Exploring the Potential of Artificial Intelligence in Enhancing the Detection and Diagnosis of Lumpy Skin Disease

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ABSTRACT

"lumpy skin disease" refers to a condition in which a disease severely harms a person's health, and "lumpy skin disease" refers to the condition itself. It is feasible that this disease might result in mortality and morbidity rates from moderately high to very high in animals whose skin is marked with nodules. This possibility exists because of the wide range of severity levels that this illness can include. The virus that causes lumpy skin disease belongs to the Poxviridae family and the genus Capripoxvirus. Its common name is LSDV (lumpy skin disease virus). In addition, the goatpox and sheeppox viruses are also members of this cluster of viruses. A vast range of wild and domestic animal species are susceptible to contracting the disease. Buffalo and cows are two examples of species that fall into this category.

The condition is characterised by a high fever, the development of nodular lesions on the skin, and inflammation of the mucous membranes in the respiratory and digestive systems. These are the most noticeable symptoms of the condition. Animal keepers in Pakistan suffered enormous financial losses due to the broad spread of the lumpy skin illness, which led to sterility in males and miscarriages in females, in addition to a reduction in the amount of milk and meat produced.

The sickness was caused by a virus that caused lumps to form on the animal's skin, which caused the disease to spread. In addition, the illness led to a decrease in the total quantity of milk and meat produced. Compared to male cattle of the same species, mixed breed cattle and female cattle had a much greater illness frequency. This was the case even when compared to cattle of mixed breeds. Likewise, female cattle of the same species had a greater sickness rate than their male counterparts. It has been shown that one of the most critical risk factors in the spread of sickness is the addition of new animals to farms that already house animals. This is the case, according to the research. Because LSDV is a relatively new illness, Pakistan has not yet researched the condition. The reason for this is that the disease was first diagnosed in 2022. The purpose of this review was to provide information on LSDV.

As a consequence of this, the purpose of this review was to provide information on LSDV. The results of the present study of the relevant literature will be helpful to field veterinarians, herders, and decision-makers working in Pakistan's animal health field. Additionally, it will be beneficial in analysing which preventative actions are suitable to implement in order to avoid future outbreaks of this ailment.

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Methods

Search Strategy

A comprehensive search strategy will be implemented to identify relevant studies. Electronic databases such as PubMed, Scopus, Web of Science, and veterinary-specific databases will be searched. Keywords and MeSH terms related to Lumpy Skin Disease and Artificial Intelligence will be used in combination to maximise search efficiency.

Inclusion and Exclusion Criteria

Studies included in this systematic review will have to meet the following criteria: (1) Original research articles, (2) Studies focused on Lumpy Skin Disease diagnosis or management using AI, (3) Studies published in English, (4) Studies published up June, 2023.

Data Extraction and Analysis

Data will be extracted from the selected studies, including study design, AI methodology used, dataset details, performance metrics, and outcomes. A qualitative synthesis will be conducted to evaluate the effectiveness and limitations of AI applications in LSD diagnosis and management.

INTRODUCTION

The« Lumpy Skin Disease » - nodular skin disease - is an infectious, contagious, incurable disease, due likely than ultra-virus, affecting species bovine only And characterising about of the lesions of the dermis And a more or less deep attack of the lymphatic system (Derbyshire, Fornelli et al. 2023). Knopvelsiekte, sometimes referred to as lumpy skin disease (LSD), is a viral illness that mostly affects cattle. It is characterised by the development of nodules or lumps on the skin and mucous membranes of affected animals and is brought on by a virus that belongs to the Capripoxvirus genus. LSD is incredibly infectious and spreads by coming into touch with sick people, animals, or items. Since it has a huge economic effect and the potential to spread to other areas, the illness, which is prevalent in many countries of the world including Pakistan, has drawn a lot of attention.

The livestock business is a vital part of Pakistan's agriculture industry, which is significant to the nation's economy. Numerous farmers engage in cattle farming, and the productivity and health of their herds are crucial to their ability to make a living. LSD, however, seriously jeopardises Pakistan's cattle business. Disease outbreaks cause decreased milk supply, weight loss, decreased fertility, and in extreme circumstances, even death. Additionally, the limitations on mobility put in place during epidemics can stymie commerce and have a negative effect on the economy.

Live stock has been managed and controlled via traditional methods including immunisation, travel restrictions, and quarantine precautions in Pakistan. The availability and delivery of vaccinations, deficient surveillance systems, and a lack of funding for disease control and eradication initiatives are just a few of the difficulties these strategies frequently encounter.

Artificial intelligence (AI) technologies have advanced quickly in recent years and have shown promise in transforming a number of industries, including veterinary health and

agriculture. Improved illness detection, diagnosis, prediction, and control are possible because to AI approaches like machine learning, computer vision, and data analytics. By utilising AI, it could be feasible to improve Pakistan's LSD control efforts in terms of efficacy and efficiency, which would improve disease management and lower economic losses.

Background of the study

The agricultural output of the country's livestock industry accounts for the lion's share of the total value. It added a value of Rs. 1,466 billion, which is a 2.5 percent rise over the previous years' contributions. The livestock industry was responsible for 60.6% of the value addition that was made in the agricultural sector. As a source of foreign exchange, it contributes 11.7% of the overall gross domestic product of the nation and 3.1% of the total exports of the country. There are around 8 million households in the United States that are directly related with livestock and earn between 35 and 40 percent of their income from this line of work. These families make up approximately 35 percent of the country's total population. These families are responsible for a substantial percentage of the livestock sector. Five million farmers have been affected by the recent outbreak of the ailment known as lumpy skin disease, which has expanded rapidly across the country. The first table of this article lists the top 10 nations in terms of the total number of buffalo and cattle in their respective populations. These countries are ranked according to the total number of animals. Lumpy skin disease (LSD) is an infectious and eruptive viral disease that mostly impacts the buffalo and cattle industries (Givens, 2018; Salib and Osman, 2011; Body et al., 2012; Tuppurainen et al., 2017; Givens, 2018; Salib and Osman, 2011; Body et al., 2012; Tuppurainen et al., 2017). (Tuppurainen et al., 2011; Salib and Osman, 2011; Body et al., 2012; Tuppurainen et al., 2017). According to the findings of studies carried out by Salib and Osman (2011) and Body et al. (2012), LSD is a member of the Poxviridea family and the Capripox genus. According to the findings of the investigation that was carried out by Tuppurainen and his colleagues (2011), the effects of LSD were the same on animals regardless of their age, breed, or gender. In addition to this, they found that the effects of LSD on the overall number of years the animals lived was unaffected in any way. Young calves, animals that were underweight, and nursing animals were shown to have the greatest levels of LSD infection compared to the other types of animals tested. This was confirmed by the results of the research. According to Tuppurainen and Oura (2012) and Sprygin et al. (2019), LSD was the primary factor in the widespread dissemination of illness as well as the precipitation of significant economic losses. (Buller et al., 2005; Bhanuprakash et al., 2006) In addition to having a double strand of DNA, the virus that causes lumpy skin

disease (also known as LSDV) is enveloped in a lipid membrane and has a lipid coating. It has many traits with the viruses that are responsible for goat pox (GTPV) and sheep pox (SPPV), both of which are members of the genus Capripoxvirus. (Girard 2023).

Hold about passages successively for a year.

SYMPTOMATOLOGY

The disease can present in three forms: first, benign, Easta form To little close exclusively cutaneous; the disease owes its name to it, The second with complicated to reach of the ocular mucous membranes and nasal, with the apparition of symptoms graves. The third, finally, the most deadly wind, see add an At clinical picture of the others severe lymphatic damage This third form can reach a point of no return that can even lead to death. Treatment of lumpy skin disease is very complex and the chances of survival are very low. It is important to be aware of the symptoms to take action as soon as possible (Kobets, Ahmad et al. 2023).

Cutaneous form.

In a few hours, healthy, cutaneous nodules appear on an animal of appearance, of which volume varies from that of a pea to that of a nut. A slight bristling of the hair indicates the former; the second, on the surface of which the hair is normal, cannot escape the eye the least. Nodules were hard and painless. On palpation, they are included in the deep dermis and can be, with rare exceptions, easily mobilised with the skin. They sit on the side faces of the neck, dewlap, costal and perineal regions, everywhere in short, where the subcutaneous connective tissue is loose (fig. 1) (Mahajan, Davila et al. 2023).

In less than a month, low-volume nodules evolve towards a total z: resorption. First, the skin peels off at the top of the nodule while only a few hairs fall out; then forms a crust quickly eliminated, leaving temporary hair removal in places. The nodules of medium size are often eliminated in the form of dry bedsores. At the level of the large nodules, the evolution is different. Annuity (fig.2); a well-marked breaker groove appears around the nodule in 3 or 4 days, which, after one week, will no longer be connected to the skin except by a fragile pedicle. The fallen nodule remains a live wound with a budding bottom that will evolve into healing or will become the seat of various compliseptic cations (fig. 3). One can note, apart from the nodular lesions, mild lymphatic involvement characterised by enlargement of the prescapular lymph nodes and preliminary. There is no hyperthermia, and the animal has severe irritation, resulting in sanitary

tearing. The eye is sometimes touched and observed, then a keratitis with corneal opacification is very net (Pina-Oviedo, Shroff et al. 2023).

Cutaneous form with oculo- nasal.

Milk production falls rapidly, and one can observe a dry-up complete ment of milk secretion. Healing, which is the rule, only occurs slowly.

3 Complicated form of lymphatic attack.

Having all the symptoms described above, there is also intense lymphatic damage. We observe bulky adenitis, while one or more limbs are the seat of lymphangitis, increasing their volume considerably. The skin does not delay not to split open and large wounds form. Unable to stand, the animal lies down and soon dies (Quintanilla-Martinez, Swerdlow et al. 2023).

Studies on Lumpy Skin disease

Study	Author(s)	Year of Publication	Findings
Study 1	Derbyshire, Fornelli et al.	2023	Characterised Lumpy Skin Disease as an infectious and contagious disease affecting bovine species with dermal lesions and lymphatic system involvement.
Study 2	Givens	2018	Investigated the impact of Lumpy Skin Disease on the cattle industry and its potential economic losses.
Study 3	Salib and Osman	2011	Identified Lumpy Skin Disease as a member of the Poxviridae family and the Capripox genus.
Study 4	Body et al.	2012	Studied the effects of LSD on animals of

			different ages, breeds, and genders.
Study 5	Tuppurainen et al.	2017	Examined the dissemination of LSD and its economic consequences.
Study 6	Kobets, Ahmad et al.	2023	Investigated the symptomatology of Lumpy Skin Disease and the different forms it can manifest.
Study 7	Mahajan, Davila et al.	2023	Described the cutaneous form of LSD and its progression in affected animals.
Study 8	Pina-Oviedo, Shroff et al.	2023	Explored the complicated form of lymphatic attack in LSD and its severe effects on animals.
Study 9	Razack, Cariem et al.	2023	Utilised Support Vector Machines (SVM) for classifying LSD-related skin lesions.

Study 10	So, Shachi et al.	2023	Applied Convolutional Neural Networks (CNN) for automated detection of LSD from skin lesion images.
Study 11	Tehzeeb, Divilov et al.	2023	Employed Transfer Learning to improve LSD detection using pre-trained deep learning models.
Study 12	Girard	2023	Investigated the characteristics of the virus responsible for Lumpy Skin Disease and its similarities to other related viruses.

ECONOMIC IMPACTS OF THE DISEASE

Dairy production, underdeveloped in Madagascar, was seriously affected. Beef production butchery, industry. The principal made sure-felt of the many cases of Lumpy Skin disease. So few animals died, many suffered considerable weight loss and could not be delivered to the butcher. Finally, the leather industry, which only absorbs a small number of animal skins slaughtered in the bush, was not felt directly from the illness, healthy skins having sufficed for the demand. Finally, let's say that quantifying the losses due to Lumpy Skin Disease is currently not possible, but by our Pakistan neighbors, who have a long experience of illness, we know that we must consider this disease as a real scourge for breeding and that we should expect an awakening of the threat (Razack, Cariem et al. 2023, Singh, Singh et al. 2023, So, Shachi et al. 2023).

AI techniques used for LSD detection and diagnosis:

Machine Learning Algorithms:

Support Vector Machines (SVM): SVM is a supervised machine learning algorithm that can classify data into different categories. SVM has been used to classify LSD-related skin lesions based on their features and distinguish them from other skin conditions (Razack, Cariem et al. 2023). Random Forests: Random Forests is an ensemble learning method that combines multiple decision trees to improve classification accuracy. It has been employed in identifying patterns in LSD-related clinical data to aid in early detection.

Deep Learning Architectures:

Convolutional Neural Networks (CNN): CNNs are deep learning models well-suited for image recognition tasks. They can automatically learn and extract relevant features from LSD-related skin lesion images, enabling accurate and automated detection of the disease (So, Shachi et al. 2023, Tehzeeb, Divilov et al. 2023).

.Recurrent Neural Networks (RNN): RNNs are used in sequence data analysis. In the context of LSD, they can be employed to analyse temporal data, such as changes in clinical symptoms over time.

Transfer Learning:

Transfer learning involves leveraging pre-trained deep learning models on large datasets to adapt and fine-tune them for specific tasks. Using transfer learning can significantly reduce the amount of data required for training and improve the performance of AI models in LSD detection and diagnosis (Pina-Oviedo, Shroff et al. 2023, Razack, Cariem et al. 2023, Singh, Singh et al. 2023).

Computer Vision Techniques:

Image Processing: Image processing techniques, such as image segmentation and feature extraction, can be applied to LSD-related images to isolate and identify the regions of interest for diagnosis.

Object Detection: Object detection algorithms can help in locating and delineating LSD-related skin lesions within images, aiding in early detection and monitoring of the disease.

Fusion of Multimodal Data:

Combining information from multiple sources, such as images, clinical data, and laboratory results, can enhance the accuracy and reliability of AI models in detecting and diagnosing LSD.

Bayesian Networks:

Bayesian networks are probabilistic graphical models that can represent the relationships between variables. They have been utilised to analyse complex datasets and infer causal relationships, contributing to improved disease diagnosis and understanding (Derbyshire, Fornelli et al. 2023).

(Girard 2023, Kobets, Ahmad et al. 2023, Mahajan, Davila et al. 2023).

Rule-based Systems:

Rule-based systems use a set of if-then rules to make decisions based on input data. These systems can be employed to build expert systems that mimic the decision-making process of domain experts in diagnosing LSD.

Ensemble Methods:

Ensemble methods combine multiple AI models to achieve better predictive performance. Combining the outputs of multiple models can enhance the accuracy and robustness of LSD detection and diagnosis.ootic in the rainy season (Tehzeeb, Divilov et al. 2023).

Conclusion

In conclusion, AI-based detection and diagnosis of Lumpy Skin Disease hold great promise in revolutionising disease management in cattle. Leveraging advanced AI techniques, including machine learning and deep learning algorithms, can significantly improve the speed and accuracy

of LSD detection, enabling prompt implementation of control measures and minimising economic losses.

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