# Artificial Intelligence: Need of Hour in Ayurveda

## Dr. Ravikumar K. Sharma[1], Dr. Yadunath C. Waykole[2]

[1]Final year Pg Scholar, Department of Agadtantra, Dr.D.Y. Patil College of Ayurveda and Research Centre, Pune-411018
[2]Associate Professor, Department of Agadtantra, Dr.D.Y. Patil College of Ayurveda and Research Centre, Pune-411018

## Abstract

*Ayurveda* an ancient method of medicine which has been practised since thousands of years to achieve balance between mind, body and spirit. Since the 18th century, modern medicine has been practiced. As the two therapeutic paths have different approaches to the pathophysiological linkage of diseases and their treatment, common tools like artificial intelligence can be employed to improve both therapeutic paths' interpretation. Institutions are working on developing various artificial intelligence tools to improve the objectivity of ayurvedic medicine and to create a disciplinary model for better integration with other medical systems because a molecular understanding of *ayurvedic* medicine is crucial for the promotion of evidence-based *ayurveda*. Artificial intelligence has a significant impact on the health care business in areas such as diagnosis, personalized treatment, patient outcomes, research, administrative needs, patient data, etc. Many institutions are digitizing old *ayurvedic* texts using artificial intelligence. In order to integrate all the data into a single platform and give *ayurvedic* practitioners a variety of individualized treatment alternatives, which differ depending on where in India *ayurveda* is practiced. Artificial intelligence's methods for observation, interpretation, and prediction may differ from those used by *ayurvedic* doctors in accordance with their training and expertise.

**Keywords:** Ayurveda, AI (Artificial Intelligence), Healthcare.

**Objective:** The objective is to explore the role of AI in the field of health care system specially in the field of *Ayurveda*

**Data source:**

Data has been collected from various websites of biotechnology, pub-med, web of science, national library of medicine, books of *ayurveda* related to *Ayurved ke mulbhut sidhant* and previous work done on this topic and other relevant information available on electronic media.

**Review method:**

Reviews of all published works of literature, blogs, and books are conducted by contrasting and assessing the various meanings and ideas of writers from the past and present.

**Result and conclusion:**

This article highlights how Artificial Intelligence can be beneficial in different sectors of *Ayurveda* and health care system.

## Introduction

### Artificial intelligence:

Definition- The simulation of human intelligence processes by machines, particularly computer systems, is known as artificial intelligence [1].

Expert systems, natural language processing, speech recognition, and machine vision are examples of AI applications [1].

AI necessitates the use of specialized hardware and software to write and train machine learning algorithms. AI systems operate by consuming massive volumes of labelled training data, analysing the data for correlations and patterns, and then using these patterns to predict future states. The following cognitive qualities are stressed in AI programming [1].

1. **Learning.** This part is mostly concerned with gathering data and developing rules for converting it into actionable information. The rules, known as algorithms, give computer equipment step-by-step instructions on how to execute a certain task [1].

2. **Reasoning-** focuses on selecting the appropriate algorithm to achieve a particular result [1].

3. **Self-correction-** Developed to constantly fine-tune algorithms and give the most accurate possible results [1].

4. **Creativity-** AI generates new images, writing, music, and ideas by utilizing neural networks, rules-based systems, statistical methodologies, and other AI tools [1].

## History of AI [2]: -

- 1943: A model of artificial neurons was proposed by Warren McCulloch and Walter pits.
- 1949: Hebbian learning rule- An updating rule for modifying the connection strength between neurons demonstrated by Donald Hebb.
- 1950: Alan Turing publishes "Computing Machinery and Intelligence" in which he proposed a Turing test.
- 1955: An Allen Newell and Herbert A. Simon created "Logic Theorist" which was first AI program.
- 1966: Joseph Weizenbaum created the first chatbot "ELIZA".
- 1972: WABOT-1, first intelligent humanoid robot was built in Japan.
- 1980: Expert systems were created to mimic the decision-making abilities of human experts.
- 1997: IBM Deep Blue beats world chess champion, Gary Kasparov.
- 2002: Roomba- a vacuum cleaner was developed.
- 2006: Companies like Facebook, Twitter, and Netflix also started using AI.
- 2011: IBM's Watson won jeopardy, a quiz show.
- 2012: "Google now" launched by google which was an android application.
- 2018: "Project Debater" from IBM debated on complex topics with two master debaters.
- "Duplex"- a virtual assistant has been demonstrated by google [2].

## Types of AI [3] -

It can be divided on the basis of capabilities and functionalities.

Based on capabilities – Three types

1. **AI:** It concentrates on a single task and cannot perform beyond its capabilities.
2. **General AI:** It is a powerful AI that can comprehend and learn any intellectual task. It enables a computer to apply information and abilities in many circumstances.

3. **Super AI: -** Super AI surpasses human intelligence and can perform any task better than a human.

**Based on functionalities- four types**

1. **Reactive Machines:** - It is the most basic type of AI and cannot conduct future actions because it does not retain past experiences and memories. It only works with current data.
2. **Limited Theory:** - To make decisions, AI learns from past data. They can access this historical data for a limited time.
3. **Theory of Mind:** -AI represents an advanced class of technology. Sophia from Hanson Robotics is an example of theory of mind
4. **Self- awareness:** -Only exists hypothetically. Such systems comprehend their internal characteristics, states, and situations, as well as human emotions.

**Branches of AI [3]-**

a) **Machine learning:** It deals with developing algorithms that can learn from data. ML algorithms are used in various applications, including image recognition, spam filtering, and natural language processing.

b) **Deep learning:** It is a subfield of machine learning that uses artificial neural networks to learn from data. This kind of algorithms effectively solve various problems, including NLP, image recognition and speech recognition.

c) **Natural language processing:** It is concerned with the interface of computers and human language. These techniques are utilized in a variety of applications, including machine translation, speech recognition, and text analysis, to interpret and process human language.

d) **Robotics:** It is a field of engineering that deals with robot design, construction, and operation. Robots can perform tasks automatically in various robotic surgeries like knee surgeries, gynaecological surgeries, laparoscopic surgeries, kidney surgeries, brain surgeries and so on.

e) **Expert systems:** They are computer programs designed to mimic human experts' reasoning and decision-making abilities. Expert systems are used in various applications, including medical diagnosis, financial planning, and customer service.

**Artificial intelligence life cycle [4]: -**

sequential progression of tasks and decisions that drive the development and deployment of AI solutions.

**Problem Definition**

It involves defining the problem to be solved or the opportunity to be explored using AI.

**Data Acquisition and Preparation**

AI and machine learning algorithms need data to learn, so this stage involves gathering relevant data and preparing it for use.

**Model Development and Training**

This phase involves developing the AI model that will solve the defined problem and training it with the prepared data.

## Model Evaluation and Refinement

Once the model has been trained, it must be evaluated to see how well it performs. This involves testing the model on unseen data and analysing its predictions.

## Deployment

Once the model is performing satisfactorily, it is deployed to a production environment where it can start solving real-world problems.

## Machine Learning Operations

Most of the time, after deployment, the model will need to be maintained and updated. In this machine learning operations phase, the team monitors the model's performance to ensure it's still working as expected.

### *Ayurveda* [5] -

*Ayurveda* is a traditional medical system that places emphasis on the need to adjust one's eating habits, engage in appropriate leisure activities to unwind the body and mind, and follow a regular life cycle in order to develop and sustain a healthy existence on all fronts. The pathophysiology of numerous diseases, according to *ayurveda*, is caused by the imbalance of one or more *doshas*, which can vary in severity depending on the individual's innate nature, which is decided at birth. Different *ayurveda* treatises have provided explanations of pathophysiology, diseases, treatments, diet and lifestyle, and many types of physical activities like yoga in numerous works. *Ayurvedic* knowledge mainly consisted of information provided by authoritative testimony, direct perception, indirect perception, means of knowledge (through guessing interpretation and analysis) and gaining knowledge via analysing multiple factors. *Ayurvedic* knowledge is dispersed throughout India; some branches of *ayurveda,* such as *Agadtantra* in southern India, are more established. Prior to the development of artificial intelligence in the health care system, all *ayurvedic* data was compiled in manuscript format; however, some data was lost due to the destruction of multiple reputed *ayurvedic* institutes such as Nalanda, Taksh Shila, and others, where we lost multiple fundamental data related to this ancient science.

### Various sources of data collection in relation to healthcare system in classical texts of *Ayurveda* [5]

*Ayurvedic* information came from a variety of sources, including authoritative testimony, direct perception, ways of knowledge, and pure intellect knowledge gained via multifactorial, multidimensional thinking relevant in the past, present, and future.

1) **Authoritative testimony**- The information provided by a reputable authority. This includes justifying a value or principle, making a prediction, solving a problem, proposing a policy, expressing an opinion that may contradict authority or prior beliefs, standard operative procedures for maintaining wellbeing, disease information including pathophysiology, early and late signs, types, differential diagnosis, treatment, and post-recovery precautions.

2) **Direct perception**- This type of knowledge is gained by all five senses, the mind, and the soul. The following are the five senses and their associated knowledge.
   a. **Sound-** Different kinds of normal and abnormal heart and lung sounds, such as whooping sound in bronchitis, cracking or popping sound of knee joint in osteoarthritis, bowel sounds for peristaltic movements, and so on.

b. **Touch-** various kinds of touching over skin rashes, lesions, lymph nodes, haemorrhoids, anatomical appearance of bony elevations, veins, arteries, various types of temperature, and so on.

c. **Vision-** Skin colour, body type, various types of skin lesions, skin changes at various stages of disease, images of various types of medicinal herbs and metals, identification of various types of soils, water, animals, and so on.

d. **Taste-** liquids, solid substances, numerous foods, medications including plants and metals, soil, toxic compounds, and so forth.

e. **Smell-** There are various types of odours, including those from medicinal herbs, metallic substances, liquids, edibles, hazardous chemical and more.

3) **Means of knowledge**- The knowledge which was gained from the past experiences is called as means of knowledge. This form of knowledge is applicable in the past, present, and future. Such knowledge is extremely important in developing health-care policies, predicting pandemics or epidemics, identifying potential risk factors, and conducting research for objectives such as prospective or retrospective studies, drug research, and so on.

4) **Knowledge of pure intellect**- This kind of knowledge is supportive to knowledge of means. It is a collaborative process of past, present, and future-focused multifactorial and multidimensional thinking. For instance, the clinical examination of a patient with an illness can predict prognosis and outcome by looking at the severity of diseases, potential causes, and organ involvement.

We can simply adhere to the established protocols for clinical examination, etiological factors, diagnostic tools, and various methods of illness prevention and therapy on the basis of the aforementioned instruments.

**Table 1: Application of AI tools and modes of *ayurvedic* data collection**

| | Operating system in Artificial Intelligent | Modes of data collection in *ayurveda* |
|---|---|---|
| A | Machine learning and natural language processing | Authoritative testimony |
| B | Machine learning, machine vision, natural language processing, creativity | Direct perception |
| C | Machine learning, machine vision, natural language processing, creativity, reasoning, self-correction, rule based expert system | Means of knowledge and knowledge of pure intellect. |

**Material and Methodology –**

Material has been collected from various websites of biotechnology, pub-med, web of science, national library of medicine, books of *ayurveda* related to *Ayurved ke mulbhut sidhant* and other relevant information available on electronic media.

**Application of AI in healthcare systems**-

1) **Diagnostic and screening [6]**-

Medical diagnostics It is a method of assessing symptoms, previous and present illness history, and test results. It is helpful in providing appropriate diagnosis, root causes and personalised treatment. Examples of diagnostic tests are imaging (X-rays, ultrasound, Magnetic Resonance Imaging, Computed

Tomography scans, Positron emission tomography scans, etc), blood tests, tissue biopsy, gastroscopy, bronchoscopy, capsule endoscopy etc. Diagnostic tools can also be used to track the evolution of a condition, evaluate therapy success, and discover potential health issues before they become critical. AI algorithms can evaluate medical images and help healthcare providers discover and diagnose diseases more consistently and quickly. AI is capable of analyzing massive amounts of patient data, including 2D/3D imaging, bio-signals (Electrocardiogram, Electroencephalogram, Electromyography, Nerve conduction velocity, and electronic health record), vital indicators (body temperature, pulse rate, respiration rate, and blood pressure), demographic information, medical history, and laboratory test results. The data from the above diagnostic tools will assist healthcare doctors in determining treatment decisions. A variety of diagnostic instruments, such as the *Nadi* analyzer, *Prakruti* analyzer are emerging in *Ayurveda*.

## 2) Therapeutics, Drug discovery and development-

The process of identifying and creating novel pharmaceuticals, known as drug discovery. It is a difficult and time-consuming task that has typically depended on labour-intensive processes like trial-and-error testing and high-throughput screening. AI techniques like as machine learning (ML) and natural language processing, on the other hand, offer the potential to accelerate and improve this process by allowing for more efficient and accurate data analysis. Prediction of the efficacy and toxicity of new therapeutic molecules is a significant use of AI in medicinal chemistry. Over the last two years, using AI to discover drugs to combat pandemics has been a promising field of research. ML algorithms were used to assess large datasets of prospective medications in order to pick those with the most potential for treating the infection [7]. In recent years, computer-aided drug design has largely superseded traditional methods of drug design. AI is being widely employed to improve drug design approaches and necessary time. Furthermore, employing AI, the target proteins may be easily identified, increasing the success rate of the proposed medicine. The use of AI at each stage of the drug design process reduces the health risks and costs associated with preclinical trials [8]. The application of AI technologies in medicine has spread to fields such as public health, disease prediction, medication research, viral mutation prediction, nutrition programs for pregnant women, and so on.

One of the most important components of producing Ayurvedic treatments is correctly identifying herbs so that safe and effective therapies may be created. Because of AI's ability to analyse huge volumes of data and discover nuanced patterns, its use in Ayurvedic product manufacturing provides further benefits for identifying herbs. Image Recognition, Spectroscopy and Chemical Analysis, Natural Language Processing (NLP), Disease-specific Herb Recommendation, Improved Herb Agriculture Efficiency, and Herb Transparency Enhancement are just a few of the many areas where AI can help [9].

## 3) Clinical Care-

Healthcare data processing, disease diagnosis, therapy development, and even disease prevention is all made possible by AI. Medical practitioners can make better educated judgments based on more accurate information by utilizing artificial intelligence in the healthcare industry. The ability of AI in healthcare to quickly analyze large amounts of clinical documentation aids in the identification of illness markers and trends [10].AI can aid in the medical identification of severely unwell patients by utilizing its powerful language and image processing skills. For example, a machine learning model can measure pulmonary oedema and distinguish between congestive heart failure and other lung disorders using a method that offers a probabilistic way to describe an observation. Furthermore, when seen on head computed tomography scans, current developments in image analysis utilizing convolutional neural networks have

made it possible to evaluate traumatic brain injury with greater accuracy than manual methods. Using random forest models, artificial intelligence can aid in the prediction of illness progression [11]. The sickness and recovery processes are complicated by critical illness, a complex condition that manifests in a variety of unforeseen ways, leading to organ malfunction. It is essential to carefully evaluate underlying etiologies and clinical factors in order to handle these critical states successfully. AI can help generate more personalized treatment regimens by discovering different patterns in complex data and identifying certain phenotypes or endotypes that reflect the individual's critical state [11].

There are also various companies that are specialized in the detection and treatment of certain tumours based on their genetic profiles. Because many malignancies have a genetic foundation, human practitioners have found it more difficult to comprehend all cancer genetic variants and their responses to novel medications and protocols. Surgical robots, which were first permitted in the United States in 2000, give surgeons an advantage by improving their ability to see, make precise and less invasive incisions, stitch wounds, and so on [12].

## 4) Epidemiology and prevention of diseases-

Infectious diseases are caused by bacteria, viruses, fungi, or parasites, and they can spread either directly or indirectly, resulting in epidemics or pandemics. The infection that follows could cause mild to severe symptoms, like a fever that could be fatal or diarrhoea. Some people may have no symptoms from infectious diseases, but others may experience terrible consequences. Infectious diseases remain a leading cause of death worldwide, particularly in underdeveloped countries. As far as epidemics are concerned, unique properties of each infection, and potential therapy targets can all be predicted using AI methods. Certain viruses, such as HIV, may only be transferred by close physical contact, whereas influenza virus infection is spread through exhaled droplets after sneezing, coughing, or speaking within a few meters. Zoonotic diseases are infectious diseases spread by animals that can infect human being [13].

We recently confronted the COVID 19 influenza virus, which is one of several pandemics; in addition to influenza, smallpox, TB, and cholera are constant threats. To reduce the spread of infectious diseases hygiene and vaccination are very important tools. In the twenty-first century, infectious pandemics such as SARS (severe acute respiratory syndrome), MERS (Middle East respiratory syndrome), Ebola, and Zika viruses have already emerged. We can minimize premature death as well as infection-related disorders such as cirrhosis (hepatitis B), liver cancer (hepatitis C), stomach cancer (Helicobacter pylori), and aggravation of conditions such as cardiovascular and respiratory (influenza A) by reducing infections. in the recent COVID 19 pandemic, respiration rate, heart rate, blood oxygen levels, and face temperature were successfully used to categorize persons at increased risk for influenza using a neural network and fuzzy clustering algorithm [13].

## 5) Behavioural and Mental Healthcare-

AI is viewed as an innovative tool for mental health service planning, as well as for recognizing and monitoring mental health disorders in individuals and communities. When AI digitizes health-care data such as electronic health records, medical photographs, and handwritten clinical notes, it will assist physicians and deepen understanding of the causes of complicated ailments [14]. Since the start of the influenza epidemic, many people have sought help from healthcare professionals for mental health issues such as depression and anxiety. Suicide is now the fourth greatest cause of mortality among those aged 15 to 29 worldwide. AI tools can also be used to examine patient medical data, behavioural data, and voice recordings from phone calls to intervention services in order to detect early warning signs of mental health

concerns before they become severe [15]. Artificial intelligence can be beneficial in reducing the stress via online yoga sessions, interaction sessions, meditation, etc.

**6) Health management systems using Artificial *I*ntelligence-**

Medical AI software for clinic and management systems-Healthcare operations continue to be an intricate and varied set of procedures, whether they are conducted in a hospital or a single clinic. Data is constantly flowing both inside and outward for healthcare operations, including internal operations like human resources, handling insurance claims, and receiving patient data from other providers. This involved a great deal of actual paper and phone conversations decades ago. In recent years, it has been reduced to emails and files, and most of the healthcare sector has moved toward cloud databases and customized applications in recent years. Today, artificial intelligence can push these limits even further to streamline operations for the healthcare sectors as a whole. For example, HR departments can use artificial intelligence to crunch employee information and provide insights for real-time actionable decisions. Finance departments can identify expenses and cost trends while handling invoicing [16].

**7) Digital library and knowledge-**

Institutions, medical groups, and colleges are all actively establishing digital knowledge repositories. Continuous medical education, e-lectures, and teleconferences can be planned with the aid of digitalization. Students, researchers, and publishers can use it to find references.

**8) Forensic medicine and toxicology-**

Forensic medicine and toxicology are critical components of crime investigation. Multiple limits can arise when doing an autopsy and forming an opinion using traditional methods, and such hurdles can be addressed with the assistance of AI. AI can play a significant role in forensic medicine procedures such as body identification, toxin analysis, collection of various body fluids from dead bodies, detection of changes in skin and internal organs of dead bodies, detection of various stains on body parts and cloths, detection of weapon used in crime, detection of time of death, DNA analysis, fingerprints, and so on. AI can aid in the prediction of likely causes of mortality and modes of death through extensive data analysis.


**Scope and Limitation of artificial intelligence in health care system [1]-**

**Scope-**

- In terms of diagnosis and therapy AI can be as good as doctor
- a variety of fast-diagnosis tools, including as histology, biochemistry, and radiology imaging.
- can be used to anticipate, combat, and comprehend pandemic patterns like COVID 19.
- Government officials may utilize it while deciding on public health measures.
- May be applied to online education, distance learning, teleconferences, and lecture series.
- Can be utilized for digital libraries by institutions, colleges, and organizations.
- robotic surgical tools
- improve patient outcome and reduce cost
- less time is required for intensive data analysis
- boosts production while lowering labor costs\
- Produces consistent outcomes
- Personalization has the potential to increase consumer happiness.
- AI-powered virtual agents are constantly available to provide assistance.

**Limitation-**

- Tools used in AI systems are expensive.

- Extensive technical knowledge is required
- Scarcity of qualified personnel to construct AI tools.
- At scale, reflects the biases of its training data.
- Inability to transition from one task to another.
- Software vulnerabilities can result in data loss.
- Viruses can cause mistakes.
- Eliminates human jobs, increasing unemployment rate.

**List of software used in ayurveda and health care systems -**

- E-Procto
- MocDoc HMS
- MocDoc Clinic management systems
- Techjocky
- SWIL software
- AyushEHR
- Avohi software
- NIWARNA
- CCRAS (central council of research in ayurvedic science)
- DSS (decision support system, data mining tool)
- *Nadi* analyser
- *Prakruti* analyser, etc.

## DISCUSSION

Artificial intelligence (AI) is a developing technology in the field of healthcare systems that is being widely embraced by a range of healthcare organisations, including healthcare providers, hospitals, clinics, pharmaceutical companies, academic institutions, and colleges. The main goal of incorporating AI into business operations is to reduce human error and improve internal communication, which will enable quicker and more affordable solutions. Notably, AI is playing a critical role in promoting evidence-based *Ayurveda* because only a small percentage of physicians practising *Ayurveda* are now capable of maintaining comprehensive patient records. AI has the potential to significantly contribute to the digitization of patient data, which can prove invaluable to other physicians and students seeking to enhance their clinical knowledge and research endeavours. This data can be accessed at any time as needed, aligning with the demands of the situation.

In the world of *Ayurveda*, it is understood that many illnesses have a pathophysiology that results from an imbalance of one or more doshas, the severity of which depends on a person & its *prakruti*, or innate nature, which is decided at birth. Artificial intelligence (AI) tools like *nadi* analyzers and *prakruti* analyzers can be used to examine a larger population in circumstances where human resources are limited. Insights on pathophysiology, illnesses, remedies, dietary guidelines, lifestyles, and diverse physical exercises, including *yoga*, have been scattered throughout multiple books of *Ayurveda*. Digitalization makes it possible to combine these books onto a single platform, allowing a broader demographic to appreciate the seriousness of illnesses and follow lifestyle changes like *pathya* (beneficial practises) and *apathya* (harmful practises) autonomously.

Artificial intelligence has a significant impact on the healthcare industry, affecting areas like disease diagnosis, personalised treatment approaches, patient outcomes, research endeavours, administrative tasks, and patient data administration, among others. Institutions are currently working on AI-powered technologies to support the development of a molecular understanding of *ayurvedic* medicine, which is essential for supporting evidence-based *ayurvedic* practises. Many organisations are using AI to digitise old *Ayurvedic* texts, which have been used as references by scholars, publishers, and students alike. AI may combine this variety of data into a single platform, providing *Ayurvedic* practitioners with a range of personalised treatment options that varies based on the particular *Ayurvedic* practises common in various parts of India.

*Ayurvedic* physicians have different training and experience than AI, thus it is important to keep in mind that their observation, interpretation, and prediction techniques may differ from AI. It is projected that the use of various software programmes and the spread of numerous diagnostic tools would considerably aid in the early identification of diseases, the development of customised treatment plans, the implementation of prevention measures, and alterations to lifestyle.

## CONCLUSION

*Ayurveda* is a traditional health care system of India with eternal values. AI technology can aid in the globalization of *ayurveda* in order to provide an alternate form of treatment and to prevent diseases. In the same way that numerous pharma corporations use AI in their drug research and manufacture, numerous healthcare practitioners, including *ayurvedic* physicians, use it in their clinics and hospitals. The digitalization of knowledge is greatly aided by AI techniques. For early diagnosis and individualized therapy, ayurvedic physicians use several diagnostic equipment like *Nadi* analysers, *Prakruti* analysers, and numerous imaging modalities. These days, new diseases are developing, necessitating the development of novel treatment regimens, which can be accomplished with the use of AI tools. As a result, with the assistance of AI, we can emphasize the adoption of *ayurveda* as a new window in the global health care system.

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