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Lassa Fever and Septic Fever: Clinical Profiles, Risk Factors, and Predictors of Mortality, Analysis of Early Clinical Predictors and Biomarkers, Global & India Mapping the Co-Prevalence, AI and 3D Identification

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Lassa fever and septic fever are important infectious diseases which cause high morbidity, mortality and healthcare burden, especially in resource-limited areas. The clinical features of both diseases are so similar, and include fever, hypotension, respiratory failure, and multi-organ failure, that early diagnosis and treatment are challenging. The clinical features, epidemiological features, risk factors, early clinical predictors and biomarkers of disease severity and mortality are analyzed. Prognosis assessment and therapeutic monitoring is an important role of a number of biomarkers, such as lactate, procalcitonin, cystatin-C, and inflammatory cytokines. The review also notes that artificial intelligence, machine learning, 3D imaging technologies and epidemiological surveillance systems are increasingly playing a key role in the prediction, monitoring and clinical decision-making of diseases. The combination of biomarker-based diagnostics, AI-driven predictive modelling, and digital healthcare technologies could greatly enhance the management of infectious diseases and the preparedness of healthcare systems. The multidisciplinary research and international co-operation continue to be critical to decrease the global burden of severe infectious diseases.

Keywords: Lassa fever; Septic fever; Sepsis; Biomarkers; Mortality predictors; Artificial intelligence; Machine learning; 3D identification; Epidemiological surveillance; Infectious diseases

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1. INTRODUCTION

Lassa fever and septic fever are among the most significant infectious diseases that are responsible for significant morbidity and mortality, especially in the developing and resource-limited countries. Lassa fever is a viral hemorrhagic fever, whereas septic fever is usually seen in contexts of severe bacterial, viral or fungal infection that is associated with a systemic inflammatory response[1]. Both diseases are significant health care problems due to speed of onset, overlapping clinical symptoms and high mortality rates in critically ill patients. Differential diagnosis is difficult early in infection as there are common features of fever, hypotension, respiratory distress, coagulation abnormalities, renal dysfunction and multi-organ failure.

Urbanization, environmental changes, antimicrobial resistance, late diagnosis and poor health care systems have contributed to the growing burden of these infectious diseases. In addition, Lassa fever is still endemic in some countries in West Africa, while worldwide, septic fever is still an important cause of intensive care unit admission and hospital mortality. However, delayed recognition and disease management in many developing countries is due to poor sanitation, inadequate laboratory facilities and inadequate infection control measures[2]. This high mortality continues in spite of the progress made in modern medicine and critical care medicine.

In recent years, molecular diagnostics, discovery of novel biomarkers, genomics, artificial intelligence, and digital healthcare technologies have revolutionized the understanding and management of severe infectious diseases. Artificial Intelligence and Machine Learning models help with the clinical decision making and epidemiological surveillance, as well as biomarker approaches are used for early diagnosis and prediction of prognosis. Likewise, real-time 3D imaging and identification technologies are becoming innovative solutions for disease monitoring and healthcare visualization. These multi-disciplinary advances have provided novel possibilities for enhancing health-care preparedness, lowering mortality and building regional and global infectious disease surveillance systems.

1.1 Background and Context

Lassa fever is an illness that was first diagnosed in Nigeria in 1969, and it is now known to be prevalent in several West African nations such as Nigeria, Sierra Leone, Guinea, and Liberia. The mode of transmission for Lassa fever includes contact with infected rats, ingestion of contaminated foods, or human-to-human interaction, particularly among healthcare professionals[3]. Septic fever is a medical emergency condition caused by severe sepsis and septic shock due to the life-threatening dysfunction of body organs resulting from an unregulated immune response to infections.

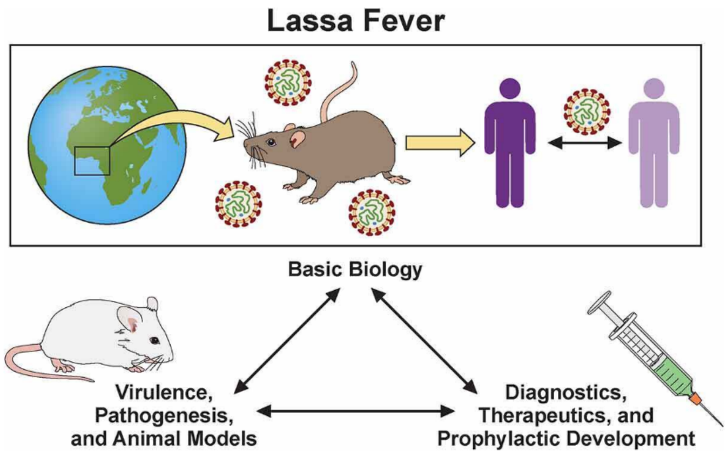

Figure 1: Transmission Cycle, Basic Biology, and Research Framework of Lassa Fever

1.2 Objectives of the Review

The major objectives of the present review are:

- To understand the clinical profiles and epidemiological aspects of Lassa fever and septic fever.
- To identify risk factors, clinical predictors, and biomarkers related to disease severity and mortality.
- To investigate how artificial intelligence, machine learning, and 3D identification can play an important part in diagnostics, surveillance, and predictive medicine[4].

1.3 Importance of the Topic

Emerging infection diseases coupled with the rising number of mortalities related to severe systemic infections have made it necessary to have an in-depth knowledge of disease pathology, epidemiology, and prognosticators[5]. Early detection and subsequent treatment of infections are still critical for the prevention of complications and improvement in the survival rates of patients who are critically ill. Moreover, the use of artificial intelligence and predictive tools such as biomarker analysis and imaging technology can revolutionize the diagnosis and management of infections in the healthcare sector[6].

2. CLINICAL PROFILES AND EPIDEMIOLOGICAL CHARACTERISTICS OF LASSA FEVER AND SEPTIC FEVER

The two diseases that will be discussed in this study are Lassa fever and septic fever, both of which can result in high morbidity and mortality rates on a worldwide scale. Lassa fever is an infectious hemorrhagic disease caused by the Lassa virus and primarily contracted via rodent and other contaminated items, while septic fever is characterized by severe inflammation of the body following infection[7]. These infections have similar clinical symptoms such as fever, hypotension, breathing difficulty, and organ malfunctioning. The rising prevalence of the conditions is attributed to several factors such as urbanization, antimicrobial drug resistance, poor hygiene, and weak health care system in developing countries. Significant research has been done in recent years in molecular diagnostic techniques, biomarker identification, artificial intelligence, and imaging, which have helped in improving disease control and management. Nevertheless, several difficulties, including delayed diagnosis and insufficient infection control, still increase mortality[8].

2.1 Clinical Manifestations and Disease Progression

Clinical presentation of Lassa fever shows wide variations, ranging from a milder disease process characterized by fever alone to more severe conditions associated with serious complications. The early signs of Lassa fever are usually fever, headache, malaise, sore throat, coughing, vomiting, chest pain, abdominal pains, and overall body weakness[9]. Later, the patient may suffer severe bleeding problems, face swelling, breathing difficulties, neurological disorders, hypotension, shock, and multiorgan dysfunction syndromes. Encephalitis, hearing impairment, kidney malfunction, and circulatory failure are among the complications that are common at advanced stages of the disease process.

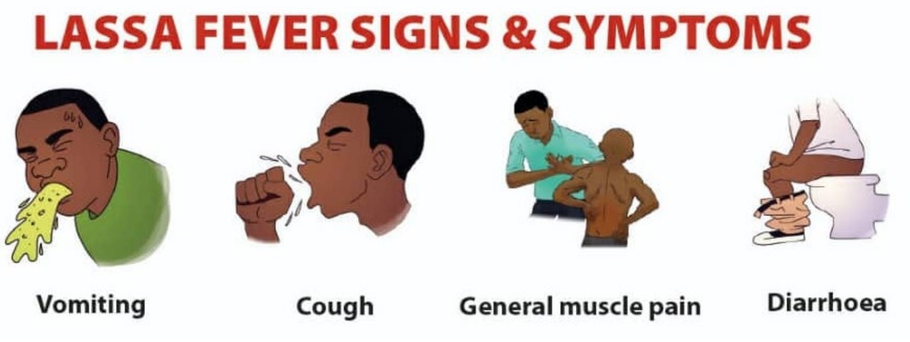

Figure 2: Common Clinical Signs and Symptoms of Lassa Fever

Likewise, septic fever manifests with inflammatory reactions throughout the body, which are triggered by serious infections. Common symptoms in such a condition typically consist of fever, increased heart rate, low blood pressure, breathing difficulties, changes in one's mental state, metabolic disturbances, and dysfunction of various organs. Should the disease become more severe, septic shock can occur owing to inadequate blood flow and poor circulation, leading to respiratory distress syndrome, disseminated intravascular coagulation, kidney failure, and multi-organ failure[10].

The pathogenesis of both illnesses is closely linked to an immunoregulatory disorder, endothelial injury, inflammation and release of inflammatory cytokines, coagulation disorders, and tissue hypoxia. Late diagnosis and suboptimal supportive treatment greatly contribute to increasing morbidity and mortality from both conditions. Research has found that there is a close correlation between hypotension, acute lung injury, inflammation, thrombocytopenia, kidney malfunction, and neurological problems[11].

2.2 Global and Indian Epidemiological Distribution

Lassa fever is highly endemic in Nigeria, Sierra Leone, Liberia, and Guinea and is responsible for considerable seasonal epidemics in these regions, adding to the burden of health services and mortality. The disease is mainly linked to exposure to the multimammate rat, the primary reservoir host of the Lassa virus. Environmental degradation, climate variability, sanitary conditions and mobility have led to higher seroprevalence rates and growing transmission patterns in epidemiological studies. In addition, human-to-human transmission, particularly in health care facilities can be significant in the spread of diseases during outbreaks[12].

Lassa fever is not endemic in India, but with the rise in international travel and global population movement, a risk of imported infections and potential future transmission is a concern. There is therefore a growing need for surveillance systems and healthcare preparedness strategies to help prevent a potential outbreak and to increase the capacity of public health to respond. Septic fever and septic-associated complications, on the other hand, continue to be a significant challenge in healthcare services in India and are associated with significant hospitalisation, intensive care burden and mortality.

Antimicrobial resistance, hospital acquired infections, delay in diagnosis, lack of infection control measures, under developed critical care facilities and limited access to care in rural areas are important issues in sepsis management in India[13]. There is epidemiological evidence that neonatal sepsis, postoperative infections, pneumonia-associated sepsis, and bloodstream infections are important contributors to the disease burden in Indian healthcare settings. Therefore, the need for the strengthening of epidemiological surveillance, healthcare infrastructure and infection prevention continues to be important to diminish the burden of disease and enhance clinical outcomes.

2.3 Comparative Clinical Challenges and Public Health Burden

The two diseases known as Lassa fever and septic fever have been a great challenge in the medical field owing to their rapidly progressing nature and high mortality rate. Both conditions are characterized by similar symptoms that make it difficult to diagnose them, manage them, and treat them, especially in poorly-equipped health facilities[14]. Apart from the effect on patient survival, the two conditions put enormous strain on the medical sector.

Comparative Clinical Challenges

The common challenges that make Lassa fever and septic fever more difficult to diagnose, treat, and manage include the similarities in their symptoms, quick disease progression, scarcity of medical facilities, and lack of monitoring systems[15]. These factors have greatly influenced the mortality rate of patients.

- **Diagnostic Challenges:** Diagnosing early Lassa and septic fever proves to be hard since both ailments exhibit signs such as high body temperature, respiratory issues, hypotension, and organ malfunction, among others[16]. As a consequence of these non-specific symptoms, misdiagnosis becomes inevitable. In addition, inadequate laboratory services hinder diagnosis efforts.
- **Healthcare Infrastructure Challenges:** The inadequate healthcare infrastructure continues to be one of the most significant challenges when trying to deal with the serious infectious diseases. There is a lack of intensive care units, skilled medical professionals, laboratories for testing and diagnosing, and emergency healthcare services in many underdeveloped countries.
- **Infection Control and Surveillance Challenges:** The lack of appropriate infection control policies and inadequate epidemiological surveillance leads to increased chances of diseases spreading and outbreaks occurring. The improper utilization of PPEs, overcrowding, and inadequate training of healthcare staff regarding infections control put healthcare personnel at an elevated risk of infection.
- **Antimicrobial Resistance and Therapeutic Challenges:** Antibiotic resistance has emerged as a significant problem in the treatment of septic fever. Multi-drug resistance infections make things difficult and cause high mortality rates[17]. Likewise, lack of treatment options for Lassa fever makes its treatment complicated.
- **Socioeconomic and Public Awareness Challenges:** Poverty, sanitation issues, overcrowding, and inadequate knowledge about health issues play an important role in facilitating disease transmission. Misleading information, social discrimination, and poor

health awareness hinder appropriate and timely treatment measures, as well as disease prevention and control efforts.

- **Public Health Burden**

Both Lassa fever and septic fever have a high public health burden due to their morbidity rate, mortality rate, and effect on the healthcare sector. The two infections play a major role in causing hospital admissions, ICU admissions, lengthened period of treatment, and increased costs in the health sector, especially in developing countries[18]. The prevalence of the infections, late detection, and lack of preparation of the healthcare sector pose a challenge to health infrastructure. In endemic areas, lack of diagnostics services and critical care increases severity of the conditions.

Apart from posing a significant burden to the patients suffering from them, these infections also pose serious socio-economic burdens on both the region and globally. Decreased productivity within the labor force, increased medical expenditure due to health care utilization, disrupted public health systems, and the associated fear that is caused by infections have a negative impact on both individuals and institutions in society. Poor sanitation, overcrowding, poor epidemiological surveillance, and infection prevention practices still pose challenges when it comes to disease transmission and outbreak containment. Thus, there is a need to enhance public health and infrastructure.

3. RISK FACTORS, EARLY CLINICAL PREDICTORS, AND BIOMARKERS OF MORTALITY

The identification of risk factors and predictors of mortality is very critical when it comes to the improvement of outcomes in patients suffering from Lassa fever and septic fever. The severity of the disease is associated with various aspects, such as demographics, the patient's immune system, comorbidities, virulence of the pathogen, and access to health care[19]. Biomarkers are increasingly being used as useful diagnostic and prognostic means among other aspects, and understanding the relationship between various clinical risk factors and mortality factors is important.

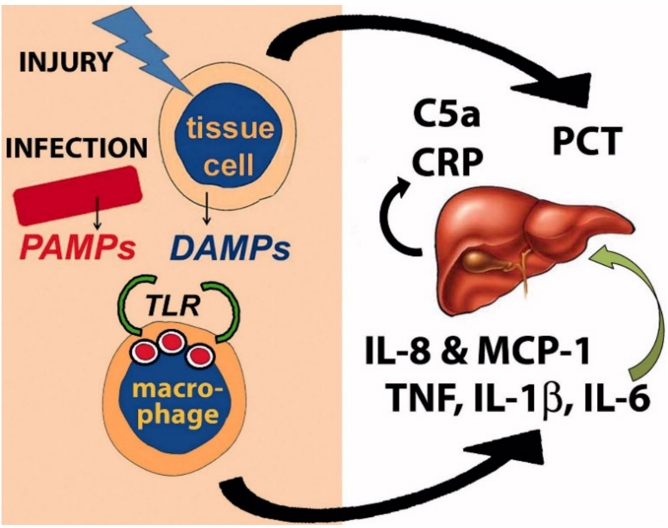

Figure 3: Inflammatory Pathways and Biomarkers Associated with Disease Severity and Mortality in Severe Infectious Diseases

3.1 Risk Factors Associated with Disease Severity

Various environmental, demographic, and clinical variables lead to more severe forms of the disease and higher mortality rates in both Lassa fever and septic fever. Poor sanitation, contact with rodents, over-crowding, malnutrition, and lack of medical attention all play an important role in increasing the chances of contracting Lassa virus infection[20]. These factors make it easier for the virus to propagate within affected environments.

In addition, health care professionals are also at risk due to occupation hazards, improper prevention of infection, and through their direct interaction with infected patients or objects. The late diagnosis of the disease and the absence of personal protective clothing during work make them even more vulnerable. Similar cases may arise among people who live in crowded places where there is poor hygiene maintenance.

Among those affected by septic fever, being old, immunocompromised, having diabetes mellitus, chronic kidney disease, malignancy, long-term hospital stays, invasive medical procedures, and multi-drug-resistant infection are strongly linked to poor prognosis. Patients staying in intensive care units are especially prone to septic fever due to weakened immunity, long-term exposure to nosocomial infection, and possibility of organ malfunctioning.

3.2 Early Clinical Predictors of Mortality

Early clinical indicators are critical to determining high-risk patients and the intensive therapeutic interventions needed. Persistent fever, hypotension, respiratory distress, altered mental status, oliguria, metabolic acidosis, and thrombocytopenia are important clinical predictors of death in severe infectious diseases[21]. They frequently indicate overall inflammatory responses, impotence of blood supply and worsening organ failure.

There are some specific features, such as multi-organ dysfunction syndrome and septic shock, which are found to be associated with high mortality in both Lassa fever and septic fever. Severe hypotension, acute respiratory distress syndrome, coagulation abnormalities and impaired renal function increase the risk for adverse clinical outcomes. Often these signs are delayed and this contributes to poor survival rates and progression of disease.

Neurological involvement, bleeding tendency, raised liver enzymes and renal impairment have been highly correlated with poor prognosis in patients with Lassa fever. The same applies if the patient has septic fever and a raised lactate, disseminated intravascular coagulation and severe metabolic disturbances[22]. Identification of these predictors also has a critical role in improving clinical decision making, use of intensive care, and survival of patients.

3.3 Role of Biomarkers in Prognosis and Diagnosis

Infectious diseases like Lassa fever and septic fever have seen great advances through the use of biomarkers for diagnostic, prognostic, and treatment purposes. Biomarkers can help determine the severity of an illness, as well as provide information about the body’s response to it, and help predict the outcome of the infection. Recent developments in molecular and genomic science have made biomarker analysis even more effective.

- **Inflammatory Biomarkers:** Inflammatory markers like procalcitonin, C-reactive protein, cytokines, and tumor necrosis factor alpha give us valuable insights into the presence of inflammation in the body and the degree of severity[23]. Higher amounts of inflammatory markers are usually seen in cases of severe infections and sepsis.
- **Metabolic Biomarkers:** Rising lactate serum levels can serve as significant indicators of tissue hypoxia, circulatory dysfunction, and septic shock. Elevated lactate levels can be linked directly to reduced tissue perfusion and mortality among patients suffering from severe cases of sepsis and systemic infection.
- **Renal Biomarkers:** Cystatin-C and creatinine are two commonly utilized biomarkers in assessing acute kidney injury and organ dysfunction in sepsis patients. Increased levels of renal biomarkers in such patients usually represent disease progression or increased severity of the disorder especially among patients with multi-organ dysfunction syndrome.
- **Liver and Coagulation Biomarkers:** In Lassa fever cases, increased liver enzyme levels, abnormal coagulation, and inflammatory molecules have shown to have high prognostic importance. This is because these biomarkers can determine liver dysfunction, hemorrhage, and the progress of the disease.
- **Molecular and Genomic Biomarkers:** Progress made in areas such as molecular biomarkers, metabolomics, proteomics, and genomic profiling has helped in gaining more knowledge about infectious disease pathophysiology. Gene expression profiling and molecular diagnostics are now frequently used in precision medicine for diagnosing and treating serious infectious diseases[24].
- **Clinical Role in Prognosis and Monitoring:** The assessment of biomarkers is essential in determining the response to treatment, predicting progression, and identifying high-risk individuals. The incorporation of biomarker profiling into clinical practice could lead to better diagnosis, risk stratification, and targeted interventions that could reduce the mortality rate of Lassa fever and septic fever.

4. ARTIFICIAL INTELLIGENCE, 3D IDENTIFICATION, AND GLOBAL SURVEILLANCE

The introduction of AI, machine learning, image technologies, and digital surveillance technology has greatly enhanced the ability to diagnose, predict, and manage infectious diseases. AI technology has helped in disease detection, mortality prediction, risk stratification, and decision making, while image and 3D identification technology have increased diagnostic precision and monitoring of patients. Global surveillance and epidemiological mapping technology have made it easier to determine disease prevalence and detect epidemics, especially severe infectious diseases like Lassa fever and septic fever.

4.1 Artificial Intelligence in Disease Prediction and Clinical Decision-Making

In the field of infectious disease management, AI has proven to be a valuable asset for diagnostics, prognosis, and health care efficiency. Machine learning algorithms can use patient data, lab results, imaging data, and demographics to detect disease patterns that would otherwise be undetectable, and to predict the disease's progression[25]. In critical care and emergency situations, AI acts as a valuable support to help clinicians make quicker and more accurate decisions.

In the field of early sepsis detection, risk stratification in the intensive care unit and mortality prediction, AI-powered predictive models have demonstrated good performance. These systems can quickly scan patient histories, inflammatory markers, and physiology to find high-risk patients that need urgent intervention. AI-powered early warning systems could have a profound impact on patient outcomes by enabling swift diagnosis and treatment initiation.

Beyond predictive models, explainable AI models can provide more clarity to clinical results, delivering transparent reasoning for their predictions and clinical recommendations[26]. AI-powered surveillance systems are also used during epidemics for real-time outbreak monitoring, epidemiological trend analysis, and healthcare resource allocation. The application of AI in healthcare systems can thus be harnessed to enhance infectious disease management, minimize diagnostic delays, and improve public health preparedness.

4.2 Real-Time 3D Identification and Imaging Technologies

The use of real-time 3D identification systems and image-based modeling technologies is emerging as a new direction for monitoring infectious disease and diagnostic applications. Advanced imaging systems provide better visualization of pathological defects, help to assess organs and support digital patient monitoring in critical care[27]. These technologies can enable clinicians to more accurately and efficiently assess structural and functional changes.

Thanks to scanner-based 3D modeling and image reconstruction techniques, the conditions for accurate structural analysis and tracking of the disease in real time are created. These technologies can help health care professionals detect tissue damage, assess organ dysfunction and track disease progression for critically ill patients. Further, remote imaging systems and digital visualization platforms could aid in the telemedicine and remote delivery of healthcare in the event of an infectious disease outbreak.

Combining AI-driven analytics with imaging technologies can further enhance the automation of disease detection and clinical workflow. AI-powered image analysis systems can quickly analyze imaging data, identify abnormalities, and provide predictive insights to support clinical decision-making. The developments could help refine the diagnosis, lessen the burden of healthcare workers and help better monitor patients with severe infectious diseases like Lassa fever and septic fever.

4.3 Global and India Mapping of Co-Prevalence

Frequent disease mapping throughout the world is necessary to determine high-risk groups, understand disease transmission patterns and better inform strategies to prepare for outbreaks. Yet Lassa fever continues to be an endemic disease in Nigeria, Sierra Leone, Liberia and Guinea, where environmental factors, exposure to rodents and poor health-care facilities all help spread the disease[28]. But septic fever has now morphed into a global health issue in both developed and developing countries.

Sepsis, antimicrobial resistance, intensive care unit admissions, and hospital-acquired infections have all been shown to be associated with increased disease burden through epidemiological mapping and surveillance studies both at a global and local level. Delayed diagnosis, poor facilities in health care, and poor infection control practices further contribute to mortality rates in developing countries. The potential for spread of infectious diseases from geographical regions is also due to international travel, urbanization and population mobility.

In India, the death rates due to sepsis, antimicrobial resistance, HAI and increased burden of intensive care are a growing concern and require more effective surveillance and infection control measures. The integration of AI-powered surveillance systems, epidemiological mapping tools, and digital health platforms could mark a new era in disease surveillance, outbreak forecasting, and healthcare planning. Combined, these AI-driven tools could revolutionize disease monitoring, prediction, and healthcare planning[29]. Better integration of surveillance data and predictive analytics can inform evidence-based public health policies and be used for better preparedness in the event of an upcoming infectious disease outbreak[30].

Table 1: Summary of Selected Studies on Lassa Fever, Sepsis Biomarkers, Artificial Intelligence, and Clinical Prediction Models

Author(s) & Year	Study Focus	Key Findings
Rabello Filho et al. (2016)[31]	Lactate levels in sepsis	Elevated lactate levels were linked with higher mortality in septic patients.
Saka et al. (2017)[32]	Lassa fever outbreak analysis	Identified major transmission patterns and risk factors in Nigeria.
Sarhadi & Armengol (2022)[33]	Molecular biomarkers	Biomarkers showed importance in disease prognosis and diagnosis.
Shen et al. (2019)[34]	AI in disease diagnosis	AI systems demonstrated improved diagnostic accuracy.
Steyerberg (2019)[35]	Clinical prediction models	Prediction models improved risk assessment and mortality forecasting.

5. DISCUSSION

This review sheds light on the increasing relevance of Lassa fever and septic fever at an international level due to their role in causing morbidity and mortality related to infectious diseases. Lassa fever and septic fever have complicated pathophysiological processes associated with them such as inflammation and immune disorders along with endothelial damage and multiple organ involvement[36]. It is imperative for improved patient care that emphasis be laid on early diagnosis, use of biomarkers for risk assessment, and application of artificial intelligence and new surveillance technology.

5.1 Interpretation and Analysis of Findings

The results from the review reveal that Lassa fever and septic fever are highly linked to the development of systemic inflammatory conditions that increase mortality rates, especially in cases where diagnosis and treatment are delayed[37]. Some of the important predictors of bad clinical outcome included hypotension, respiratory symptoms, acute kidney injury, change in mental state, thrombocytopenia, and multi-organ dysfunction. Serum lactate levels, procalcitonin, cystatin-C, inflammatory cytokine levels, and genomic biomarker analysis proved highly useful in predicting bad prognosis. Moreover, artificial intelligence tools proved highly promising in predicting disease progression.

5.2 Implications and Significance

Given the current trend of worsening cases of infectious illnesses, it is increasingly critical that there be an emphasis on preparing healthcare facilities for such situations, as well as developing rapid diagnosis systems and interdisciplinary approaches to disease control. The identification of clinical predictors and the use of a biomarker approach can greatly enhance the effectiveness of treatment and save the lives of critically ill patients[38]. Moreover, the implementation of artificial intelligence, machine learning technology, and advanced imaging systems could revolutionize disease detection and healthcare through predictive analysis.

5.3 Research Gaps and Limitations

Even with the substantial progress made in the research on infectious diseases and digital medicine, some research issues and constraints still exist. For example, current investigations that focus on Lassa fever are mainly conducted in Africa because of the disease's prevalence there, thus limiting global data and comparisons among the different populations[39]. Furthermore, multi-center trials investigating the role of biomarkers, artificial intelligence, and imaging technology in disease diagnosis and treatment are currently rare. Other issues include lack of lab capacity, underreporting, surveillance constraints, and inaccessible healthcare.

5.4 Future Research Directions

Integrated diagnostic and surveillance systems incorporating biomarker analysis, molecular profiling, artificial intelligence and advanced imaging technologies for prompt disease diagnosis and patient treatment should be developed for the future. To confirm new biomarkers and AI-driven predictive models, there is a need for large-scale multicenter trials in a wide variety of populations and healthcare environments. The strengthening of the genomic surveillance, digital healthcare infrastructure, preparedness systems for outbreaks and international collaboration of scientific research to mitigate the burden of Lassa fever and septic fever at the global level should also be highlighted for further research[40].

6. CONCLUSION

The majority of the cases of Lassa fever and septic fever are still a public health problem due to their complicated clinical presentations, high morbidity and mortality. The both diseases have significant inflammatory responses, multi-organ dysfunction, and significant diagnostic challenges especially in resource-limited health care settings. The early recognition of clinical predictors and risk factors can help minimize deaths and positively affect patient outcomes. The role of the biomarkers (lactate, procalcitonin, cystatin-C and inflammatory cytokines) in prognosis assessment and therapeutic monitoring is of crucial importance. Furthermore, the implementation of AI, machine learning, epidemiological monitoring and 3D imaging technologies have enhanced prediction and diagnostic accuracy of diseases. The integration of biomarkers with AI-powered health systems could help bolster the management of infectious diseases and outbreak preparedness. So, further multi-disciplinary studies and international collaboration will still be significant to decrease the burden of severe infectious diseases around the world.

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