's quality of life. However, because of the fast flow and uncertainty of the research and the industrialization of products, these are promising potentials that bring challenges, particularly in measuring, understanding, and accepting such influential and innovative technologies (Shaheen, 2022).

Veterinary medicine is undergoing a major and erratic alteration in technology which, if properly tapped, has the potential of revolutionizing the livestock sector by the solicitations of AI in livestock management and animal health monitoring as shown in Figure 1. The current average veterinarian does not know computer programming to aptly use and implement AI, because Adopting technology is similar to introducing new diagnostic tools in a practice. Veterinarians have adequate knowledge of antigens, antibodies, and ELISA testing to competently utilize SNAP tests in a clinic (Ouyang, 2021). Physicians appreciate that the quality management system can be used to ensure accurate results in a test to be conducted. People generally have no idea about the disease diagnosed by computer algorithms. In this knowledge area, veterinarians require some fundamental perception to assess the possibilities of AI both as potential benefits and drawbacks. It should be noted that at the moment, artificial intelligence is still in its early phases and can have a certain impact on our profession in the future. The profession of veterinarians requires them to understand the potential and limits of AI (Stockham & Scott, 2024). The purpose of this chapter is to discuss the definition of AI, its advantages and disadvantages, and recommendations for its use by practicing veterinarians.

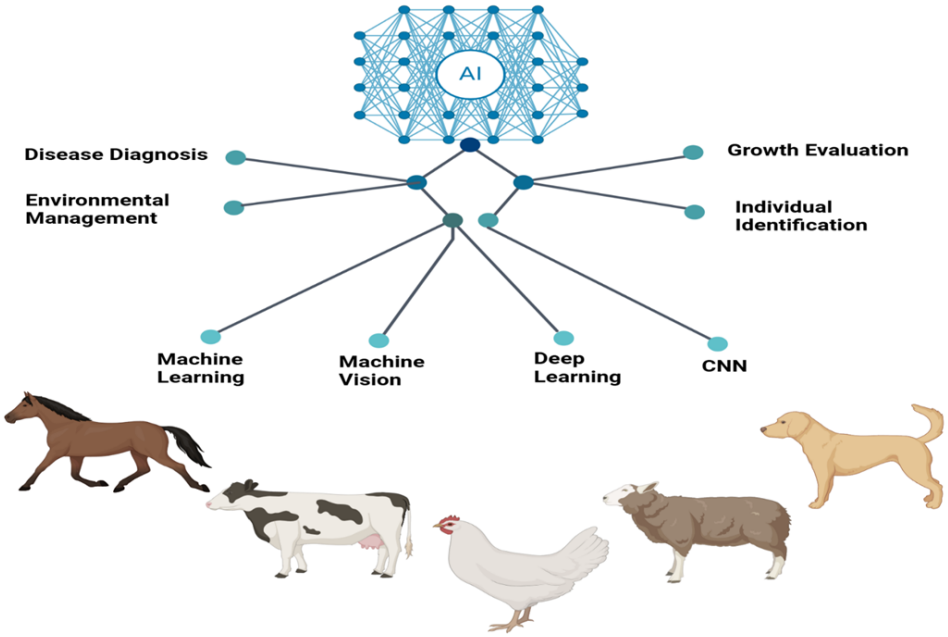

Fig. 1: Applications of AI in Livestock Management and Animal Health Monitoring.

1. Background of AI

AI principles date back at least 70 years ago, meanwhile, most of the modern AI applications are no older than a decade. At the end of the 1940s and the beginning of the 1950s, the scientific community got acquainted with the first AI principles. A British computer scientist named, Alan Turing first time introduced the idea of intelligent activities by a computer in 1950. After that, John McCarthy coined the term artificial intelligence, in the year 1955 (Jaeger & Dacorogna, 2024). The overall history of AI in Veterinary Medicine is shown in Table 1. In the past few years, AI has been successfully utilized in the veterinary field because of enhanced robotic power in the diagnosis, and treatment of diseases. In veterinary medicine, such AI robotic power may include radiology films (x-ray, CT, MRI), cytology and histology slides, and note and record documentation (text and numeric data such as lab results). In veterinary medicine, it exists as analytics that employs computer algorithms to analyze large amounts of data to improve diagnosis, treatment, and improving patient outcomes. Hence the approach we use in analyzing and putting this information to work varies depending on the overall objective of the AI system (Ali et al., 2024).

Table 1: A Brief History of AI in Medicine

Timeline	History of AI in Medicine		
	Key Events	Impact on AI Development	References
Late 1940s	Alan Turing's concept of computers performing intelligent tasks		(Bowen, 2024)
Early 1950s	John McCarthy coins the term "Artificial	Laid the foundation for AI research	(Rojas, 2024)
Mid-20th Century	Extensive AI research Limited practical applications due to computational constraints	Theoretical advancements but slow progress in real-world applications	(Qureshi, 2024)
Recent Decades	Advancements in computing power Increased data availability (e.g., medical imaging, electronic health records) Rapid growth in AI applications	Significant progress in AI-powered medical solutions, including diagnosis, treatment and patient outcomes	(Kalra et al., 2024)

2. Types of AI in Veterinary Medicine

The first AI classification is based on capacity and extensiveness. Human-like cognition is also referred to as artificial generalized intelligence or strong artificial intelligence. Superintelligence is an AI, which is higher in intelligence than the human brain. Though these AI types provide quite a deal of horror considering their image in movies and TV shows, they exist, and their risk is often external rather than internal (Bose et al., 2024). Currently, computers are continually becoming more advanced and innovative systems. Some analysts believe that this sort of AI might not come into being. AI means are generally constructed to execute some particular functions such as walking, speaking, thinking, and replying to heard instructions. In medicine, they may have some solutions to some scientific issues (Gill et al., 2024). The AI technology that is employed in veterinary medicine is known as artificial narrow intelligence. These AIs are designed for a unique mission and since they can only conduct a single task, they are known as limited or weak AIs. An example in medical practice is the detection of an abnormality on a radiography image. These difficulties suggest that such systems are relatively limited or even poor in intelligence even though the hard tasks concern large quantities of data (hundreds of radiographic photos) (Akinsulie et al., 2024). The types of AI with their potential role are discussed in Figure 2.

3. AI in Veterinary Diagnostic Imaging

Digital technology's implications for veterinary care are virtually endless. The possibilities of transforming veterinary practice using AI appear almost limitless in the contexts of diagnostics, companion animal care, shift to veterinary research and education. Veterinary diagnostic

imaging applying AI aims at identifying, partitioning, and categorizing image characteristics as shown in Figure 3. Some distortion in the examined photograph might be seen, for instance, the presence of the lung nodule. Segmentation allows for the delineation of characteristics within an image, such as the perimeter of a nodule (Blaer, 2024).

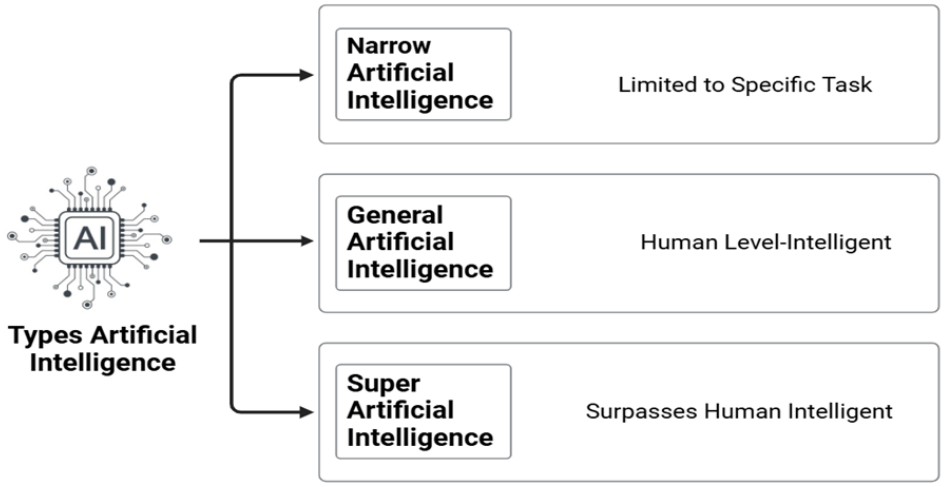

Fig. 2: Types of AI, and their potential Role.

Similarly, radiographers, other veterinary personnel may also apply detection, segmentation, and classification algorithms. Such apps might supply fast narratives for those photographs in which an AI has recognized an issue or assist in prioritizing patients for fast treatment of severe cases. By inclining AI technology in the management of patient records and e-health, veterinary caregivers could realize that they have lighter working loads and faster completion of duties. When used alongside diagnostic equipment, these tools can identify or categorize diseases to aid veterinarians diagnose them (Karimi, 2024).

Although they haven't undergone peer review, there are a few commercial AI systems for veterinary diagnostic imaging. To present, the vast majority of peer-reviewed AI applications for veterinary imaging have focused on proving that AI can reliably identify anomalies in the canine thorax (Samuel et al., 2021).

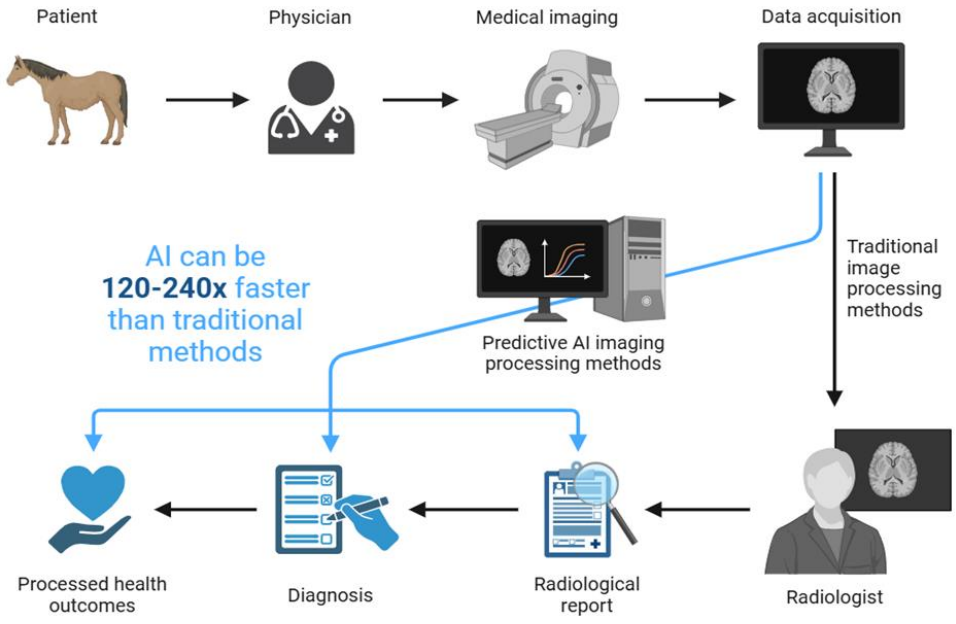

Fig. 3: Integration of Artificial Intelligence in Veterinary Medical Imaging and Diagnosis.

4. AI and Radiomics in Veterinary Medicine

AI has the potential to revolutionize veterinary medicine by reinventing treatment delivered and improving the welfare of animals. Radiation imaging is a relatively new medical imaging branch of precision medicine that employs complicated mathematical algorithms for quantification. This means that medical images have information on disease-related processes that are hidden from humans (Basran & Porter, 2022).

Radiology is the mining of numerous features from images and their translation to quantitative information. When such data are analyzed using complex and enhanced statistical techniques it forms the need for the development of individualized personalized medicine. Radiation appears in various medical imaging modalities like Computed tomography, Magnetic Resonance Imaging, Positron Emission Tomography, and

Ultrasonography (Figure 4). By building algorithms that make application of the current data and outcome, machine learning, an important sub-domain of AI, offers a significant contribution by making accurate predictions (Hosny et al., 2018).

AI in veterinary medicine includes quantitative and predictive epidemiology as well as precision-based medicines for humans and animals, and host-parasite relationships. In the area of diagnosis, AI can assist in disease detection, where AI comprises a small margin of error, a relationship between multiple biological systems, a solution to multiple problems, an assessment of risk, and tailor-made medicines to particular targets (Ezanno et al., 2021).

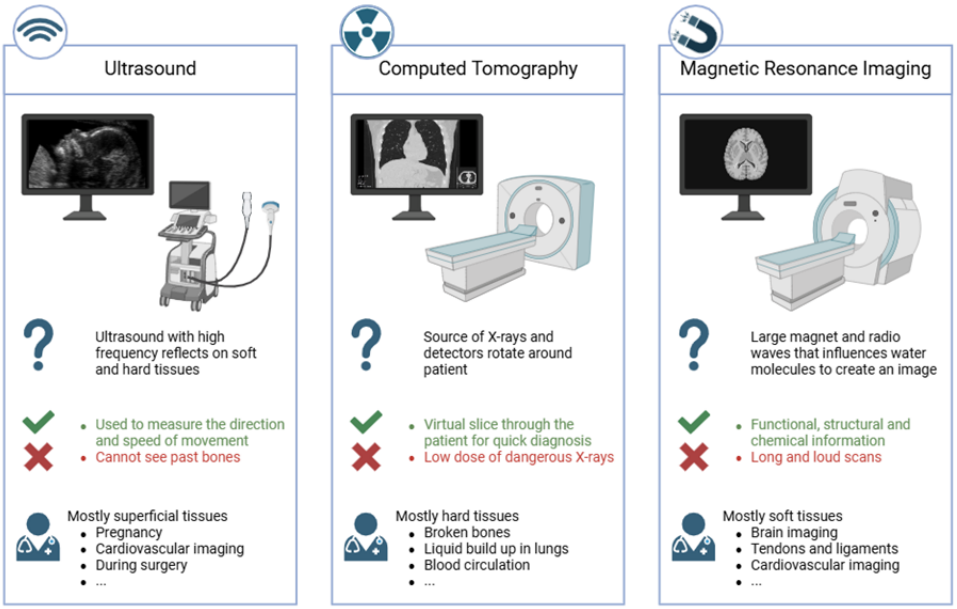

Fig. 4: Comparison of Medical Imaging Modalities: Ultrasound, CT, and MRI.

5. AI Applications in Veterinary Science

AI is revolutionizing animal healthcare by enabling early detection, prevention, and management of diseases (Ezanno et al., 2021). Below are specific examples showcasing the integration of AI in veterinary medicine and research as shown in Table 2.

Table 2: AI Applications in Veterinary Science

Field	AI Applicatisons in Veterinary Science			
	Application	Technology/ Methodology	Outcome	References
Epidemiology	National Animal Disease Referral Expert System	AI algorithms	Provides actionable insights and trend analysis for managing animal health.	(Hartung, 2023).
Cardiology (Canine)	Detection of Left Atrial Enlargement in Dogs	Convolutional Neural Networks (CNN)	Accurately distinguishes between positive and negative cases. Demonstrates AI's efficacy in interpreting complex veterinary imaging data.	(Xu et al., 2021).
Endocrinology (Canine)	Diagnosing Persistent Hypoadrenocorticism	Machine learning systems	Reliably predicts hypoadrenocorticism based on Na: K ratios and cortisol thresholds.	(Shaheen, 2022)
Oncology (Canine)	Osteosarcoma Diagnostics	AI-enabled bioinformatics and RNA sequencing	Precise diagnostic methods for osteosarcoma using exosomal mRNA patterns.	(Basran & Porter, 2022)
Oncology (Canine)	Categorization of Osteosarcoma	AI models	Predicts prognosis and treatment outcomes. Dogs classified as "osteosarcoma not detected" showed survival of up to 15 months.	(Ali et al., 2024)

6. Harnessing AI for Personalized Veterinary Care from Diagnosis to Treatment

AI can be utilized to diagnose the genetic data and medical imaging before determining the appropriate treatment plan for the patient. This might reduce the spread of infectious diseases, as the accuracy and the speed up the diagnosis as shown in Figure 5. AI is important in the proper diagnosis of the disease because it uses computer learning and complex analysis of various medical databases such as radiological and clinical information for the developing successful treatment (Abdallah et al., 2023).

AI approaches should be invariably employed in the treatment of animals due to challenging tasks that touch on quantitative and prediction epidemiological analysis, and host-pathogen interaction for human and animal health. Weekly check-ups with the help of AI give a chance to constantly observe patients with potential tendencies in deterioration of biomarkers. It is even more crucial in chronic diseases as it ensures an early approach, and therefore better treatment for the patients (Hartung, 2023).

At present, there are various determinations to introduce AI and radionics into clinical practice as additional aids to support decision-making and become components of everyday clinical work on the further enhancement of sensitivity, accuracy, and reproducibility of

diagnostics. A quantitative approach to medical imaging known as "Radiomics" maximizes the analysis of information through the use of complicated and frequently contradicting calculations in mathematics (Gopalakrishnan et al., 2023).

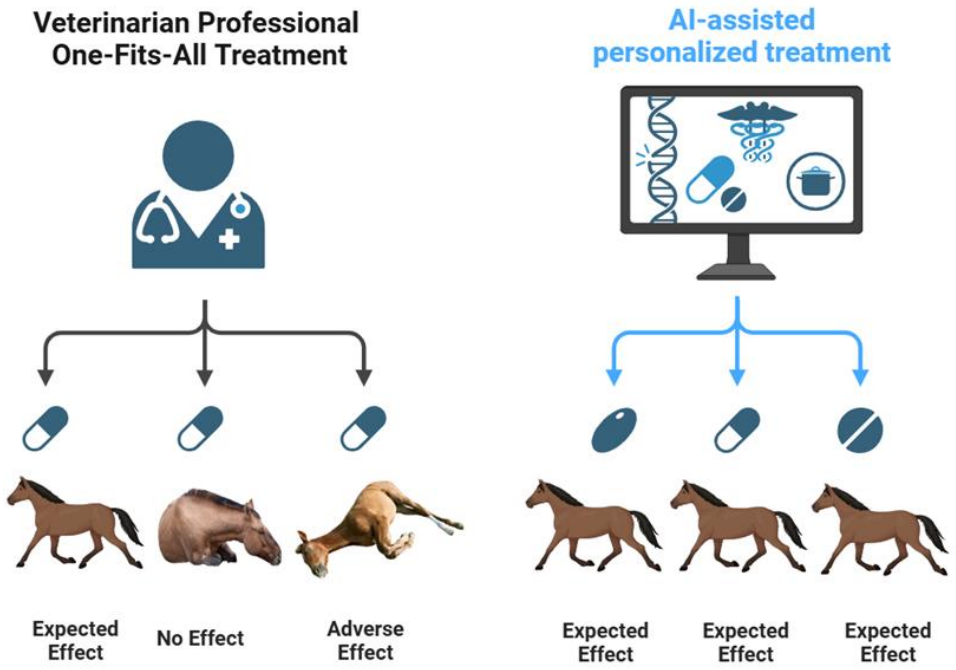

Fig. 5: Veterinarian Professional One-Fits-All Treatment vs. AI-Assisted Personalized Treatment

7. AI for Zoonotic Disease Surveillance

In terms of surveillance and tracking of zoonotic diseases, AI technology offers great potential to achieve significant success. The advancement of AI in the medical and veterinary fields has the forecasted potential to approach the concerns related to rising zoonotic diseases. A synchronous combination of AI technologies with the more traditional disease control measures based on machine learning and complicated algorithm models reveals new possibilities for the identification, analysis, and management of the effects of zoonotic diseases (Zhang et al., 2024). Several AI risk models can help predict important indicators and calculate the probability of a patient's illness being diagnosed on time. Some of the AI algorithms have been employed to predict host range vulnerability and viral hosts. Forecasting the host ranges of the Influenza virus involves the use of an NLP model like Word2vec to vector attributes obtained from viral nucleotide and protein sequences. It was established to assist in the selection of high-risk viral strains for future study, as well as to evaluate the emergence or danger that a new influenza virus poses if it develops the capacity to spread from person to person (Kaur at el., 2022).

8. AI in Disease Surveillance and Epidemiology

AI is employed to diagnose and treat various diseases in the field of veterinary medicine and help research scientists and veterinarians identify samples or cases that could be positive. So AI has been extensively used for the analysis of animal diseases, and nutritional diseases to obtain maximum information from body samples or instances (Munagandla et al., 2024). Two systems that have been devised in recent years include the PADI-web which is a machine learning algorithm integrated with an online/web-based system, and second is bio surveillance systems that are employed for early diagnosis of emerging animal diseases. Moreover, machine learning techniques have also been utilized in the evaluation of concomitant use of both genomic and epidemiological data for the early detection and reporting of food or water-borne diseases. AI has been playing a significant role in the epidemiology and surveillance of disease in veterinary medicine (Wong et al., 2019).

9. Machine Learning in Animal Health Surveillance

ML is critical in the construction of animal health surveillance models. For example, when an individual can recognizes the risk factors that make a particular farm susceptible to a given virus, so they can be easily identified given virus. This is obtained from previous case performance and a pool of potential risk factors (Neethirajan, 2020).

In Canada, ML models have been applied for *porcine epidemic diarrhoea virus* (PEDV) where the model is used to predict future trends of the disease. It is also utilized for the analysis of the susceptibility of hosts to diseases. It has also been used in the analysis and interpretation of genomic sequencing data during the course of the clinical investigation. Dealing with vast, intricate structures and relationships may not be easy using conventional approaches, thus ML might be preferable (Barragán-Montero et al., 2021). ML in the whole genome sequencing (WGS) analysis improves source attribution, pathogenicity assessment, antibiotic resistance phenotype prediction, and clinical outcome predictions. In other words, enhanced knowledge of host-pathogen relations and disease origin and prevalence contributes to more effective molecular surveillance of most processes (Ardila et al., 2024). The comparison of traditional trial and error method vs. AI machine learning model are shown in Figure 6.

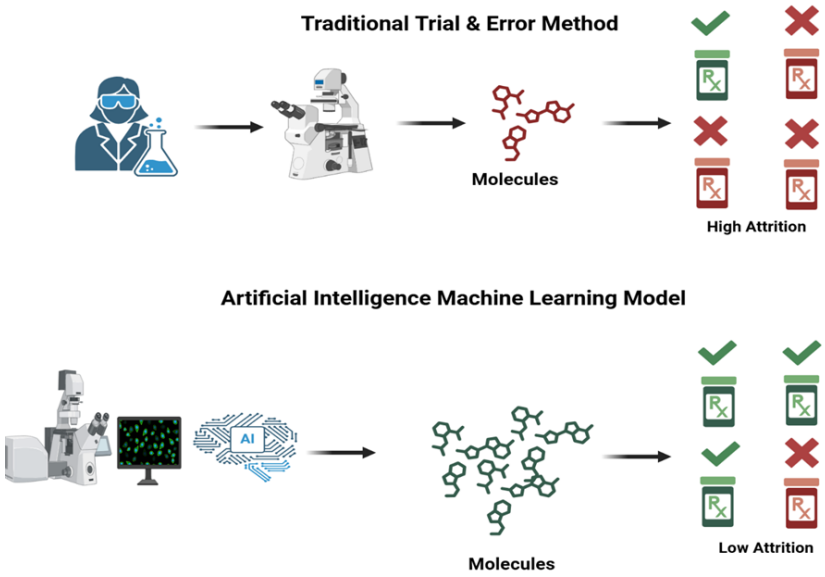

Fig. 6: Traditional Trial & Error Method vs. AI Machine Learning Model

10. Role of Computer Vision and AI in Veterinary Surgery

Computer enhanced visualization (CV) involves use of images, as well as interpretation with ultrasonic gadgets. The fields in which CV is transforming the units include image diagnosis and image surgery. This CV imaging has a variety of applicable sites in both medicine and veterinary science and this include such as radiography, ultrasound (US), computed tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET), retinal photography, and histology etc., (Zuraw & Aeffner, 2022). A basic prejudice rooted in the use of AI along with deep learning algorithms could possibly minimize the subjectivity in visual assessment. While great advancement has been observed in the area of human medical image analysis over the last few decades, its application in veterinary clinical practice is ongoing, particularly in poor and middle-income countries (Barragán-Montero et al., 2021).

A smart tissue autonomous robot (STAR) has been made to have capabilities to beat human surgeons and it has been designed by the Johns Hopkins University. The smart tissue autonomous robot has been employed in surgeries especially in intestinal anastomosis in animals. Therefore, by utilizing surgical algorithms that indicate the specific direction of the surgical action, evaluate the potential, and drawbacks (Fuentes et al., 2022). The effective strategy based on the patient's characteristics, it could be assumed that AI-assisted surgical procedures would increase their efficiency. They would also help surgeons overlay important information on actual images to increase precision and avoid errors at the same time they would provide advice or warnings of the actual activity of the surgeon or should be in situations in which surgery is to become unexpectedly difficult (Shi et al., 2021).

11. Role of AI in Disease Control

The role of AI in the study of disease spread and epidemiology will be mainly to analyse large amounts of data and thereby infer patterns and predict outbreaks by AI in both humans and animals (Secinaro et al., 2021). The AI applications in disease surveillance, and control shown in Table 3.

Table.3: Key AI Applications in Disease Surveillance, and Control

Category	AI Applications in Disease Surveillance, and Control			
	Application	Technology	Outcome	References
Disease Surveillance	Real-time outbreak detection	AI algorithms	Enables faster outbreak detection and control.	(Shi et al., 2021)
Vaccine Development	Developing new vaccines	Machine learning	Accelerates vaccine creation and reduces disease cases.	(Zuraw & Aeffner, 2022)
Animal Disease Surveillance	Tracking exotic diseases	AI, satellite imaging	Reduces losses in the cattle industry and prevents zoonotic disease transmission.	(Gopalakrishnan et al., 2023)
Flu Tracking	Monitoring flu outbreaks	Google search data, machine learning	Allows faster public health response to flu outbreaks.	(Abdallah et al., 2023)
COVID-19 Tracking	Research and spread prediction	Machine learning	Improves control, response, and therapeutic target identification.	(Neethirajan, 2020).
Ebola Prediction	Outbreak prediction	AI probability models	Predicts and helps control Ebola outbreaks.	(Neethirajan, 2020)
Dengue Fever Surveillance	Predicting dengue outbreaks	Aedes AI, machine learning	Enables timely dengue outbreak prediction.	(Olawade et al., 2024)
Avian Influenza	Monitoring H5N1 (bird flu)	AI-based analysis	Enhance monitoring and response strategies.	(Ezanno et al., 2021)
Newcastle Disease	Monitoring poultry disease	AI combined with classical methods	Improves ND control through AI and traditional approaches.	(Shah et al., 2024)

12. AI in Animal Production

AI can revolutionize the whole animal industry by improving the sustainability and efficiency of the processes that the animal industry applies in its production. Some examples of applications of AI in animal production such as precision livestock farming (Davis & White, 2020). A Passenger Locator Form (PLF) is a management system in which the sensors and AI employed to address health, welfare and behaviour of animals in real-time. This will raise the level of animal welfare and productivity, since the farmers will be able to detect the early signs, and symptoms of disease in their animals (Neethirajan, 2020).

13. AI in Veterinary Vaccine Technology

AI has been adopted as an innovation asset in the production of vaccines for animals as shown in Figure 7. ML techniques and other computational methods are used to process the data of genomics and proteomics. These methods incorporate antigen- antibody interactions and emulates immune response to several vaccines. AI enables the determination of the best formulations of the vaccines through the analysis of genetic information, and biomarkers (Aida et al., 2021).

The use of AI algorithms is essential in estimating the consequences of existing adjuvants and in the development of new vaccines. AI enhances the effectiveness of immunogenicity by analyzing molecular structures and operations of immune cells to afford superior formulation of adjuvants for vaccines. Computerized algorithms employ huge data such as, electronic medical data to estimate possible consequences of vaccination. AI algorithms may also estimate the protective effectiveness of vaccines through reactivity to trial data, genetic data, and biomarkers guaranteeing safety as well as effectiveness (Olawade et al., 2024).

Reverse vaccinology is based on AI methods that scan pathogen genomes for genes that code for surface-exposed immunogenic proteins. Community health services (CHs) have proven AI as useful in identifying vaccination objectives and resulted in enhanced speed and efficiency of discovered vaccines against several diseases. AI algorithms predict antigens containing parts of pathogen proteins, by analyzing protein sequences and structures in terms of potential epitopes. This aids in selecting the vaccination targets and in designing peptide-derived vaccines that can provoke substantial immune reactions. AI has been effectively employed to identify crucial targets for human vaccinations and is similarly used in veterinary medicine (Ezanno et al., 2021).

AI was used in the identification of S protein of SARS-CoV-2 and supported the development of Pfizer/ BioNTech and Moderna vaccines. These algorithms predicted the immunogenic surface of spike protein using viral genome sequences. AI also contributed to the designing of HPV vaccines including Gardasil and Cervarix as well as malaria vaccines including RTS, and S/AS01 based on predictions of immune responses on viral protein structures. AI's capability in processing complex data, mimicking immune reactions, and identifying potential vaccine objectives transform veterinary vaccine science by providing veterinarians with quicker, safer, and more efficient solutions for animals' welfare (Lungren & Wilson, 2022).

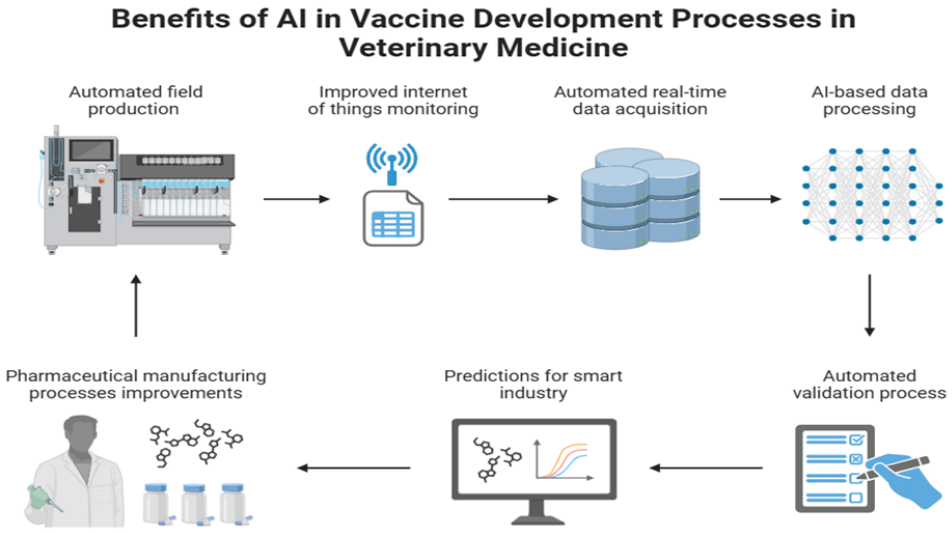

Fig. 7: Benefits of AI in Vaccine Development Processes in Veterinary Medicine.

14. Ethical Considerations in AI-Powered Veterinary Care

The application of AI in veterinary medicine presents ethical issues. The main concern is the handling of data generated by AI, while utilizing in veterinary clinically practice, so the question arises, who interprets the data? This is important to proper examine, and interpret the results generated by AI, because correct interpretation of results is scarce and incredibly beneficial (Shah et al., 2024). On other hand, the patient record, confidentiality data and security are also the stringent issues. AI related results and data on medical practices in humans are regulated by the FDA in the United States, or other related bodies globally but no sort of regulation exist on AI in veterinary medicine. The application of AI in veterinary care is vital for guaranteeing ethical, responsible, and targeted development (Albadrani et al., 2024).

15. Challenges of Implementing AI in Veterinary Medicine

AI has prodigious potential but utilizing it effectively in the veterinary medicine has not been easy, and has number of challenges. Other implementation problems appear to be similarly likely even though FDA clearance, which is not mandatory in veterinary medication. AI in the

veterinary practices, it is very critical to build good governance polices (Zuraw & Aeffner, 2022). AI critical responsibilities include defining the purpose of use or application, guaranteeing adequate infrastructure and resource requirements, and overseeing the different stages in the system's life cycle. While using the AI in the field of veterinary medicine, its significant to implement the effective data management practices, performing thorough acceptance testing and clinical deployment, offering educative sessions and creating quality assurance programs (Hull & Schumaker, 2018).

16. Client Acceptance of AI in Veterinary Care

Client acceptance is another main disquiet that how customers react AI technology involved in the treatment of patients. Though, AI integration is partially beyond the control of the veterinarian, and its success will only be determined by AI's popularity among the consumers. Perhaps they may support acceptance in terms of integrity and enlightenment of the clients (Coghlan & Quinn, 2024).

17. Data Limitations and Challenges in AI-Powered Veterinary Medicine

The practical application of AI in diagnosis and treatment is very limited because most of the practioners require labelled data for their use in supervised learning and the whole process of labelling is very tedious and cannot be done manually. Sample data are given with unsymmetrical data distribution, which does not make the process of learning deep and efficient (Albadrani et al., 2024). The aforementioned perfect reporting system does not exist in any way such as, tens of millions of samples of images and texts are needed. In other words, laboratories and other health centre must collaborate to advance the adaptation and use of electronic health records to achieve the required effectiveness, precision, and efficiency (Ali & Al-Zu'bi, 2023).

18. Conclusion

AI is an emerging field of computer science that are being capable of performing the task like humans intelligent. AI is a digital brain or a very complex computer program that mimics human learning and problem-solving seen in both humans and primates. Veterinary medicine is undergoing a major and erratic alteration in technology which, if properly tapped, has the potential of revolutionizing the livestock sector.

References

Abdallah, S., Sharifa, M., Almadhoun, M. K. I. K., Khawar, M. M., Shaikh, U., Balabel, K. M., Saleh, I., Manzoor, A., Mandal, A. K., Ekomwereren, O., Khine, W. M., & Oyelaja, O. T. (2023). The impact of artificial intelligence on optimizing diagnosis and treatment plans for rare genetic disorders. *Cureus*, *15*(10), e46860.

Abdulrazaq, K., Arif, B., Mehboob, R., & Mehboob, A. (2024). Combating zoonotic diseases: collaboration of veterinary and medical practitioners. *Research Journal of Veterinary Practitioners, 12*(1), 1-10.

Aida, V., Pliasas, V. C., Neasham, P. J., North, J. F., McWhorter, K. L., Glover, S. R., & Kyriakis, C. S. (2021). Novel vaccine technologies in veterinary medicine: a herald to human medicine vaccines. *Frontiers in Veterinary Science, 8*, 654289.

Akinsulie, O. C., Idris, I., Aliyu, V. A., Shahzad, S., Banwo, O. G., Ogunleye, S. C., . . . Oladapo, I. P. (2024). The potential application of artificial intelligence in veterinary clinical practice and biomedical research. *Frontiers in Veterinary Science, 11*, 1347550.

Albadrani, B. A., Abdel-Raheem, M. A., & Al-Farwachi, M. I. (2024). " Artificial Intelligence in Veterinary Care: A Review of Applications for Animal Health. *Egyptian Journal of Veterinary Sciences, 55*(6), 1725-1736.

Ali, A. A., & Al-Zu'bi, M. (2023). Application of artificial intelligence in monitoring of animal health and welfare. *Indian Journal of Animal Research, 57*(11), 1550-1555.

Ali, G., Mijwil, M. M., Adamopoulos, I., Buruga, B. A., Gök, M., & Sallam, M. (2024). Harnessing the Potential of Artificial Intelligence in Managing Viral Hepatitis. *Mesopotamian Journal of Big Data, 2024*, 128-163.

Ardila, C. M., Yadalam, P. K., & González-Arroyave, D. (2024). Integrating whole genome sequencing and machine learning for predicting antimicrobial resistance in critical pathogens: a systematic review of antimicrobial susceptibility tests. *PeerJ, 12*, e18213.

Barragán-Montero, A., Javaid, U., Valdés, G., Nguyen, D., Desbordes, P., Macq, B., . . . Löfman, F. (2021). Artificial intelligence and machine learning for medical imaging: A technology review. *Physica Medica, 83*, 242-256.

Basran, P. S., & Porter, I. (2022). Radiomics in veterinary medicine: Overview, methods, and applications. *Veterinary Radiology & Ultrasound, 63*, 828-839.

Blaer, M. (2024). Animal rescue tourism: digital technology-enhanced approaches to support voluntourist engagement, animal welfare and rights. *Tourism Recreation Research, 49*(3), 471-485.

Bose, M., Jagtap, A., & Shah, T. (2024). Intervention of Artificial Intelligence in Disease Diagnosis. *Computational Biology in Drug Discovery and Repurposing*, 19.

Bowen, J. P. (2024). Alan Turing: Breaking the Code, Computing, and Machine Intelligence. In *The Arts and Computational Culture: Real and Virtual Worlds* (pp. 75-94): Springer.

Coghlan, S., & Quinn, T. (2024). Ethics of using artificial intelligence (AI) in veterinary medicine. *AI & Society, 39*(5), 2337-2348.

Davis, T. C., & White, R. R. (2020). Breeding animals to feed people: The many roles of animal reproduction in ensuring global food security. *Theriogenology, 150*, 27-33.

Ezanno, P., Picault, S., Beaunée, G., Bailly, X., Muñoz, F., Duboz, R., . . . Guégan, J.-F. (2021). Research perspectives on animal health in the era of artificial intelligence. *Veterinary Research, 52*, 1-15.

Fuentes, S., Viejo, C. G., Tongson, E., & Dunshea, F. R. (2022). The livestock farming digital transformation: implementation of new and emerging technologies using artificial intelligence. *Animal Health Research Reviews, 23*(1), 59-71.

Gill, S. S., Wu, H., Patros, P., Ottaviani, C., Arora, P., Pujol, V. C., . . . Lutfiyya, H. (2024). Modern computing: Vision and challenges. *Telematics*

and Informatics Reports, 100116.
Gopalakrishnan, K., Adhikari, A., Pallipamu, N., Singh, M., Nusrat, T., Gaddam, S., . . . Yadav, A. (2023). Applications of microwaves in medicine leveraging artificial intelligence: Future perspectives. *Electronics, 12*(5), 1101.
Hartung, T. (2023). ToxAIcology: The evolving role of artificial intelligence in advancing toxicology and modernizing regulatory science. *Alternatives to Animal Experimentation. Springer Spektrum, 40*(4), 559-570.
Hosny, A., Parmar, C., Quackenbush, J., Schwartz, L. H., & Aerts, H. J. W. L. (2018). Artificial intelligence in radiology. *Nature Reviews Cancer, 18*(8), 500-510.
Hull, N. C., & Schumaker, B. A. (2018). Comparisons of brucellosis between human and veterinary medicine. *Infection Ecology & Epidemiology, 8*(1), 1500846.
Jaeger, L., & Dacorogna, M. (2024). Artificial Intelligence from Its Origins Via Today to the Future: Significant Progress in Understanding, Replicating, and Changing Us Humans or Solely Technological Advances Contained to Optimising Certain Processes? In *Where Is Science Leading Us? And What Can We Do to Steer It?* (pp. 207-235): Springer.
Kalra, N., Verma, P., & Verma, S. (2024). Advancements in AI based healthcare techniques with focus on diagnostic techniques. *Computers in Biology and Medicine, 179*, 108917.
Karimi, P. (2024). *Designing intelligent assistants to support older adults' personal health information management at home* [Doctoral dissertation, Indiana University Indianapolis]. *ProQuest Dissertations & Theses Global*.
Kaur, I., Sandhu, A. K., & Kumar, Y. (2022). Artificial intelligence techniques for predictive modeling of vector-borne diseases and its pathogens: a systematic review. *Archives of Computational Methods in Engineering, 29*(6), 3741-3771.
Konar, A. (2018). *Artificial intelligence and soft computing: behavioral and cognitive modeling of the human brain*: CRC press.
Lu, Y. (2019). Artificial intelligence: a survey on evolution, models, applications and future trends. *Journal of Management Analytics, 6*(1), 1-29.
Lungren, M. P., & Wilson, D. U. (2022). Artificial intelligence in veterinary care will be a major driving force behind AI advancements in healthcare. *Veterinary Radiology & Ultrasound, 63*, 913-915.
Munagandla, V. B., Dandyala, S. S. V., & Vadde, B. C. (2024). AI-powered cloud-based epidemic surveillance system: A framework for early detection. *Revista de Inteligencia Artificial en Medicina, 15*(1), 673-690.
Neethirajan, S. (2020). The role of sensors, big data and machine learning in modern animal farming. *Sensing and Bio-Sensing Research, 29*, 100367.
Olawade, D. B., Teke, J., Fapohunda, O., Weerasinghe, K., Usman, S. O., Ige, A. O., & David-Olawade, A. C. (2024). Leveraging artificial intelligence in vaccine development: A narrative review. *Journal of Microbiological Methods*, 106998.
Ouyang, Z. (2021). Health Informatics in Veterinary Medicine: State of the Literature, Day-1 Competencies, Perceptions of Telemedicine and Application of Predictive Modeling. [Doctoral dissertation].
Qureshi, F. K. (2024). The Evolution of AI Algorithms: From Rule-Based Systems to Deep Learning. *Frontiers in Artificial Intelligence Research, 1*(02), 250-288.
Rojas, R. V. B. (2024). Artificial Intelligence: Genesis, Development, and Future. In *Revolutionizing Communication* (pp. 1-15): CRC Press.
Samuel, G., Chubb, J., & Derrick, G. (2021). Boundaries between research ethics and ethical research use in artificial intelligence health research. *Journal of Empirical Research on Human Research Ethics, 16*(3), 325-337.
Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V., & Biancone, P. (2021). The role of artificial intelligence in healthcare: a structured literature review. *BMC Medical Informatics and Decision Making, 21*, 1-23.
Shah, S. M. A., Shamim, A., & Tariq, F. (2024). Applications of ai in veterinary medicine. *Digital Evolution: Advances in Computer Science and Information Technology*, 88.
Shaheen, M. N. F. (2022). The concept of one health applied to the problem of zoonotic diseases. *Reviews in Medical Virology, 32*(4), e2326.
Shi, Y., Wang, X., Borhan, M. S., Young, J., Newman, D., Berg, E., & Sun, X. (2021). A review on meat quality evaluation methods based on non-destructive computer vision and artificial intelligence technologies. *Food Science of Animal Resources, 41*(4), 563.
Stockham, S. L., & Scott, M. A. (2024). *Fundamentals of veterinary clinical pathology*: John Wiley & Sons.
Wong, Z. S. Y., Zhou, J., & Zhang, Q. (2019). Artificial intelligence for infectious disease big data analytics. *Infection, Disease & Health, 24*(1), 44-48.
Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., . . . Qiu, C.-W. (2021). Artificial intelligence: A powerful paradigm for scientific research. *The Innovation, 2*(4).
Zhang, L., Guo, W., & Lv, C. (2024). Modern technologies and solutions to enhance surveillance and response systems for emerging zoonotic diseases. *Science in One Health, 3*, 100061.
Zuraw, A., & Aeffner, F. (2022). Whole-slide imaging, tissue image analysis, and artificial intelligence in veterinary pathology: An updated introduction and review. *Veterinary Pathology, 59*(1), 6-25.