VNU Journal of Science: Medical and Pharmaceutical Sciences, Vol. 41, No. 3 (2025) 1-15

VNU Journal of Science: Medical and Pharmaceutical Sciences

Journal homepage: https://js.vnu.edu.vn/MPS

Review Article

Application of Artificial Intelligence in Healthcare in Vietnam: A Scoping Review of Current Status and Future Research Directions

Dai Tran Le Vuong[1], Viet Vu Duc[1], Bao Minh Phuong Long[1], Hung Pham Xuan[1], Dat Tran Vuong Quoc[2], Thanh Nguyen Ha[3], Linh Nguyen Khanh[4], Khoa Nguyen Dinh[5], Cuong Do Duy[6], Duc Nguyen Dinh[7,*]

[1]*VinUniversity, Vinhomes Ocean Park, Gia Lam, Hanoi, Vietnam*
[2]*Hanoi University of Science and Technology, 1 Dai Co Viet, Hai Ba Trung, Hanoi, Vietnam*
[3]*National Institute of Informatics, Tokyo, Japan, 2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo*
[4]*International School of Vietnam National University, Hanoi G7 & G8 Building, 144 Xuan Thuy, Cau Giay, Hanoi, Vietnam*
[5]*The university of Melbourne, Parkville VIC 3010, Australia*
[6]*Bach Mai Hospital, 78 Giai Phong, Kim Lien, Hanoi*
[7]*VNU University of Engineering and Technology, 144 Xuan Thuy, Cau Giay, Hanoi, Vietnam*

Received 16th June 2025
Revised 04th July 2025; Accepted 11th August 2025

Abstract: Artificial Intelligence (AI) is emerging as a strategic solution to healthcare challenges in developing countries, such as Vietnam, where systems face overcrowding, workforce shortages, and quality demands. This scoping review aims to explore the current applications and research directions of AI in Vietnamese healthcare. Following the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines, we searched international databases (PubMed, Google Scholar, and ScienceDirect) and major Vietnamese medical journals, identifying 37 relevant studies from 2018 to 2024. They were categorized into six groups: diagnostic imaging support, complication and treatment prediction, community screening, healthcare chatbots, smart health record management, and drug development assistance. These findings show that Vietnam has made initial progress in applying AI, especially in diagnostic imaging. However, most of the current models focus on analyzing isolated images that lack data

[*] Corresponding author.
E-mail address: ducnd@vnu.edu.vn

https://doi.org/10.25073/2588-1132/vnumps.4799

integration. Consequently, these models are limited to disease detection without identifying the underlying causes. To address the existing gaps, we propose the development of a multimodal AI model for pneumonia etiology diagnosis by integrating chest X-rays with clinical and laboratory data. In conclusion, our findings highlight Vietnam's initial progress and propose future directions for AI in precision medicine, contributing to antibiotic resistance control and healthcare resource optimization.

Keywords: Artificial intelligence, Machine learning, Deep learning, Neural networks, Healthcare, Medical application.

1. Introduction

As the world moves toward digitalization, artificial intelligence (AI) is becoming widely acknowledged as a game-changing technology. AI has found applications in a wide range of industries, including finance, education, transportation, and most importantly, healthcare, owing to its capacity to analyze enormous datasets, pattern learning, and complex decision-making. AI technologies present promising ways to improve clinical workflows, increase treatment personalization, improve diagnostic accuracy, and ultimately improve patient outcomes in the healthcare industry. The need for high-precision, prompt interventions and customized care, all of which are in line with the core capabilities-underlines the significance of AI in healthcare [1].

Many nations have created national strategies to encourage AI research and adoption to recognize these capabilities. Vietnam showed no difference. By introducing comprehensive policy frameworks and strategic directives, the Vietnamese government demonstrated a strong commitment to the development of AI. The 2021 Decision No. 127/QĐ-TTg, which outlines the National Strategy on Research, Development, and Application of Artificial Intelligence until 2030, is one of the most important. This approach recognizes the potential of AI to address significant inefficiencies and improve the general quality of healthcare services by specifically designating the healthcare industry as a priority domain for AI integration.

Despite significant advancements in recent decades, Vietnam's healthcare system still faces several enduring difficulties. These include the ongoing overcrowding of public hospitals, lack of qualified medical personnel, disparity in access to healthcare between rural and urban areas, and rising prevalence of both infectious and non-communicable diseases. AI offers a calculated opportunity to address these systemic problems in this context. AI-driven technologies can improve the management of electronic health records, automate repetitive administrative tasks, help physicians diagnose patients more quickly and accurately, and support predictive analytics for early disease detection and prevention [2].

The use of AI in healthcare has shown notable advantages on a global scale. AI-powered diagnostic imaging, virtual medical assistants, clinical documentation using natural language processing, risk stratification using machine learning models, drug discovery, and personalized medicine platforms are examples of frequently used cases [3]. These developments support more effective use of scarce healthcare resources, lower costs, and increased clinical efficacy.

Despite these worldwide advancements, AI research and adoption in Vietnamese healthcare are still comparatively sparse and uneven. Previous research and pilot projects have mostly concentrated on specific uses, such as the classification of medical images and the COVID-19 pandemic response. Comprehensive, system-wide research examining the wider potential of AI applications across various healthcare domains in Vietnam is lacking. Additionally, there is little cooperation among academic institutions, medical facilities, and tech firms, and a large portion of the current research is dispersed.

Given these limitations, this study sought to comprehensively review and synthesize the existing body of research on AI in healthcare within the Vietnamese context. By mapping out current efforts, identifying knowledge gaps, and analyzing patterns of implementation, this study aims to provide a clearer understanding of where the field stands and how it might evolve. The ultimate objective is to propose a set of recommendations and directions for future research with the goal of fostering the development of AI models and applications that are both contextually relevant and scalable within Vietnam's healthcare ecosystem. In doing so, this study contributes to the broader national objective of leveraging AI to enhance the quality, accessibility, and sustainability of healthcare services for the Vietnamese population.

2. Methodology

This scoping review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. Literature searches were performed using three international databases, PubMed, Google Scholar, and ScienceDirect, as well as major Vietnamese medical journals, including *Vietnam Medical Journal*, *Hue Journal of Medicine and Pharmacy*, *Ho Chi Minh City Journal of Medicine*, *Journal of Preventive Medicine*, *Journal of Clinical Medicine Practice*, *VNU Journal of Science*, *Vietnam Journal of Public Health*, and *Journal of Medical Research*. A variety of search terms were applied, which included "Artificial intelligence," "AI", "Machine learning", "Deep learning", "Neural networks", "Medicine", "Healthcare", and "Medical".

To minimize bias, the study selection and data extraction were independently conducted by four reviewers. The selection process consisted of four stages: excluding studies not conducted in Vietnam, removing duplicates, screening titles and abstracts, and reviewing the full text of the remaining articles. Data were then extracted into an Excel spreadsheet and synthesized using a narrative approach. Figure 1 below illustrates the selection flow.

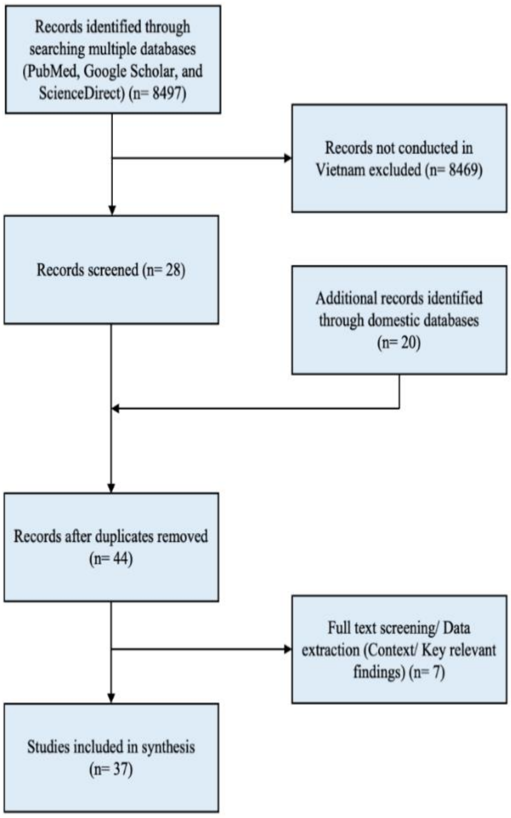

Figure 1. Inclusion flow diagram.

3. Results

This study gathered 37 published works related to AI applications in healthcare in Vietnam from 2018 to 2024, classified them into six main groups: early diagnosis via medical imaging, complication prediction and treatment, community screening, medical chatbot, smart health record management, and support for new drug control and development. In this modern era of high technology, conducting research and implementing Artificial Intelligence in the healthcare system plays an essential role in reducing physician workload and minimizing human errors. Table 1 below provides an overview of AI applications that have been and are being implemented in the healthcare field in Vietnam, reflecting the overall picture of the current implementation, accessibility, and preliminary effectiveness of this technology.

Table 1. Classification of AI studies by application direction in healthcare

AI Application Direction	Description	Number of Studies	Notable Studies
1. Early disease diagnosis support via medical imaging.	AI detects early lesions from X-ray, CT, MRI, endoscopy, etc.	17 studies	Pham Nhat Sinh (2024) (Tran Duc Hai (2023), Dimitry Tran (2023), Le Hoan (2023), Dao Viet Hang (2023), Nguyen Thi Hung (2024) – Supporting pulmonary X-ray image diagnosis [4-8].
2. Prediction of recurrence/complications, treatment adjustment support.	ML predicts drug resistance, complications, and personalized treatment outcomes.	5 studies	Viet Tran Quoc (2023), Anh Mai Kieu (2024), Phan-Mai Tuong-Anh (2020), Truong X. Nguyen (2024), Sarvakar (2025), Bui Hanh My (2022) – Antibiotic resistance prediction [9-13].
3. Community or preclinical disease screening.	AI screens for tuberculosis, COVID-19, depression, thalassemia, and chromosomal aneuploidy.	5 studies	Vo Luan (2021), Nguyen Ba Tung (2023), Nguyen Thi Trang (2023), Dinh Son Nguyen (2022), Hoang Nguyen Tu Anh (2024) – Prenatal thalassemia screening [14-18].
4. Virtual assistants, medical chatbots, symptom recognition, and initial health consultation.	AI systems interact with patients, assist in initial symptom recognition.	4 studies	Dinh Son Nguyen (2022), Nguyen Van Hieu (2018) – Diagnosis of COVID-19 and autism spectrum disorder [17, 19].
5. Smart health record management, personalized patient care.	AI integrates HIS/LIS, synchronizes DICOM data, and automates result analysis and reporting.	3 studies	Bui My Hanh (2023), Nguyen Hoang Bach (2023), Le Tuan Thanh (2019), Bui My Hanh et al. (2023) – EEG interpretation, automated antibiotic susceptibility test recognition [13, 20, 21].
6. Support for drug/therapy R&D using AI simulations and complex clinical data.	AI simulates molecular interactions, optimizes treatment (dosage, regimens, drug metabolism).	3 studies	Anh Mai Kieu (2024), Truong Thi Hong Thuy (2023) – Predicting Olanzapine plasma concentration in schizophrenia patients [10, 22].

It can be said that the majority of current implementations focus on supporting the diagnosis of disease, particularly through imaging techniques such as X-ray, Computed Tomography (CT) scan, or endoscopy. Meanwhile, AI applications in predicting complications, community screening, healthcare record management, and medication control and development have emerged but remain in the preliminary or experimental phases.

3.1. Early Disease Diagnosis Support via Medical Imaging

Early diagnostic support through medical imaging is one of the most outstanding and practically implementable directions for AI development in healthcare. About the shortage of highly specialized radiologists, especially at the local community level, AI serves as a supportive detector that enables rapid, accurate, and efficient detection of potential lesions.

In Vietnam, many studies have applied AI to various imaging platforms, such as X-ray, computed tomography (CT), fundus photography, endoscopy, ultrasound, dental imaging, and optical coherence tomography (OCT), which are summarized in Table 2. These implementations not only demonstrate high applicability but also offer opportunities for developing localized datasets and AI models within the Vietnamese healthcare context.

Table 2. Summary of studies on early diagnosis support using medical imaging

Medical Imaging Type	Number of Studies	Notable Studies
X-ray	8	Tran Duc Hai (2023), Le Hoan (2023), Nhan Ngo (2022), VinDr-CXR (2022), Le Thuy Phuong Nhu (2023), Luan Nguyen Quang Vo (2021) – Supporting pulmonary X-ray diagnosis [4, 5, 7, 14, 23, 24].
Endoscopy (gastrointestinal)	2	Dao Viet Hang (2022) – Detection of reflux esophagitis [25].
Fundus photography	2	Nguyen Thi Hung (2024), Ha Luong Thi Hai (2024) – Retinal evaluation in diabetic patients [26, 27].
OCT (3D retinal imaging)	1	Truong X. Nguyen (2024) – Detection of diabetic macular edema using 3D optical coherence tomography [12].
Cardiac ultrasound	1	Chi Thang Doan (2024) – Left ventricular function analysis [28].
CT perfusion (brain perfusion imaging)	1	Hoang Quoc Viet (2023) – Assessment of endovascular intervention criteria [29].
Digital dental imaging	1	Tran Tuan Anh (2023–2024) – Detection of dental caries lesions [30].
Macro physical imaging (stones)	1	Le Tuan Thanh (2019) – Atrial fibrillation recognition [21].

The majority of studies have focused on the use of X-ray imaging, especially in diagnosing respiratory diseases such as tuberculosis, pneumonia, pulmonary nodules, or signs of occupational lung diseases. For instance, Pham Nhat Sinh (2024) at Vinh City General Hospital utilized Qure.AI technology to identify pulmonary lesions on chest X-rays, attaining a sensitivity and specificity of 95.7% and 83.3%, respectively, indicating the potential of AI in the screening of tuberculosis, pneumonia, pulmonary fibrosis, and cardiopulmonary abnormalities [4]. Meanwhile, Tran Duc Hai (2023) at Cho Ray Hospital applied the Lunit CXR-v3 software built on the ResNet deep learning architecture, which significantly enhanced the diagnostic performance, increasing the sensitivity from 73.01% to 97.51% and specificity to 94.90% [5].

Several studies have broadened the scope of abnormal recognition. For instance, Dimitry Tran (2023), working alongside the Annalise.ai model, proved that AI assistance impressively enhanced physicians' classification precision for 127 radiographic patterns (increasing the AUC from 0.713 to 0.808). Similarly, Nhan Ngo (2022) used a model, named RetinaNet-based, to find out conditions such as cardiomegaly, interstitial fibrosis, infiltration, and tumors from chest X-rays, achieving a mean Average Precision at IoU=0.5 (mAP@0.5) of 0.55 for a set of five critical diseases [23].

In the endoscopic field, Dao Viet Hang (2022) used a YOLOv8 model to identify reflux esophagitis lesions in esophageal endoscopy images under various lighting systems, achieving an overall accuracy of 81.7% [8]. Moreover, the researcher utilized AI in colonoscopy to identify proximal colon polyps and implemented real-time support for polyp identification while performing endoscopic procedures.

In the field of ophthalmology, AI has been used in fundus photography and 3D OCT to identify early complications of diabetic retinopathy. Nguyen Thi Hung (2024) applied

Cybersight AI at Duc Giang Hospital and reported an accuracy of 91.92% [26]. Nguyen (2024) used a federated learning AI model for 3D OCT image analysis and detection of diabetic macular edema (DME), reporting an accuracy of up to 93.7% [12].

The dental field has also been working with AI by implementing this technology in the use of intraoral digital images for the diagnosis of dental caries. Tran Tuan Anh (2023) trained an AI model using Teachable Machine and gained a 97.8% accuracy in identifying dental caries from clinic-acquired intraoral images [30].

Finally, AI was effectively implemented in the analysis of CT perfusion (CTP) images of the brain. Hoang Quoc Viet (2023) used RAPID software for acute stroke evaluation, precisely spotting the infarct core and salvageable penumbra, thus enhancing timely endovascular intervention decisions within the extended therapeutic window [29].

3.2. Risk Prediction for Recurrence and Complications, and Support for Treatment Adjustment

One of the impressive advantages of artificial intelligence (AI) in modern medicine is its ability to predict the probability of disease recurrence and complications and personalize the treatment regimens for each patient. By gathering huge datasets from medical records, laboratory tests, imaging, and previous treatment responses, machine learning models can precisely predict disease prognosis, support physicians in making appropriate treatment regimens, reduce complication rates, and improve treatment outcomes. Table 3 summarizes key studies in this area.

Table 3. Studies on Predicting Recurrence Risk, Complications, and Treatment Adjustment

Disease Area	Number of Studies	Notable Studies
Psychiatry (Olanzapine)	1	Anh Mai Kieu et al. (2024) – Prediction of olanzapine drug levels [10].
Cardiology (Heart failure)	1	Chi Thang Doan (2024) – EF and GLS analysis via AI in echocardiography [28].
Urology (Urinary stones)	1	Le Tuan Thanh (2019) – Stone composition analysis using macro imaging [21].
Gastroenterology (Complicated appendicitis)	1	Tuong-Anh Phan-Mai (2020) – Prediction of appendicitis complications [11].
Developmental disorders (ASD)	1	Nguyen Van Hieu (2018) – Autism detection expert system using neural networks and fuzzy logic [19].

In Vietnam, early promise has been shown through several initial studies on the application of AI in terms of outcome and treatment adjustment, typically in chronic diseases such as cardiovascular conditions, psychiatric disorders, urology, and severe infectious diseases requiring personalized therapy.

A potential study by Kieu et al., (2024) used clinical information from the CATIE trial to develop an AI model to predict the concentration of olanzapine in plasma, a commonly used medication in schizophrenia treatment [10]. The model optimizes and safely ensures individualized dosing, avoiding overdose or inadequate therapeutic levels, with a Root Mean Square Error (RMSE) of only 29.566 on the validation dataset.

In the cardiology field, Chi Thang Doan (2024) made a comparison between the performance of AI and cardiologists in the evaluation of left ventricular function via ejection fraction (EF) and global longitudinal strain (GLS) [28]. The results showed that the AI model had a strong correlation with expert performance (EF: $r = 0.701$) in supporting early diagnosis of heart failure risk and appropriate medication adjustments. Impressively, the AI model automatically identified 98.5% of ultrasound segments and 100% of standard cardiac views, saving time and ensuring consistent patient monitoring.

In urology, Le Tuan Thanh (2019) implemented AI to analyze the components of urinary stones using postoperative macroimages [21]. Studies have aimed at classifying stones as calcium oxalate or non-calcium oxalate, a key factor in lowering the risk of recurrence. The model used in this study, ResNet-18, attained an accuracy and sensitivity of 71.4% and 81.5%, respectively, while achieving an AUC of 0.715, indicating high feasibility.

Furthermore, a study conducted by Tuong-Anh Phan-Mai (2020) applied machine learning algorithms, such as Gradient Boosting, SVM, and KNN, to anticipate complicated cases of appendicitis in 1,950 patients at Gia Dinh Hospital [11]. The Gradient Boosting model achieved an AUC > 0.8, enabling the identification of high-risk patients and guiding early intervention or appropriate surgical decisions.

Another study by Nguyen Van Hieu (2018) implemented a combination of artificial neural networks and fuzzy logic to evaluate Autism Spectrum Disorder (ASD) [19]. The model helped with the detection of subtle signs, provided early intervention pathways, and provided personalized behavioral and educational support.

3.3. Disease Screening in the Community and Preclinical Settings

Screening for diseases in the community and at the preclinical stage is a critical strategy to enable early detection and timely intervention and to reduce treatment costs and disease burden. However, the implementation of large-scale screening programs often faces many challenges, such as a shortage of specialized physicians, high costs, and limited medical infrastructure, especially in remote or underserved areas. In this context, artificial intelligence (AI) has emerged as an effective support tool because of its ability to automate processes, rapidly handle large volumes of data, and generate accurate diagnostic suggestions. Table 4 summarizes key studies in this area.

Table 4. Summary of AI Applications in Community and Preclinical Disease Screening

Disease/Health Issue	Number of Studies	Notable Study
Community-based pulmonary tuberculosis	1	Luan Nguyen Quang Vo (2021) – Portable X-ray + qXR v3 [14].
Chromosomal aneuploidy	1	Nguyen Thi Trang (2023) – AI screening for Down, Edward, and Patau syndromes [16].
Prenatal thalassemia	1	Nguyen Ba Tung (2023) – AI-assisted carrier gene screening [15].
COVID-19 (cough audio)	1	Dinh Son Nguyen, Khoa Tran Dang (2022) – CNN/SVM models detecting cough via smartphone [17].
Seasonal disease forecasting	1	Dang Anh Tuan, Tran Ngoc Dang (2024) – LSTM predicting dengue, hand-foot-mouth, and flu [31].

In the context of Vietnam, many researchers have implemented the application of AI in remote screening using handheld devices, mobile applications, or basic medical images. A trial of a portable X-ray system integrated with aXR v3 software was conducted in the Philippines by Luan Nguyen Quang Vo et al. (2021) [14]. Among 4,425 chest X-rays, the AI system identified 273 cases of active pulmonary tuberculosis. Interestingly, this smart device can operate without electricity, making it accessible to people residing in remote and underprivileged areas.

In the field of obstetrics, a researcher named Nguyen Thi Trang (2023) started an AI system that runs based on a combination of machine learning and expert clinical knowledge to prenatally screen for chromosomal abnormalities, such as trisomies 13, 18, and 21

(Down, Edward, and Patau syndromes) [16]. The outcome was significantly impressive with 100% sensitivity, while the specificity ranged from 80% to 100%, allowing the early recognition of fetal abnormalities without invasive testing.

Nguyen Ba Tung (2023) also developed an AI model for prenatal screening of thalassemia by inputting 244 medical records from couples [15]. The outcome showed an accuracy of over 95%, with a sensitivity varying from 96.02% to 100%. The model efficiently provides timely evidence-based genetic counseling.

A smart and breakthrough approach was implemented by two Vietnamese researchers, who used the sound of cough recorded from smartphones to detect COVID-19. A total of 7300 records of cough sounds were collected by Nguyen and Dang (2022), who used trained convolutional neural network (CNN) and Support Vector Machine (SVM) models to identify COVID-19 cough characteristics [17]. The results showed a high accuracy in asymptomatic cases. This innovation provides a rapid and cost-effective screening method that is suitable for public health programs.

Meanwhile, an effort to develop a forecast seasonal disease model was made by Dang Anh Tuan and Tran Ngoc Dang (2024) from Ba Ria–Vung Tau province [31]. By collecting 10 years of climate data and the prevalence of seasonal diseases, the study implemented an LSTM model to predict possible future outbreaks. Their AI model precisely forecasted the occurrence of dengue fever, hand-foot-mouth disease, and influenza, allowing for early prevention and control.

3.4. Virtual Assistants, Medical Chatbots, and Initial Health Consultation

Modern healthcare is implementing virtual doctors, also called medical chatbots, for remote assistance and consultations. Artificial intelligence, with its capabilities in natural language processing, image, or sound recognition, can exchange information with patients as a friend or more professionally, as a “preliminary physician.” As a result, this model can help the patient reflect on and evaluate the symptoms themselves, receive initial suggestions, and recommend a context that requires medical care. This application is especially helpful in remote and underprivileged areas, where physician shortages and limited access to healthcare services are commonly observed. Table 5 summarizes key studies in this area.

Table 5. Notable Studies on Virtual Assistants and Initial Health Consultation

Application Type	Number of Studies	Notable Study
Arrhythmia detection via mobile devices	1	Le Tuan Thanh (2019) – AI-powered Kardia Alivecor for atrial fibrillation detection [21].
Disease recognition from cough sounds	1	Dinh Son Nguyen, Khoa Tran Dang (2022) – CNN/SVM models for COVID-19 detection [17].
Automated prenatal genetic counseling	2	Nguyen Thi Trang (2023), Nguyen Ba Tung (2023) – AI screening for aneuploidies, Thalassemia [15].

Although this area of research is still in its early stages and few complete medical chatbot systems have been officially published, several studies have demonstrated the initial feasibility of symptom recognition and risk classification using AI-integrated mobile devices or automated systems.

Thanh et al., (2019) developed a device called Kardia Alivecor, which was integrated with AI software to record ECG [21]. The device is separated from the smartphone; however, it can be attached whenever needed to record a single-lead ECG in 30 s, and the result returned as normal, possible atrial fibrillation, or inconclusive. Sixty patients were included in the study, and the AI system achieved 85.29% sensitivity, 93.54% specificity, and 100% correct recognition in both cases of normal and persistent atrial fibrillation. This AI device is an outstanding example of how AI can support patients in recognizing initial symptoms at home, thereby making appropriate and timely decisions to reach out for physician support.

In addition, systems supporting automated prenatal genetic counseling, such as the studies by Nguyen Thi Trang (2023) and Nguyen Ba Tung (2023), have shown the capability of simulating decision-making and interactive responses based on AI algorithms [15]. These tools help individuals to understand the risk of congenital abnormalities during pregnancy, thus allowing timely and informed decisions.

Nevertheless, most existing systems remain specialized and built for a single purpose rather than comprehensive multitasking chatbots. Consequently, this raises a gap that can potentially be discussed, invested in, and developed further in the future, particularly in this era of AI integration in every application platform in general, and in healthcare in particular (telemedicine, healthcare app tracking, etc.).

3.5. Smart Health Record Management and Personalized Patient Care

In the era of technology and Artificial Intelligence, physicians handle less paperwork compared to the past, when all information was stored in ink and paper. Electronic Health Record (EHR) was only implemented in Vietnam a few years ago; for example, Bach Mai Hospital used EHR last year for the management of patients' information. Many things have changed according to the development of technology, and EHRs have become the foundational element of modern healthcare systems. Integration with AI can bring EHR not just a simple data storage platform, but also a potential personalized healthcare application for each patient to remind them of appointments, monitor vital signs, remind medication consumption, or warn of future risks and complications. In the context of Vietnam, many researchers have started to embed AI-based models using medical record data to support clinical decision making, genetic screening, or automated antibiogram analysis, which are summarized in Table 6.

A representative study by Kim et al. (2022) implemented an AI system using the CatBoost algorithm on EHR data from Central Vietnam. The objective of this study was to assist in the classification and prediction of infectious diseases based on clinical records, symptoms, and vital signs. The results showed that the AI model attained the highest accuracy in cases related to damage to the central nervous system, helping clinicians handle and treat one of the hardest fields in medicine.

Table 6. Notable Studies on Health Record Management and Personalized Care

Application Type	Number of Studies	Notable Study
Infectious disease record analysis	1	Kim et al. (2022) – CatBoost model for infectious disease diagnosis [32].
Integrated antibiogram analysis with LIS	1	Nguyen Hoang Bach (2023) – AI system for automated zone of inhibition recognition [20].
Personalized prenatal screening counseling	1	Nguyen Thi Trang (2023) – AI screening for aneuploidies using maternal profiles [16].

In the field of microbiology, Kirby-Bauer antibiotic susceptibility test results have been integrated with AI for multiple purposes. Nguyen Hoang Bach et al., (2023) developed this system, involving computer vision and machine learning, to analyze test results to reduce human error and rapid return of results [20]. The input was standardized data collected from various laboratories, which were then incorporated into the Laboratory Information System (LIS) of hospitals. The model ran with more than 95% accuracy and helped significantly save time for physicians, along with reducing human error.

In addition, research conducted by a researcher named Nguyen Thi Trang (2023) focused on prenatal chromosomal aneuploidy to provide consultation for case-specific recommendations by integrating AI with maternal healthcare records [16]. This points to the development of a smart healthcare ecosystem, where patient records are not only stored but also “learned from” to generate compatible medical advice.

3.6. Supporting Medication/Treatment Development Through AI Simulation and Complex Clinical Data

AI has begun to be involved in not only diagnosing but also recommending medication usage and dosage. This is an advanced and promising direction that can be achieved by teaching AI to understand pharmacokinetics, analyze complex patient data, and perform medication reactions. Patients have always been administered conventional protocols and regimens; however, with the help of AI, physicians can tailor the unique characteristics of medication usage and dosage for each patient. This can significantly reduce the risk of unwanted side effects from medication overdoses or reduce medication waste. A summary of notable studies on AI-based treatment simulation and drug development is presented in Table 7.

Table 7. Notable Studies on AI-Based Treatment Simulation and Drug Development

Type of Simulation/Treatment	Number of Studies	Notable Study
Prediction of psychotropic drug concentration	1	Anh Mai Kieu (2024) – Olanzapine concentration prediction using CATIE data [10].
Modeling depression risk	1	Hoang Nguyen Tu Anh (2024) – ML-based prediction of depression levels in students [18].
Traditional medicine-based treatment simulation	1	Nguyen Van Hieu (2018) – ANN + fuzzy logic for syndrome classification [19].

A potential study by Kieu et al. ,(2024) used clinical information from the CATIE trial to develop an AI model to predict the concentration of olanzapine in plasma, a commonly used medication in schizophrenia treatment [10]. The model optimizes and safely ensures individualized dosing, avoiding overdose or inadequate therapeutic levels, with a Root Mean Square Error (RMSE) of only 29.566 on the validation dataset.

Another approach involves the implementation of an AI model to assess behavioral and psychological factors. A study conducted by Hoang Nguyen Tu Anh (2024) utilized machine learning to evaluate student survey data, thereby creating a depression risk stratification system to determine the need for psychological therapy [18]. Despite not being a traditional medication study, the model represents a behavioral treatment strategy tailored to individual psychological profiles.

In the field of traditional medicine, AI studies have been conducted to build a model of syndrome differentiation and provide suggestions based on the syndrome type. Nguyen Van Hieu (2018) utilized artificial neural networks combined with fuzzy logic to develop a model that helps with treatment recommendations using herbal remedies or acupuncture based on the syndrome type [19]. This is an interesting approach that includes a combination of modern AI technology and traditional medical knowledge to address the disease and serve patients personally.

4. Discussion

4.1. Comparison of AI Applications in Healthcare: Vietnam and the World

In terms of data integration**,** advanced AI platforms now routinely combine imaging, electronic health records (EHRs), laboratory results, genomic data, and even patient-generated data from wearable devices (Rajpurkar et al., 2018) [33]. This holistic approach greatly enhances the predictive performance and clinical relevance. In contrast, Vietnam's AI research remains predominantly single-modality, with models often trained solely on imaging data, without linkage to clinical, demographic, or laboratory information. The lack of interoperability among hospital information systems (HIS), radiology systems (PACS), and laboratory systems (LIS) further inhibits cohesive data flow, limiting the development of AI capable of true clinical decision-making (Nguyen & Bui, 2023) [34].

In terms of research scale and validation, models in leading AI health ecosystems are subjected to multicenter studies, external peer review, and rigorous validation protocols before being approved for clinical use (Esteva et al., 2017) [35]. For example, algorithms are now being evaluated through real-world evidence trials and compared directly with human clinician benchmarks. In Vietnam, although several high-potential studies have emerged, such as the VinDr-CXR dataset (Pham H. H., 2022) [7] and federated learning models for OCT analysis (Nguyen et al., 2024) [12], these remain isolated initiatives. Most research is single-center, lacks external validation, and does not follow regulatory-grade AI development pipelines. Moreover, there is no national infrastructure for open, standardized, and annotated medical datasets, which is essential for reproducibility and generalizability.

In terms of AI adoption scale, the global scale of AI adoption in healthcare has accelerated rapidly in the past five years. According to HIMSS and Medscape (2024) [36], more than 70% of healthcare organizations in developed countries such as the United States, South Korea, and the United Kingdom have integrated at least one AI-based solution into their clinical or administrative workflows. These include radiology image analysis, automated clinical documentation, virtual triage systems, and AI-enhanced EHR navigation (McKinsey & Company, 2024) [37]. In contrast, Vietnam has the lowest reported adoption rate among the surveyed nations — only 9% of healthcare institutions reported using AI tools in practice (Iqbal, Siddique, & Safdar, 2023) [38]. Most of these applications remain confined to pilot projects in major urban hospitals, with a few systems achieving broad or national-level integration.

In terms of application, global healthcare systems employ AI in a diverse range of cases. Beyond radiology and diagnostics, AI is now widely used in predictive analytics for early disease detection, precision oncology, drug discovery, epidemiological modeling, and natural language processing (Topol, 2019; The Lancet Public Health, 2024) [1, 39]. AI tools are also integrated into clinical decision support systems (CDSS), often leveraging real-time patient data to provide context-sensitive alerts or care recommendations. Conversely, in Vietnam, AI usage is largely limited to image-based diagnostics such as chest X-rays for tuberculosis screening, endoscopic images for gastrointestinal lesions, and retinal scans for diabetic retinopathy (Pham, 2024; Tran, 2023) [4, 5]. Companies such as VinBrain have achieved national recognition of platforms such as *DrAid*, which supports radiology departments in large hospitals. However, broader domains, such as AI-assisted decision support, personalized treatment planning, and mental health triage, remain underexplored.

In terms of regulatory fronts, advanced healthcare systems operate within well-defined frameworks, governing the development and deployment of AI. The U.S. FDA's guidance on Software as a Medical Device (SaMD), the EU's General Data Protection Regulation (GDPR), and similar legislation in countries like South Korea have enabled innovation while safeguarding patient rights (The Lancet Public Health, 2024) [39]. These frameworks also help to establish accountability, transparency, and criteria for performance evaluation. Vietnam is still developing a regulatory environment.

Although AI and digital health appear in strategic national documents, enforceable regulations specific to AI in clinical care remain absent. Hospitals and researchers currently operate without clear legal guidance on issues such as algorithm explainability, liability, or data governance (Nguyen & Bui, 2023) [34]. This regulatory gap underscores the urgent need for multidisciplinary collaboration. Effective integration of AI into clinical practice requires coordinated efforts among healthcare providers, legal experts, data scientists, ethicists, and policymakers. In Vietnam, this collaboration should involve key governmental bodies such as the Ministry of Health, the Ministry of Science and Technology, and the Ministry of Finance, along with relevant departments and local agencies. Without such coordinated efforts, AI applications risk remaining fragmented, unregulated, and underutilized in practice.

Despite these challenges, Vietnam has exhibited several encouraging results. Public sector hospitals have shown openness to innovation, and several international collaborations have emerged to facilitate technology transfer and training. Vietnam's young and dynamic AI research community is a strong asset. Initiatives such as the DrAid system by VinBrain and participation in global AI challenges using Vietnamese data (e.g., VinDr-CXR) demonstrate both technical competence and potential for scalability if supported by structural reforms.

In conclusion, the gap between global and Vietnamese AI healthcare integration is still widebut not insurmountable. Vietnam's healthcare sector has made meaningful early strides, particularly in the fields of radiology and diagnostics. However, substantial investments are required in data infrastructure, interdisciplinary collaboration, regulatory oversight, and training to move from fragmented experimentation to systemic transformation. Drawing on global best practices while adapting to local realities will be the key to ensuring that AI becomes a reliable and ethical component of Vietnamese healthcare.

4.2. Proposed New Research Direction for AI Applications in Vietnam

As previously discussed, Vietnam has made notable progress in the application of artificial intelligence (AI) in healthcare, particularly in the domain of medical imaging. These AI models have demonstrated capabilities in identifying morphological changes such as lung nodules, tumors, opacities, and consolidations. However, they are yet to advance toward a statistically meaningful inference of disease etiology, which is an essential aspect of clinical practice.

A major limitation of most current studies is the lack of integration between the imaging data and clinical information. Many models have been developed in isolation, based solely on imaging inputs, without linkage to symptoms, laboratory results, patient history, or treatment progression. As a result, AI systems function primarily as "detection tools" rather than "diagnostic assistants".

Furthermore, many existing studies remain at the pilot stage with small sample sizes and lack independent validation and broad implementation. Some models demonstrate high accuracy in controlled laboratory settings but fail to generalize to real-world data because of insufficient optimization of local clinical conditions in Vietnam. The absence of large-scale, standardized, and consistently labeled datasets also presents a significant barrier to the development of robust, generalizable, and predictive AI models.

Given these challenges, future research should shift toward developing integrative multimodal AI systems that can analyze and synthesize various types of data, combining medical images with clinical, paraclinical, and personalized patient information. A promising direction that we propose is the application of multimodal AI in diagnosing the etiology of pneumonia. Specifically, our upcoming study aimed to build an AI model capable of differentiating between gram-positive and gram-negative bacterial pneumonia by integrating chest X-ray images with patient clinical data.

To support this direction, we propose building a hybrid AI model that combines chest X-ray images and clinical data. For image analysis, we will apply deep learning models such as ResNet or DenseNet to detect abnormal lung patterns. For structured clinical data, models like TabNet or simple neural networks will be used. These two data sources will then be merged—initially through early fusion—to improve diagnostic accuracy. In future phases, we may explore attention-based methods to better link clinical findings with imaging features.

Successful implementation of such a system is expected to provide multiple benefits. First, it enhances diagnostic accuracy by providing early, data-driven insights into the likely pathogen, even before culture results are available. Second, it would support a more rational use of antibiotics by helping physicians choose empiric antibiotic regimens that are pathogen-specific, thereby reducing reliance on broad-spectrum antibiotics and combating antimicrobial resistance. Third, it would shorten the time to diagnosis and initiation of appropriate treatment, and improve patient outcomes. Lastly, this technology could be especially valuable in resource-limited settings, where access to advanced diagnostic tools or infectious disease specialists is restricted.

Conclusion

Artificial intelligence is gradually affirming its vital role in improving the quality of healthcare services in Vietnam, including supporting medical imaging diagnosis, community screening, identifying disease etiology, personalized treatment recommendations, and prenatal screening. Initial studies have demonstrated the positive impact of AI in increasing diagnostic accuracy, reducing processing time, and supporting clinical decision-making, especially in resource-limited settings. However, most current models are still limited to detecting lesions or disease signs without identifying the underlying cause, as exemplified in pneumonia diagnoses. Therefore, it is essential to develop AI models capable of determining disease etiology, such as multimodal AI systems that integrate imaging and clinical data to support the diagnosis of pneumonia. This represents a practical direction for the application of precision medicine and has the potential to significantly enhance treatment effectiveness in the future.

Limitation

Our scoping review has some limitations. First, our search was limited to selected databases and Vietnamese journals, so some relevant grey literature or unpublished studies may have been missed. Second, although we followed the PRISMA-ScR methodology, we did not register a formal protocol or conduct critical appraisals, which may affect reproducibility. This is due to the exploratory nature of most included studies, which did not follow standardized methodologies necessary for the valid use of appraisal tools like CASP. Third, study classification was done manually, introducing potential bias. Lastly, as the AI field in Vietnamese healthcare is rapidly evolving, our findings reflect the state of research only up to 2024. Many included studies are early-stage or pilot projects with limited generalizability.

Disclosure

The authors declare that they have no conflicts of interest for this work.

Funding

There was no financial support for the research and publication of this article.

Data Availability Statement

All data that support the findings of this study are included within the article.

Author Contributions

Dai Tran Le Vuong, Viet Vu Duc, Bao Minh Phuong Long, Hung Pham Xuan, Dat Tran Vuong Quoc, Thanh Nguyen Ha, Cuong Do Duy, and Duc Nguyen Dinh have contributed to the conceptualization.

Viet Vu Duc, Bao Minh Phuong Long, and Hung Pham Xuan have contributed to the data curation. Dat Tran Vuong Quoc, Thanh Nguyen Ha, and Khoa Nguyen Dinh have contributed to the formal analysis.

Bao Minh Phuong Long has contributed to the methodology. Cuong Do Duy and Duc Nguyen Dinh have contributed to the project administration.

Dai Tran Le Vuong, Cuong Do Duy, and Duc Nguyen Dinh have contributed to the supervision. Dai Tran Le Vuong has contributed to the visualization.

Dai Tran Le Vuong, Viet Vu Duc, Bao Minh Phuong Long, Hung Pham Xuan, Linh Nguyen Khanh, and Nguyen Dinh Khoa have contributed to the writing - original draft.

Dai Tran Le Vuong, Viet Vu Duc, Linh Nguyen Khanh, and Nguyen Dinh Khoa have contributed to the writing, review & editing.

All the authors have read and agreed to the published version of the manuscript.

Reference

[1] E. Topol, Deep Medicine: How Artificial Intelligence Can Make Healthcare Human Again, Basic Books, 2019.

[2] J. He et al., The Practical Implementation of Artificial Intelligence Technologies in Medicine, Nature Medicine, Vol. 25, No. 1, 2019, pp. 30-36, https://doi.org/10.1038/s41591-018-0307-0.

[3] A. S. Nejad et al., Health Intelligence: How Artificial Intelligence Transforms Population and Personalized Health, NPJ Digital Medicine, Vol. 1, No. 1, 2018, https://doi.org/1038/s41746-018-0058-9.

[4] N. S. Pham, Research on the Application of Artificial Intelligence to Support Chest X-ray diagnosis at Vinh City General Hospital, Thai Binh Medical and Pharmaceutical Journal, Vol. 52, No. 1, 2024, pp. 12.

[5] T. D. Hai, Preliminary Study on the Role of Artificial Intelligence in Interpreting Chest X-rays at Cho Ray Hospital, Vietnamese Journal of Radiology and Nuclear Medicine, Vol. 993, 2023.

[6] L. Hoan et al., The Role of the ViNDr AI Application in Predicting Malignancy Risk of Solitary Pulmonary Nodules, Journal of Medical Research, Vol. 165, No. 4, 2023, pp. 17-24, https://doi.org/10.52852/tcncyh.v165i4.1480.

[7] H. Q. Nguyen et al., VinDr-CXR: An Open Dataset of Chest X-rays with Radiologist's Annotations, Scientific Data, Vol. 9, No. 1, 2022, pp. 1-7, https://doi.org/10.1038/s41597-022-01498-w.

[8] D. V. Vo et al., Development of AI Algorithms to Detect Reflux Esophagitis on Endoscopic Images, Journal of Medical Research, 2023.

[9] V. T. Quoc et al., Predicting Antibiotic Resistance in ICU Patients Using Machine Learning in Vietnam, Infection and Drug Resistance, Vol. 16, 2023, pp. 5535-5546, https://doi.org/10.2147/IDR.S415885.

[10] H. T. Anh et al., Development and Validation of A Machine Learning-Based Predictive Clinical Decision Support System for Olanzapine in Patients with Schizophrenia, Pharmaceutical Sciences Asia, 2024.

[11] T. A. P. Mai et al., Validity of Machine Learning in Detecting Complicated Appendicitis in A Resource-Limited Setting: Findings from Vietnam, Biomed Research International, Vol. 2023, 2023, https://doi.org/10.1155/2023/5013812.

[12] C. Y. Nguyen et al., Advancing Diabetic Macular Edema Detection from 3D OCT Scans: Integrating Privacy-Preserving AI and Generalizability Techniques - A Prospective Validation in Vietnam, NEJM AI, 2024.

[13] H. M. Bui et al., Predicting the Risk of Osteoporosis in Older Vietnamese Women Using Machine Learning Approaches, Scientific Reports, Vol. 12, No. 1, 2022, pp. 1-17, https://doi.org/10.1038/s41598-022-24181-x.

[14] L. N. Q. Vo et al., Early Evaluation of an Ultra-portable X-ray System for Tuberculosis Active Case Finding, Tropical Medicine and Infectious Disease, Vol. 6, No. 3, 2021, https://doi.org/10.3390/TROPICALMED6030163.

[15] C. T. K. Tung et al., Application of AI in Prenatal Screening Counseling for Thalassemia, Vietnam Journal of Medicine, 2023.

[16] N. H. Trang et al., Research on AI Application in Prenatal Screening for Chromosomal Aneuploidies (Down, Edward, and Patau Syndromes), Vietnam Journal of Medicine, 2023.

[17] D. K. Nguyen et al., COVID-19 Detection Through Smartphone-recorded Coughs Using Artificial Intelligence: Applicability Analysis for Pre-Screening COVID-19 Patients in Vietnam, ResearchGate, 2022.

[18] L. T. T. Nguyen et al., Enhancing Machine Learning Approaches for Early Detection of Depression Levels in Vietnamese Students, in AI Applications, Springer Nature, pp. 495-510, 2024.

[19] N. Van Hieu, N. L. H. Hien, Artificial Neural Network and Fuzzy Logic Approach to Diagnose Autism Spectrum Disorder, International Research Journal of Engineering and Technology, Vol. 5, No. 6, 2018, pp. 1-7, Available: https://www.irjet.net/archives/V5/i6/IRJET-V5I601.pdf (accessed on: May 4^{th}, 2025).

[20] B. N. Hoang et al., Building an Application for Automatic Identification of Kirby-Bauer Disk Diffusion Susceptibility Test Results, Journal of Medicine and Pharmacy, Vol. 1, No. 1, 2023, pp. 192-199, https://doi.org/10.34071/jmp.2023.3.28.

[21] T. Q. Bach et al., Preliminary Evaluation of Atrial Fibrillation Detection by Kardia Alivecor AI Using Portable ECG Devices, Vietnam Journal of Cardiology, Vol. 255, 2019, pp. 286.

[22] T. T. H. Thuy, N. H. Phuong, A Novel Approach to Modeling Diagnosis and Treatment in Traditional Vietnamese Medicine, Journal of Computer Science and Cybernetics, Vol. 3, No. 10, 2023, pp. 279-290, https://doi.org/10.15625/1813-9663/18015.

[23] N. Ngo, Application of Deep Learning in Chest X-ray Abnormality Detection, Vietnam Journal of Science and Technology, Vol. 65, No. 4, 2023, pp. 84-93, https://doi.org/10.31276/vjste.65(4).84-93.

[24] L. Thuy et al., Using Convolutional Neural Network (CNN) for COVID-19 Chest X-ray Diagnosis, Vol. 228, No. 15, 2023, pp. 126-135.

[25] D. V. Hang et al., Application of AI-assisted Colonoscopy in Detecting Proximal Colon Polyps, Vietnam Journal of Medicine, 2022.

[26] D. V. Hung et al., Assessment of Diabetic Retinopathy in Patients at Duc Giang General Hospital, Vietnam Journal of Medicine, Vol. 535, No. 1, 2024, pp. 23.

[27] T. Hai et al., Artificial Intelligence, Cybersight Detection of Diabetic Retinopathy in the Elderly in Vietnam, Journal of Current Science and Technology, Vol. 11, No. 1, 2024, pp. 45.

[28] C. T. Doan et al., Efficacy of AI Software in Automated Analysis of Left Ventricular Function in Echocardiography in Central Vietnam, Acta Informatica Medica, Vol. 32, No. 1, 2024, pp. 32-36, https://doi.org/10.5455/aim.2024.32.32-36.

[29] N. Q. Viet et al., Evaluation of Endovascular Intervention Criteria Based on Clinical, Imaging, and AI-Derived RAPID Software Indicators in Stroke Patients Within the First 24 Hours, Vietnam Journal of Medicine, 2023.

[30] T. H. Tran et al., Application of AI to Detect Dental Caries Using Teachable Machine Open-Source Tool, Vietnam Journal of Medicine, 2023.

[31] T. N. Tuan et al., Climate-driven Dynamics of Infectious Diseases: Machine Learning-based Predictive Modeling in Ba Ria-Vung Tau, Vietnam, ResearchGate, 2024.

[32] K. Kim et al., Development and Application of Survey-based AI for Clinical Decision Support in Managing Infectious Diseases: A Pilot Study in A Hospital in Central Vietnam, Frontiers in Public Health, Vol. 10, 2022, https://doi.org/10.3389/fpubh.2022.1023098.

[33] P. Rajpurkar et al., Deep Learning for Chest Radiograph Diagnosis: A Retrospective Comparison of the Chexnext Algorithm to Practicing Radiologists, PLoS Medicine, Vol. 15, No. 11, 2018, pp. 1-17, https://doi.org/10.1371/journal.pmed.1002686.

[34] M. H. Nguyen, T. A. Bui, Current Status and Orientation of AI Applications in Healthcare in Vietnam, Vietnam Journal of Medicine, Vol. 535, No. 1, pp. 45-52.

[35] A. Esteva et al., Dermatologist-level Classification of Skin Cancer with Deep Neural Networks, Nature, Vol. 542, No. 7639, 2017, pp. 115-118, https://doi.org/10.1038/nature21056.

[36] HIMSS & Medscape, AI Adoption in Health Systems: Global Trends, 2024, Available: https://www.himss.org/news/himss-and-medscape-unveil-groundbreaking-report-ai-adoption-health-systems (accessed on: May 4^{th}, 2025).

[37] McKinsey & Company, Generative AI in Healthcare: Adoption Trends and what's Next, 2024.

[38] M. Iqbal et al., Current Status and Perception of AI Adoption in Healthcare: A Global Survey, Frontiers in Digital Health, 2023.

[39] The Lancet Public Health, Artificial Intelligence in Healthcare: Promise and Pitfalls, Lancet Public Health, Vol. 9, No. 4, 2024, pp. e243-e244.