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ADVANCEMENTS IN MACHINE LEARNING FOR VETERINARY DIAGNOSTICS: APPLICATIONS, CHALLENGES, AND FUTURE DIRECTIONS

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Abstract: *Machine learning (ML) is revolutionizing veterinary diagnostics by enhancing accuracy and efficiency across diverse areas such as imaging, disease prediction, histopathology, and genomics. Through its ability to process and learn from complex data patterns, ML enables earlier and more precise diagnoses, supports decision-making, and optimizes therapeutic interventions. However, challenges such as limited datasets, lack of standardization, and species-specific variability restrict widespread adoption. This review details major applications of ML in veterinary diagnostics, supported by examples from recent literature, and explores critical challenges and promising future directions for integrating ML technologies in veterinary practice.*

• Introduction

Machine learning (ML), a branch of artificial intelligence, enables systems to learn from data without explicit programming. With the increasing use of digital tools, data volume grows in veterinary medicine. ML can be used to enable faster, more precise care. This review covers key uses, challenges, and ethics.

• Current applications in veterinary diagnostics

Machine learning is increasingly used in veterinary diagnostics to improve accuracy, speed, and early disease detection across species and data types:

- Diagnosed sow pregnancy via ultrasound with >90% accuracy.
- Detected hip dysplasia and classified thoracic radiographs in dogs.
- Identified TB biomarkers from radiographic data.
- Predicted cow fertility using fuzzy logic (92.6% accuracy).
- Forecasted disease in pets from clinical history (e.g., IBD vs. lymphoma).
- Classified canine skin tumors from histopathology (95% accuracy).
- Identified antimicrobial-resistant *S. aureus* in mastitis cases (97% accuracy) (Figure 1).
- Predicted hypothyroidism in dogs with up to 99% accuracy.
- Detected horse parasites using AI-powered fecal analysis.

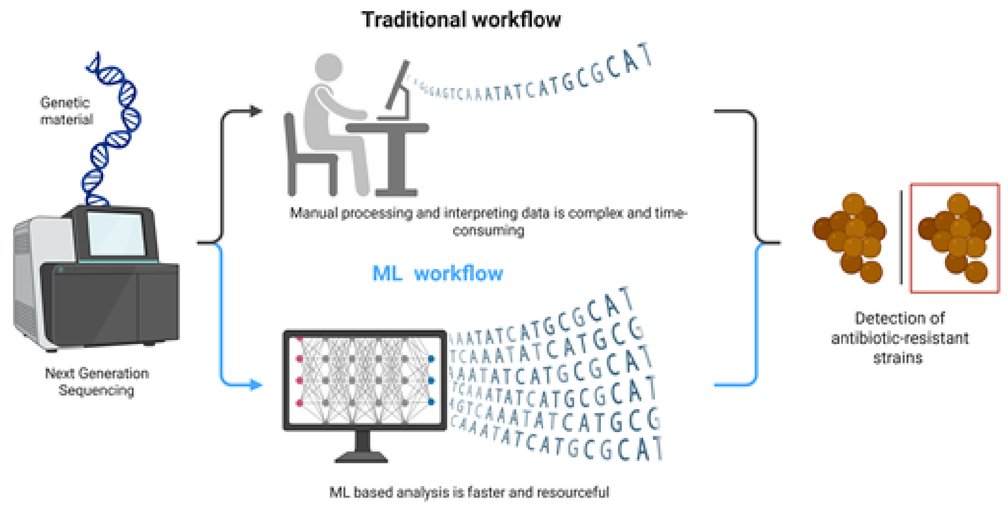

Fig. 1 ML enables rapid, accurate detection of antibiotic-resistant *S. aureus* in bovine mastitis

• Challenges in veterinary machine learning

Several key barriers limit ML adoption in veterinary medicine, including data, species variability, and ethics:

- Lack of standard data formats across clinics limits model generalization.
- Small datasets, especially for rare diseases or exotic species, hinder model training.
- Ethical concerns include data privacy, misuse, and owner consent.
- Interspecies differences reduce model portability (e.g., dog vs. cat).

• Future trends

To overcome data and species variability challenges, machine learning will rely on smart devices, integrated data sources, and standardized health records.