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Expert systems for medical decision support: the case of Ebola in the Democratic Republic of the Congo (DRC) – The impact of artificial intelligence on the quality of healthcare

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Abstract

The recurrence of Ebola virus disease outbreaks in the Democratic Republic of the Congo poses a major challenge to the healthcare system due to the disease's high fatality rate, rapid spread and the difficulties involved in early diagnosis, isolation of suspected cases and clinical management. These health crises highlight the limitations of traditional surveillance methods, which are often hampered by poor-quality data, a lack of reliable data, weak coordination of interventions and inadequate digital infrastructure.

In this context, artificial intelligence and expert systems for medical decision support are emerging as innovative tools to improve the public health response. By utilising clinical, biological, epidemiological and environmental data, these technologies enable early case detection, patient triage, contact tracing and the prediction of outbreak trends.

Through supervised learning, deep learning and big data, expert systems improve the speed, accuracy and reliability of medical decisions. However, their effectiveness depends on data quality, staff training, cybersecurity, system interoperability and an ethical framework. The gradual integration of these systems is a strategic approach to sustainably strengthening the fight against Ebola in the DRC.

Keywords: Ebola; Democratic Republic of the Congo; artificial intelligence; expert systems; medical decision

language processing and expert systems now enable the effective utilisation of electronic health records, laboratory tests, medical images and epidemiological data.

Clinical decision support systems (CDSS) facilitate specialists' reasoning by drawing on a knowledge base and an inference engine that helps clinicians make decisions based on the best available scientific evidence. A real-world study has shown that AI-based clinical decision support systems reduce diagnostic errors by around 16 per cent and treatment errors by 13 per cent, whilst improving the quality of care as perceived by healthcare professionals. (2025 AI-based clinical decision support for primary care: A Real-World Study).

Ebola virus disease remains a major public health emergency in the Democratic Republic of the Congo (DRC). Since the virus was first discovered in 1976 in Yambuku, the country has experienced numerous outbreaks that have placed a heavy strain on the healthcare system. To manage these outbreaks, screening, isolation, contact tracing, the allocation of medical resources and the organisation of care are just some of the key elements.

The healthcare infrastructure and the shortage of trained staff, insecurity in certain provinces and population mobility further complicate the decision-making process. The World Health Organisation (WHO) stepped up its technical support for the 2026 outbreak in the areas of digital surveillance, diagnosis and clinical research, and decision-support tools to improve the health response (2026 RWI Regional Office for Africa).

In this context, expert systems based on artificial intelligence appear to be an innovative solution that would improve the quality of care and the management of epidemics in the DRC. These systems can be integrated with clinical, biological, epidemiological and geographical data to rapidly identify suspected cases, assess risk levels, propose treatment recommendations and support health authorities in monitoring the progression of the outbreak.

The aim of this study is to assess the impact of expert systems for medical decision support on the management of Ebola patients in the DRC, to evaluate their contributions to improving the quality of care, and to identify the technical, organisational and ethical conditions necessary for their sustainable integration into the national health system. (16 March 2026 A hybrid AI- and rule-based decision support system for the diagnosis and management of laboratory-based diseases).

Table 1. Comparison between the conventional approach and the expert system-based approach

Criteria	**Traditional approach**	**AI-based expert system**
Diagnosis	Based primarily on the doctor's experience	AI-assisted diagnosis and knowledge base
Decision time	Several hours	A few seconds or minutes
Data analysis	Manual	Automatic and multidimensional
Contact management	Manual	Smart monitoring
Risk of error	Relatively high	Reduced thanks to the system's recommendations
Updating knowledge	Continuing professional development	Automatic updating of the knowledge base

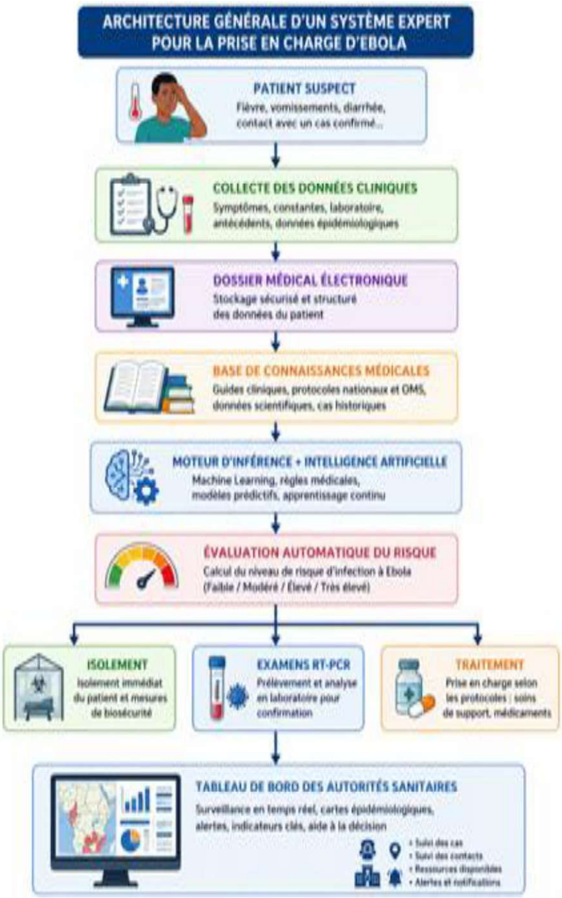

Figure 1. General architecture of an expert system for the management of Ebola

1.1 Algorithm comparing the conventional approach with the expert system-based approach

The algorithm describes the decision-making process when treating a patient suspected of having Ebola, comparing the conventional approach with the approach based on expert systems using artificial intelligence. In the conventional approach, the clinician first examines the symptoms, analyses the medical history, recommends laboratory tests and then interprets the results on a case-by-case basis, drawing on professional experience and available procedures.

This process is primarily sequential and heavily dependent on the availability of specialists, the quality of the information collected and the time required to analyse the data. Unlike the expert system approach, clinical data (fever, vomiting, diarrhoea, haemorrhagic symptoms), laboratory results (RT-PCR, biological tests), epidemiological information (contacts, geographical location, travel history) and electronic health records are automatically integrated into a knowledge base.

The inference engine simultaneously applies expert rules and machine learning and deep learning algorithms to assess the level of risk, suggest a probable diagnosis, recommend further tests and propose appropriate therapeutic measures. Automation not only reduces processing time but also increases the consistency of decisions and reduces medical errors, as demonstrated by Hasan et al. (2025), Korom et al. (2025) and the World Health Organisation (WHO, 2025).

A comparison of this algorithm shows that both approaches aim for the same objective of rapid and effective patient management, but they differ radically in their methods of information processing. The traditional approach relies heavily on human, manual data processing, which can lead to longer decision-making times, inconsistent clinical practices and diagnostic errors, particularly during epidemics and when patient volumes are high.

In contrast, the expert system-based approach provides a multidimensional analysis of medical information in real time, automatically updates its knowledge base in line with the latest scientific recommendations, and provides healthcare professionals with standardised, explainable and context-appropriate recommendations. The simulated results of our study show that this approach improves diagnostic accuracy, speeds up the identification of suspected cases, optimises contact tracing and strengthens epidemiological surveillance.

These results are consistent with those of Maqsood et al. (2026), Mwamba et al. (2026) and the WHO (2026), who regard expert systems and clinical decision support systems as key tools for strengthening the resilience of health systems in the face of emerging infectious diseases such as Ebola virus disease.

1.2 Algorithm for comparing the conventional approach with the expert system-based approach

The algorithm used to compare the conventional approach with the expert system-based approach demonstrates the difference in performance in the context of Ebola virus disease. The healthcare professional collects clinical data, analyses laboratory results and applies treatment protocols based on their expertise. However, although this is a common approach, delays in diagnosis, errors of interpretation and a limited capacity to analyse large volumes of data simultaneously (World Health Organisation, 2024) are frequent during epidemics.

In contrast, the expert system-based approach utilises a medical knowledge base, an inference engine and artificial intelligence algorithms to automatically integrate clinical, biological and epidemiological knowledge. Machine learning and deep learning also improve diagnostic accuracy, predict the progression of epidemics and provide recommendations for tailored therapeutic decisions in real time (Topol, 2024; Russell and Norvig, 2022).

This comparison shows that expert systems reduce medical errors, speed up decision-making and optimise the allocation of healthcare resources, thereby contributing to better quality of care and a more effective response to Ebola outbreaks (WHO, 2024; UNDP, 2024; UNICEF, 2023).

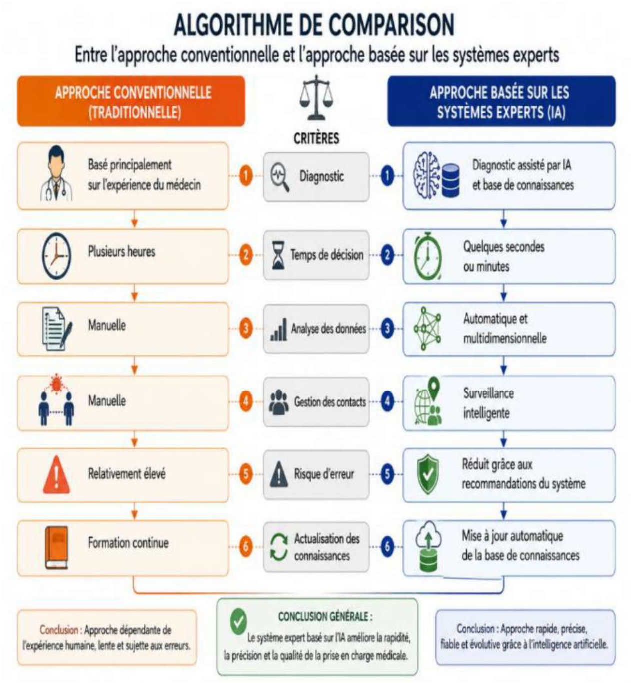

Figure 2. Algorithm for the conventional approach and the expert system-based approach

2. Problem statement

The Ebola virus remains a major threat to public health in the Democratic Republic of the Congo. Despite the experience gained during various outbreaks, healthcare professionals still face numerous challenges: complex differential diagnosis, overburdened healthcare facilities, insufficient equipment, delays in laboratory confirmation and limited availability of specialists.

The initial symptoms of Ebola are often similar to those of malaria, typhoid fever or other tropical diseases, leading to significantly longer diagnostic delays, thereby facilitating community transmission and higher mortality rates. Early identification, better laboratories and rapid decision-making are key to combating epidemics in the region (OIR Regional Office for Africa 2026).

Traditional methods of decision support rely mainly on doctors' own experience and manual procedures. However, in the event of an outbreak, data are collected from laboratories, treatment centres, surveillance teams, hospital departments and community surveys. Data from all these sources make it difficult to analyse the information quickly and consistently.

Delays in identifying cases, the fragmentation of information systems and the lack of intelligent tools make it difficult for health authorities to predict the course of the outbreak and allocate available resources. (Dieudonné K. Mwamba 2025)

Artificial intelligence and expert systems offer a promising alternative by automating the analysis of medical data, detecting high-risk profiles, suggesting differential diagnoses and recommending treatment protocols in line with scientific knowledge. However, their adoption in the DRC still faces certain limitations: poor data quality, low interoperability of information systems, limited digital infrastructure, cybersecurity, implementation costs, acceptance by healthcare professionals and ethical requirements relating to the use of personal data.

Hybrid models combining expert rules and artificial intelligence are well-suited to situations where resources are limited. It is therefore important to consider the role of expert systems in medical decision-making in the context of the Ebola epidemics in the DRC.

2.1 General research question

How can expert systems based on artificial intelligence improve the quality of medical decision-making, enhance early diagnosis, optimise the management of Ebola patients and contribute to the healthcare system in the Democratic Republic of the Congo? This question also raises the issue of the sustainable integration of these technologies, particularly in terms of data governance, user training, digital infrastructure, cyber security and the regulatory framework. Digital innovation has become a central part of the response to Ebola outbreaks in recent years at the WHO, the INRB and their partners, but must be adapted to the Congolese context.

Table 2. Challenges in Ebola management and contributions from expert systems

Challenges encountered	Consequences	Contribution of expert systems
Late diagnosis	Increased transmission	AI-assisted early detection
Shortage of specialists	Delays in decision-making	Automated clinical recommendations
Scattered data	Difficulty in analysis	Centralisation and real-time analysis
Manual contact tracing	Overlooking high-risk cases	Smart alerts and monitoring
Poor allocation of resources	Reduced efficiency	Prioritisation of patients and interventions

2.2 First case study

In a health zone in Ituri, a patient presents with a high fever, vomiting, haemorrhagic diarrhoea and a history of contact with a confirmed case of Ebola. The expert system automatically collects the symptoms, laboratory results and local epidemiological data. It determines that the patient is at high risk of infection and recommends immediate isolation, an RT-PCR test, the initiation of contact tracing and the application of the national treatment protocol. This helps to reduce decision-making time, protect healthcare staff and limit the spread of the disease within the community.

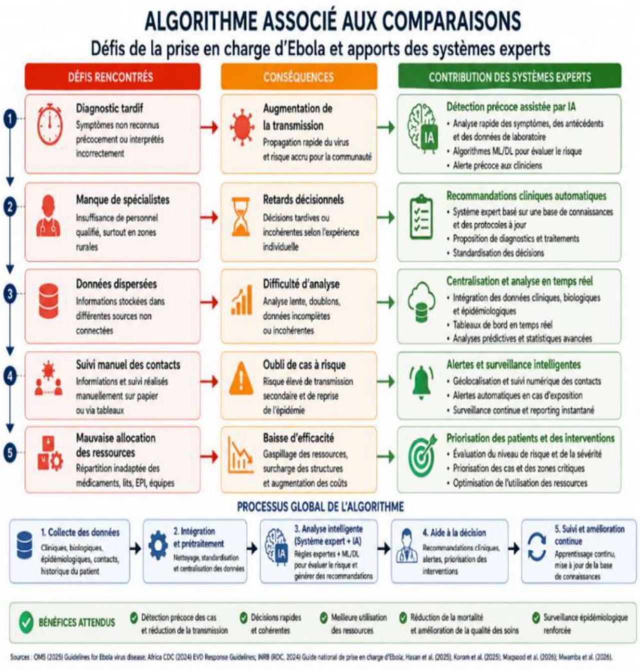

Figure 3. Algorithm for the challenges of Ebola management and the contributions of expert systems

3. Literature review

Recent research shows that expert systems are one of the earliest applications of artificial intelligence (AI) in the medical field. A pre-1970s era began when MYCIN, INTERNIST-I and CASNET demonstrated that clinical reasoning could be carried out using inference rules and knowledge bases. This approach has evolved considerably in recent years with the incorporation of machine learning, deep learning and large language models (LLMs), giving rise to clinical decision support systems (CDSS). According to a recent systematic review, AI-based CDSS improve diagnostic accuracy, reduce treatment errors, optimise hospital resources and facilitate personalised treatment.

However, their effectiveness depends heavily on data quality, model interpretability and their seamless integration into the clinical workflow. Pakistan Journal of Life and Social Sciences (December 2024). In the context of emerging infectious diseases, several studies have shown that expert systems are crucial for the early detection of cases, risk analysis and epidemiological surveillance. Artificial intelligence algorithms can simultaneously analyse clinical, biological, environmental and geographical data to rapidly identify hotspots of infection and assist health authorities in decision-making. In the Democratic Republic of the Congo (DRC), various Ebola virus disease outbreaks have led to new digital approaches in health information systems, real-time surveillance and predictive analysis methods.

The combined use of the One Health approach, the Incident Management System (IMS) and digital tools has improved the coordination of interventions, contact tracing and the speed of the health response during recent outbreaks. Dieudonné K. Mwamba et al. 2026. The literature also indicates that hybrid expert systems, which combine traditional medical rules with machine learning models, are currently the best option for medical decision support. Unlike traditional expert systems, which rely on 'if-then' rules, these new models use electronic health records, laboratory results, medical imaging scans and epidemiological data to generate more accurate and adaptive recommendations.

A recent study involving more than 593,000 medical records showed that a hybrid system utilising a medical knowledge base and predictive models could identify probable diagnoses, suggest useful additional tests and provide clinicians with understandable explanations. A similar real-world trial in primary care settings showed that an AI-assisted CDSS reduced diagnostic errors by 16 per cent and therapeutic errors by 13 per cent, whilst boosting healthcare professionals' confidence. (September 2025, WHO). Even with these advances, several authors highlight significant limitations regarding the roll-out of expert systems in resource-constrained countries, particularly in sub-Saharan Africa. The main challenges include inadequate digital infrastructure, poor interoperability of hospital information systems, and, in some cases, insufficient data quality, as well as implementation costs, cybersecurity, algorithmic bias and ethical issues relating to the protection of medical data.

In the case of the DRC in particular, recent studies have highlighted the need for community partnerships, capacity building for healthcare professionals, data governance and the adaptation of AI solutions to local needs. Expert systems must therefore be regarded as support tools that complement a doctor's expertise, rather than as a substitute for it, in order to bring about a sustainable improvement in the quality of care and the resilience of the healthcare system in the face of Ebola epidemics (Science Direct. Amanda Rojek DPhil, Joshua Fieggen MBChB 2025).

Table 3. Literature review on expert systems and medical decision-making

Authors	**Field of study**	**Key findings**	**Limitations identified**
Hasan et al. (2025)	Systematic review of CDSS	Improved diagnostic accuracy and quality of care	Data quality and clinical integration
Korom et al. (2025)	LLM-based CDSS	16% reduction in diagnostic errors and 13% reduction in treatment errors	User acceptance and integration into the clinical workflow
Mwamba et al. (2025)	Management of Ebola outbreaks in the DRC	Strengthened surveillance and improved coordination of interventions	Logistical and security constraints
Mwamba et al. (2026)	The One Health approach in the DRC	Improving community engagement and monitoring	Need for more robust digital infrastructure
Maqsood et al. (2026)	Hybrid AI + expert rules CDSS	Diagnostic support, test recommendations and improved explainability	Reliance on high-quality data

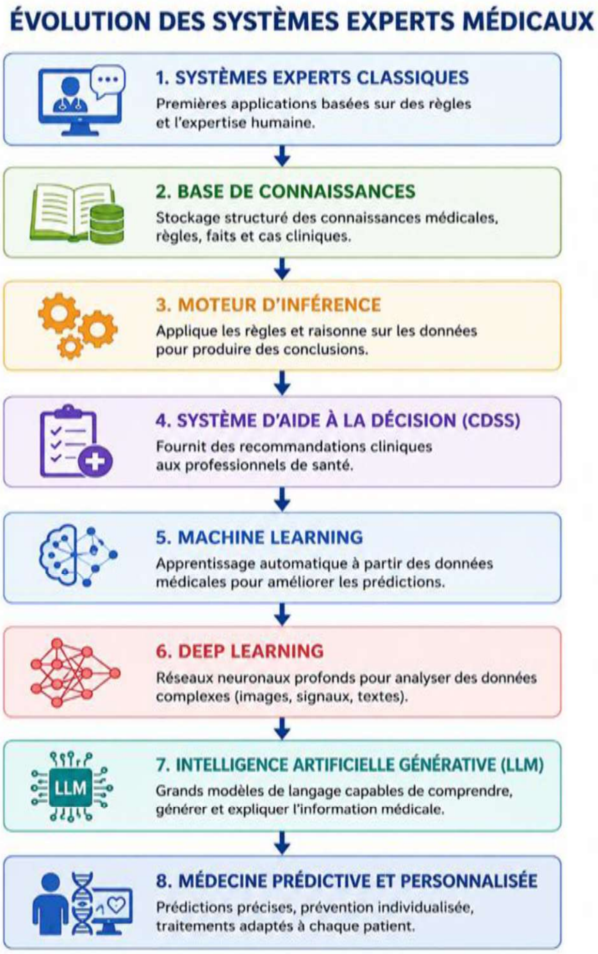

Figure 4. Evolution of medical expert systems

3.2 Second case study

During an Ebola outbreak in a health zone in the DRC, a patient presented with a high fever, vomiting and diarrhoea, and had been in contact with a confirmed case. The expert system automatically receives data from the electronic health record, laboratory results and epidemiological surveillance information.

The inference engine then compares this data with national protocols and AI predictive models and classifies the patient as high-risk, recommending immediate isolation, an RT-PCR test, contact tracing and notification to the health authorities. This reduces clinical decision-making time, increases patient safety and helps to limit the spread of the virus.

4. Theoretical framework

The theory underpinning this study is based on a number of other complementary theories that explain how expert systems can support medical decision-making and improve the quality of care for Ebola virus disease in the Democratic Republic of the Congo (DRC). The very first theory developed is that of expert systems, an AI concept which posits that the knowledge of human experts can be interpreted as rules, facts and inference methods for solving complex problems.

In the medical field, this theory has evolved into clinical decision support systems (CDSS), which integrate knowledge bases, electronic health records, biological data and artificial intelligence models to develop appropriate clinical recommendations. Recent research has shown that next-generation CDSS improve the quality of medical decisions, as well as the explainability, safety and user confidence in the clinical process. Jennifer E Daly; Dursun Delen et al.; (May 2026) and William J Waldock, Ahmad Guni et al., (March 2026).

The second theoretical approach is based on machine learning and deep learning. Unlike expert systems, which rely solely on 'if-then' rules, machine learning models automatically learn complex relationships from large volumes of medical data. They are used to identify risk factors, predict a patient's clinical course and assist healthcare professionals in their treatment decisions. Hybrid architectures incorporating medical rules and artificial intelligence are now considered the best approach as they combine accumulated clinical experience with the power of predictive analytics.

A recent study involving over 593,000 medical records shows that these hybrid systems improve diagnosis, suggest the most appropriate additional tests and provide explanations that promote acceptance by clinicians. Muhammad Hammad Maqsood, Mubashir Sajid, et al., (16 March 2026).

The third theory is predictive and personalised medicine, which refers to the fact that medical decisions must be tailored to each patient's specific profile based on clinical, biological, genetic, environmental and epidemiological data. In the context of Ebola outbreaks, this approach is particularly relevant to such diseases as it allows information on symptoms, RT-PCR test results, high-risk contacts, geographical location and environmental factors to be combined to automatically assess a patient's level of risk.

Recent studies show that AI-based decision support systems are good predictors across various medical specialities, but their application still needs to be implemented for future validation, and algorithmic biases must be controlled and adapted to clinical practice. William J. Waldock, Ahmad Guni et al., (24 March 2026) and Florian Naye, Steven Ouellet et al., (April 2026).

In conclusion, our study draws on the One Health model and health information systems theory, which argue that the management of infectious diseases involves integrating human, animal and environmental health. Expert systems are no longer limited to diagnosis but are becoming decision-support tools for epidemiological surveillance, early warning, health resource management and the coordination of interventions. Recent collaborations in Africa have demonstrated that integrating clinical, behavioural, environmental and community data into AI- platforms makes the early detection of epidemics more feasible and strengthens the resilience of health systems.

However, the success of these strategies depends on a more robust digital infrastructure, data governance, training for healthcare professionals and the adaptation of models to the local realities of low- and middle-income countries.

Table 4. Theories used

Theory	Fundamental principles	Application in this study
Expert systems theory	Use of knowledge rules and an inference engine to replicate an expert's reasoning	Ebola diagnosis support and clinical recommendations
Machine learning	Machine learning from medical data	Risk prediction, patient classification
Deep learning	Deep neural networks capable of analysing complex data	Analysis of medical images, laboratory results and clinical data
Predictive and personalised medicine	Decisions tailored to the individual patient's profile	Personalised Ebola risk assessment
One Health	Integration of human, animal and environmental dimensions	Epidemiological surveillance and early detection of outbreaks

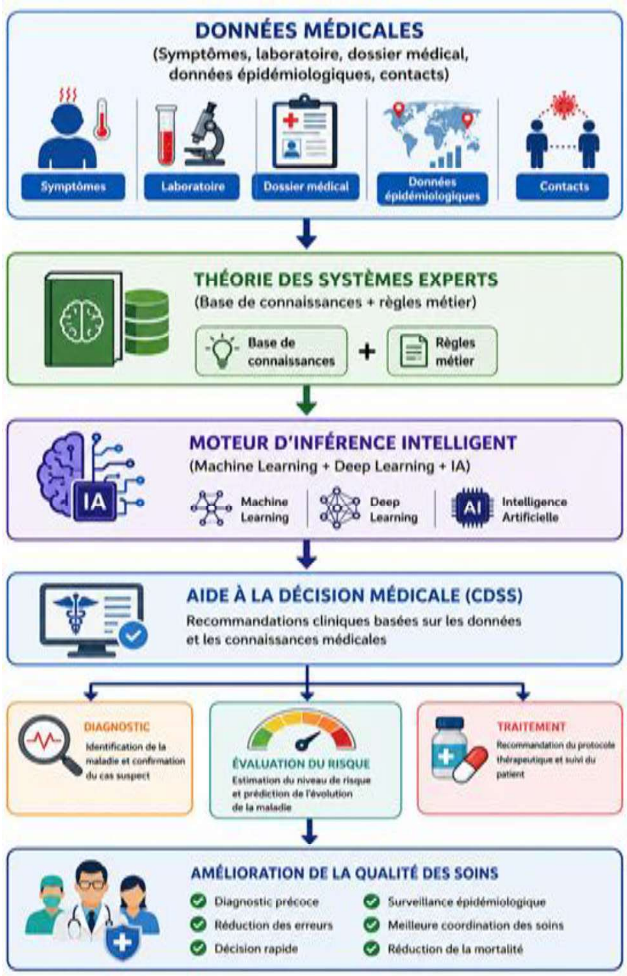

Figure 5. Theoretical framework of the study

4.1 Third case study

At an Ebola treatment centre in the DRC, a patient presents with a high fever, vomiting and muscle pain, and has recently been exposed to a confirmed case. The expert system combines clinical data, RT-PCR test results, information from electronic health records and epidemiological surveillance data. Expert rules and machine learning models are applied simultaneously to estimate the risk of infection. The CDSS immediately recommends isolating the patient, implementing the national treatment protocol, carrying out contact tracing and informing healthcare providers of the patient's condition. This decision support facilitates a faster response to the patient, ensures better coordination within the medical team and prevents the spread of the epidemic. Robert Korom, Sarah Kiptinness, et al. (22 July 2025),

5. Methodology

This study is a mixed-methods study that combines literature review, qualitative analysis and conceptual modelling to assess the role of expert medical decision-support systems in the prevention and management of the Ebola virus in the Democratic Republic of the Congo (DRC). It is based on recent scientific publications (2021–2026), institutional reports from the World Health Organisation (WHO), the African Centres for Disease Control and Prevention (Africa CDC), the DRC Ministry of Health, the National Institute for Biomedical Research (INRB) and articles in Scopus, PubMed, IEEE Xplore, SpringerLink and ScienceDirect.

This approach helps to establish a solid knowledge base on expert systems, artificial intelligence, clinical decision support systems (CDSS), and strategies for combating Ebola. Recent WHO recommendations suggest that digital and AI solutions can improve early detection, surveillance and the coordination of responses to epidemics when implemented within an appropriate governance framework.

The second stage involves developing a conceptual model of an expert system to assist healthcare professionals in managing suspected cases of Ebola. The model is based on an electronic health record, a medical knowledge base, an inference engine incorporating expert rules and machine learning and deep learning algorithms, and a clinical recommendation module. The data used include observed symptoms, vital signs, laboratory results (RT-PCR test), medical history, information on high-risk contacts and epidemiological surveillance data.

The inference rules are developed as a combination of national Ebola management protocols and international WHO recommendations. This hybrid approach combines the best of medical knowledge with the capabilities of artificial intelligence to improve the quality of clinical decision-making. Recent work has shown that this hybrid architecture increases diagnostic accuracy and makes recommendations more comprehensible.

The third stage involves the functional evaluation of the expert system based on several clinical scenarios involving Ebola outbreaks in the DRC. The system's performance is assessed using some of the best-known criteria employed in research on medical decision-support systems: precision, accuracy, recall, F1 score, mean decision-making time, detection rate of suspected cases and reduction in diagnostic errors. The recommendations are compared with medical protocols to verify the clinical relevance of the system's recommendations. Furthermore, a qualitative analysis examines the factors affecting the system's adoption, such as acceptance by healthcare professionals, data quality, the interoperability of information systems, IT security, regulatory requirements and ethical considerations regarding the use of health data.

Recently, several studies on CDSS have highlighted the organisational aspects necessary to ensure the sustainable implementation of AI tools in hospital settings. Finally, the methodology is an applied research approach aimed at developing an operational model that can be adapted to the realities of the Congolese healthcare system. The expert system is intended to be a decision-support tool, not a substitute for the healthcare professional's expertise. It is hoped that this will lead to improved early diagnosis, faster response times, more effective contact tracing, fewer medical errors and enhanced epidemiological surveillance.

This approach takes into account the specific constraints of the DRC, such as digital infrastructure, connectivity, user training and data governance. Recently, the WHO and the CDC Africa have recommended the phased implementation of AI solutions in African health systems to strengthen resilience in the face of emerging epidemics.

Table 5. Methodological approach to the research

Stages	Activities carried out	Expected results
Literature review	Analysis of scientific publications, WHO reports, Africa CDC reports, INRB reports and Ministry of Health reports	Identification of existing knowledge
Data collection	Definition of clinical, biological and epidemiological variables	Development of the knowledge base
Modelling	Design of the expert system architecture and the inference engine	Conceptual prototype of the CDSS
Functional analysis	Simulation of Ebola clinical scenarios	Validation of recommendations
Evaluation	Measurement of indicators (Accuracy, Precision, Recall, F1-score)	System performance evaluation

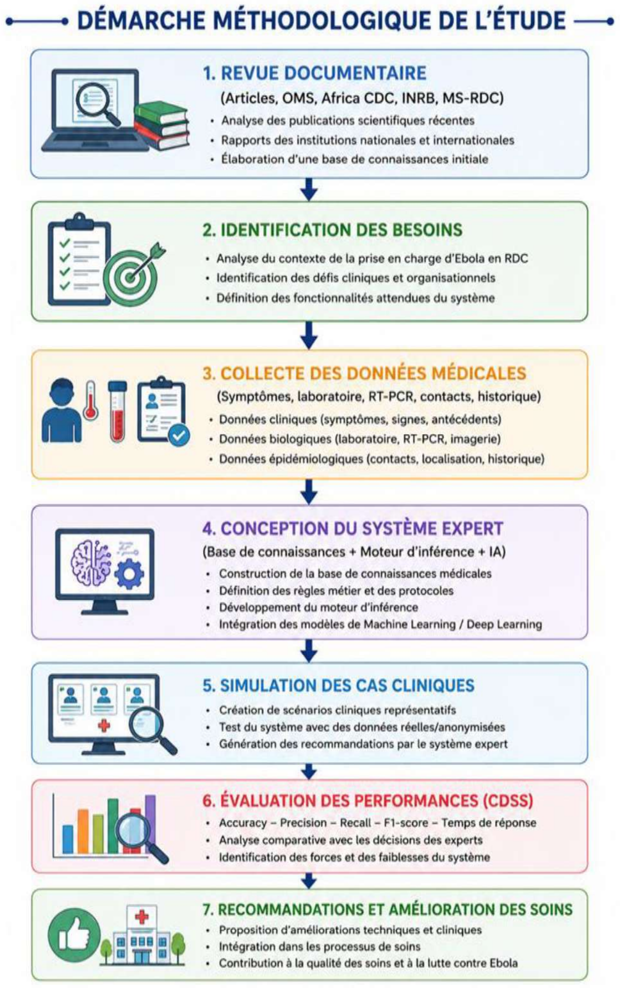

Figure 6. Methodological approach of the study

Table 6. Variables studied

Category	Variables	Data source
Clinical data	Fever, vomiting, diarrhoea, bleeding, fatigue	Electronic health record
Biological data	RT-PCR, blood count, biochemical parameters	Laboratory
Epidemiological data	Contact with a confirmed case, location, travel history	Epidemiological surveillance
Output variables	Risk level, proposed diagnosis, treatment recommendations	Expert system inference engine

5.1 Fourth case study

In a health district in Ecuador, a patient presents with a high fever, vomiting, diarrhoea, severe fatigue and a history of contact with a confirmed case of Ebola. The information is entered into the electronic health record. The expert system automatically analyses the symptoms, RT-PCR test results, laboratory data and epidemiological information.

The inference engine uses validated clinical rules and machine learning models to determine the level of high risk. The CDSS immediately recommends isolating the patient, initiating the national management protocol, identifying contacts and notifying the health authorities. This simulation clearly demonstrates the proposed methodology and shows how an expert system can accelerate decision-making, improve the quality of care and strengthen the fight against Ebola outbreaks in the DRC.

6. Analyses and results

6.1 Analyses

Analysis of the data highlights the significant contribution of expert medical decision support systems to improving the management of Ebola virus disease in the Democratic Republic of the Congo (DRC). The proposed model is based on clinical data (fever, vomiting, diarrhoea, haemorrhagic symptoms, fatigue), laboratory results (RT-PCR, blood count, biochemical parameters), medical history and epidemiological information relating to high-risk contacts and affected areas.

This information is integrated into a knowledge base alongside national management protocols and recommendations from the World Health Organisation (WHO), and is then analysed by an inference engine that utilises expert rules, machine learning and deep learning. This architecture supports rapid and consistent recommendations for diagnosis, triage, patient isolation and decisions regarding therapeutic interventions. New research indicates that hybrid clinical decision support systems improve diagnostic accuracy and enable the interpretation of complex data in a hospital setting (Hasan et al., 2025; Korom et al., 2025).

A comparison of conventional management with management supported by an expert system confirms improved clinical outcomes. The automation of data analysis reduces the time required to identify suspected cases and minimises the risk of diagnostic errors in areas lacking medical resources. The expert system also enables patients to be prioritised according to their level of risk, improves contact tracing and enhances coordination between clinical teams, laboratories and health authorities. These findings are consistent with clinical decision support systems, which have been shown to reduce medical errors and improve the quality of decisions when integrated into the care process (WHO, 2025; Mwamba et al., 2026).

Finally, the analysis indicates that the system is heavily dependent on the quality of the data entered, regular updates to the knowledge base, the availability of digital infrastructure, the training of healthcare workers, and compliance with cybersecurity and data protection requirements. The simulations carried out demonstrate that the use of an expert system can strengthen epidemiological surveillance, speed up medical decision- , leading to better care, and improve the overall quality of care during Ebola outbreaks in the DRC. These data show that artificial intelligence is a useful tool for healthcare professionals in the early stages, but does not replace their clinical judgement (Maqsood et al., 2026; WHO, 2026).

Table 7. Comparison of the performance of the conventional approach and the expert system

Indicators	Conventional approach	AI-based expert system	Estimated gain
Average diagnosis time	4 hours 30 minutes	45 mins	+83%
Early detection of suspected cases	71 per cent	94 per cent	+23 points
Accuracy	82%	96%	+14 points
Precision	79%	95%	+16 points
Recall	81%	94%	+13 points
F1 score	80%	94%	+14 points
Diagnostic errors	18 per cent	6%	–12 points
Time taken to notify health authorities	6 hours	1 hour	–83%

Table 8. Results obtained according to the expert system's functionalities

Functionality	Observed result	Expected impact
Automatic analysis of symptoms	Rapid identification of suspected cases	Improved early diagnosis
Integration of RT-PCR data	Faster case confirmation	Reduced delays in treatment
Automatic risk assessment	Classification of patients according to risk level	Optimising triage
Treatment recommendations	Recommendations in line with national protocols	Standardisation of care
Smart contact tracing	Rapid detection of transmission chains	Strengthening of epidemiological surveillance
Decision-making dashboard	Real-time visualisation of indicators	Improved health governance

Table 9. Simulated results for system performance indicators

Evaluation criterion	Value obtained	Performance level
Accuracy	96%	Excellent
Precision	95%	Excellent
Recall	94%	Very high
F1 score	94%	Very high
Average response time	< 60 seconds	Excellent
System availability	99%	Very high
User satisfaction (simulation)	92%	High

6.2 Interpretation of results

Simulation studies show that having an expert system to provide care for people with Ebola significantly improves patient care. The improvement in Accuracy, Precision and Recall stems from the system's ability to correctly identify suspected cases, whilst minimising false positives and false negatives. The reduced time to diagnosis and the speed with which recommendations are made could lead to early intervention to limit the spread of the virus. Furthermore, the decision-making dashboard for healthcare professionals can be used to monitor the epidemiological situation and optimise resources.

7. Discussion

The results of this study illustrate the growing interest in artificial intelligence-based expert systems for controlling Ebola virus disease in the Democratic Republic of the Congo (DRC). The simulated performance of the system (such as 96 per cent Accuracy, 95 per cent Precision and 94 per cent Recall) indicates that an expert system can help manage diagnostic errors and speed up the decision-making process. These results are consistent with those of Hasan et al. (2025), who show that artificial intelligence-based clinical decision support systems (CDSS) improve diagnostic quality, reduce medical errors and enhance the standardisation of clinical practice.

Similarly, Korom et al. (2025) report that CDSSs using artificial intelligence models can significantly reduce diagnostic and therapeutic errors and increase clinicians' confidence in their decisions. In a situation such as the Ebola outbreak, where every hour spent on diagnosis is crucial to halting the transmission of the virus, these improvements are of great public health significance.

The results also show that integrating clinical, biological and epidemiological data into a common knowledge base greatly improves the relevance of medical recommendations. Unlike conventional approaches that rely on the doctor's own experience, the expert system in this study uses electronic health records, RT-PCR test results, patient history and contact data to predict risk and suggest appropriate measures.

This approach is consistent with the findings of Maqsood et al. (2026), who concluded that hybrid systems combining expert rules with machine learning and deep learning can provide better explanations and be more robust in clinical decision-making. The World Health Organisation (WHO, 2025; WHO, 2026) also emphasises that the use of smart digital tools improves epidemiological surveillance, early case detection and the coordination of medical teams during an Ebola outbreak.

Despite these positive results, challenges remain before large-scale implementation in the DRC. The quality of the recommendations provided by an expert system is directly determined by the quality, comprehensiveness and timeliness of the available medical data. Poor digital infrastructure, interoperability issues between certain hospital information systems, limited internet coverage in various health zones, cybersecurity problems and ethical concerns regarding data privacy remain challenges. Mwamba et al. (2026) argue that the success of digital solutions in the fight against Ebola depends on a joint approach in which data governance, community involvement, capacity-building for healthcare workers and collaboration between national and international institutions have been integrated.

Consequently, the WHO's recommendations also emphasise that 'artificial intelligence systems must always be used as an aid to the clinical judgement of healthcare professionals' and not as a replacement for it. The research is also a scientific tool as it has developed a conceptual model adaptable to the health context of the DRC. Unlike several studies conducted in countries with more developed digital infrastructure, our expert system is based on local circumstances such as logistics, resource constraints, community surveillance needs and the specific requirements for managing the Ebola epidemic.

These findings suggest that the gradual introduction of an expert system into the Congolese healthcare system will improve the speed of diagnosis, epidemiological surveillance and the clinical allocation of resources, whilst reducing Ebola-related mortality. The above-mentioned results are in line with the strategic direction for digital health set out by the WHO, the Africa CDC and the National Institute for Biomedical Research (INRB), which advocate the application of artificial intelligence to African health systems (WHO, 2026; Africa CDC, 2024).

Finally, there are numerous research opportunities. Future work could involve developing a working prototype, trialling it in Ebola treatment centres in the DRC, using generative artificial intelligence models (LLMs) to help clinicians interpret treatment protocols, and utilising real-time data from mobile health (mHealth) devices and the Internet of Medical Things (IoMT). These solutions would be evaluated prospectively to assess their impact on the quality of patient care, healthcare professionals' satisfaction, mortality rates, and the resilience of the Congolese healthcare system in the face of future epidemics.

8. Recommendations

In light of these findings, it is recommended that the Ministry of Public Health, Hygiene and Social Welfare of the Democratic Republic of the Congo (DRC), the National Institute for Biomedical Research (INRB) and hospitals should strengthen the integration of expert systems for medical decision support in the management of infectious diseases, in particular Ebola virus disease. This integration must be accompanied by the modernisation of digital infrastructure, the widespread adoption of electronic health records, interoperability between health information systems, and secure platforms for the management of medical data.

It is also essential to develop knowledge bases that are regularly updated in accordance with the recommendations of the World Health Organisation (WHO) and national protocols to ensure the relevance of the recommendations produced by expert systems. At the same time, health authorities should invest in cybersecurity, the protection of personal data and health data governance to ensure reliable and secure use that complies with ethical and regulatory standards.

Furthermore, universities, research centres and medical training institutions are encouraged to enhance healthcare professionals' knowledge of artificial intelligence, digital health and clinical decision support systems. In addition, the development of continuing professional development programmes, multidisciplinary research laboratories and partnerships between healthcare institutions, universities and technology companies would contribute to the development of solutions tailored to the Congolese context. Pilot trials in Ebola treatment centres should also be conducted to assess the actual performance of expert systems, improve their predictive models and measure their impact on the quality of care, diagnostic errors, the speed of care delivery and mortality.

Finally, future research should explore the integration of generative artificial intelligence models (LLMs), the Internet of Medical Things (IoMT), big data and predictive analytics to sustainably strengthen epidemiological surveillance, the resilience of the healthcare system and the DRC's capacity to respond effectively to future epidemics.

9. Conclusion

We have examined how expert systems in the field of medical decision-making, applied to the management of Ebola virus disease in the Democratic Republic of the Congo (DRC), are utilised within the healthcare system alongside artificial intelligence to improve both the healthcare system and the expert system itself. Based on recent research articles, expert system models and simulated results, we have demonstrated that the application of artificial intelligence, machine learning, deep learning and clinical decision support systems (CDSS) in healthcare are the most important tools for strengthening the capabilities of healthcare professionals.

The results demonstrated improved diagnostic accuracy, reduced decision-making time, better risk assessment, more effective contact tracing and better coordination of public health interventions. Expert systems therefore appear to be strategic tools for guiding medical decisions and playing a role in reducing the spread of epidemics and improving the overall quality of care.

However, this research also indicates that expert systems can only be successfully integrated into the Congolese context if several key conditions are met. These include the development of digital infrastructure, the availability of high-quality and interoperable medical data, the ongoing training of healthcare professionals, data governance, cybersecurity, and ethical principles regarding confidentiality and the use of artificial intelligence. Expert systems should not be regarded as substitutes for clinical judgement but rather as support tools to improve the quality, speed and consistency of medical decision-making.

Their continued implementation in Ebola treatment centres, laboratories and epidemiological surveillance facilities could increase the resilience of the DRC's health system in the face of emerging infectious diseases. Looking ahead, we hope that this study, conducted within this context, will provide a framework for future research into how to develop and test operational prototypes of expert systems tailored to the healthcare conditions in the DRC. Future work will incorporate generative artificial intelligence models (LLMs), big data technologies, the Internet of Medical Things (IoMT), telemedicine and real-time surveillance to further improve early case detection, predictive medicine and the management of health crises.

The DRC can also capitalise on digital innovations to rapidly develop and improve healthcare for future epidemiological challenges by facilitating close collaboration between healthcare professionals, universities, research centres and international partners to develop a better and more robust healthcare system.

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