



## INTEGRATING ARTIFICIAL INTELLIGENCE WITH AYURVEDA : OPPORTUNITIES AND CHALLENGES

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### ABSTRACT

**Background:** In today's fast paced world, where change is accelerated and technological advancements are rapid. Ayurveda's timeless principles which prioritize health as the foundation of Dharma, Artha, Kama and Moksha must be adapted to modern realities through a strategic convergence with Artificial Intelligence. Different branches of Ayurveda also have many hidden opportunities which needs to be revealed so a comprehensive study of all the departments in integration with A.I. is a major requirement. **Aim and Objective:** The aim of this study is to explore the opportunities and challenges of integrating Artificial intelligence with Ayurveda. **Methods:** It is an attempt which provides a conceptual framework of A.I. in the various Departments of Ayurveda. **Discussion:** This synergistic fusion transforms the healthcare landscape by facilitating seamless collaboration among patients, clinicians, learners and academicians, making Ayurvedic knowledge accessible and user friendly, compiling and organising material. It will increase the effectiveness, accuracy and improves personalized diagnosis and treatment. Opportunities includes Data analysis, simulations, Robotics, A.I powered tools, In silico modelling, Smart learning, 3D modules and Online consultations. There are several limitations including lack of data availability, complexity of concepts of Ayurveda, lack of expertise. **Conclusion:** Opportunities and challenges goes hand in hand challenges must be ruled out while looking at opportunities. Several challenges are data privacy and security, misunderstanding complex Ayurvedic concepts, chances of technical errors, increases unemployment, reduces human skills. To combat these challenges Artificial intelligence can be utilised as an assistant but it can not take the lead.

**KEYWORDS :** Ayurveda , Artificial intelligence, Robotics, 3D modules

### INTRODUCTION

Time, the dynamic force, has been the cornerstone of Ayurveda, influencing healthcare practices for centuries. As Charaka Samhita aptly states, Time is the ultimate healer<sup>1</sup>, highlighting the importance of timing in diagnosis and treatment. Sushruta Samhita's quote, Time is the ultimate reality<sup>2</sup>, resonates with the AI-driven approach, where timing and precision are crucial. Furthermore, Bhagavad Gita states, I am time<sup>3</sup>, the destroyer of worlds, highlighting the profound impact of time on human existence. In today's fast-paced world, where change is accelerated and technological advancements are rapid, Ayurveda's timeless principles – which prioritize health as the foundation of Dharma, Artha, Kama, and Moksha, as encapsulated in Charaka Sutrasthana's first chapter<sup>4</sup>– must be adapted to modern realities through a strategic convergence with Artificial Intelligence (AI). This fusion enables adaptive, learner-centric platforms for immersive education and training, and paves the way for sophisticated, AI-driven diagnostic tools that decipher intricate patterns in health data, leveraging Natural Language Processing (NLP), Machine Learning (ML), Deep Learning (DL), and Expert Systems to simulate Ayurvedic diagnosis and treatment protocols, ultimately unlocking new possibilities in Ayurvedic healthcare, education, and research. In Kalyuga already the intellectual power got reduced of man, and man has been Manda Buddhi nowadays so in order to attain the goal of Trividh Shishya Buddhi Hitam<sup>5</sup> it becomes very important to take the help of Artificial intelligence. When technology meets traditional Ayurvedic practices miracles takeplace. To bring out these miracles and to fulfil the aim of attaining global health this amalgamation of Ayurveda is very important. This study deals with the scope, possibilities, limitations and challenges on Ayurveda in the technological era.

### Aim and Objective

To explore the opportunities and challenges of integrating Artificial intelligence with Ayurveda.

### Materials and Methods

This study is an attempt which provides a conceptual framework of A.I. in the various Departments of Ayurveda.

### Opportunities Of Artificial Intelligence In Various Departments Of Ayurveda:

In the department of Basic Principles, Artificial Intelligence (AI) revolutionizes literary research by decoding ancient manuscript languages, translating manuscripts into multiple languages, and discovering new knowledge through data analysis. AI also streamlines

the collection, preservation, and cataloguing of manuscript data digitally, significantly reducing researcher's workload. This enables researchers to focus on higher-level analysis and insight extraction, leading to breakthroughs in Ayurvedic studies.

AI also enhances Ayurvedic education by creating intelligent learning modules for complex subjects, interactive technology-driven learning experiences, and engaging presentations that improve teaching methodologies. Additionally, AI facilitates efficient distance learning platforms, making Ayurvedic knowledge accessible to a broader audience. By automating administrative tasks, AI alleviates teacher's burdens, allowing them to focus on teaching with renewed enthusiasm.

In clinical practice, AI supports Samhita-based clinical practice in Ayurveda by elaborating basic concepts applicable to diagnosis and treatment, compiling relevant information and suggesting optimal treatment plans based on data analysis. This integration of AI in Ayurveda transforms the effectiveness and accessibility of this ancient science, holding immense potential for improved healthcare outcomes.

The departments of Dravyaguna and Rasashastra are undergoing a transformative revolution through Artificial Intelligence (AI). AI-driven natural language processing extracts valuable information from historical Ayurvedic texts, as demonstrated by Fathifar et al. (2021), leading to novel herb discoveries<sup>6</sup>. AI-generated models, machine learning, and bioinformatics facilitate standardization, consistency, and efficacy, while AI-generated genetic makeup enables pharmacogenomics understanding<sup>7</sup>. Robotics, powered by AI, streamlines medicine preparation, ensuring quality and alleviating labor-intensive tasks, even in extreme conditions. AI also aids in creating scientific nomenclature, identification, effects and side-effects calculation, quality control, and drug dosage optimization, generating evidence-based medicine. By integrating AI, researchers enhance drug discovery, standardization, personalized treatment, efficiency, and evidence-based practice, propelling Ayurvedic research and medicine into a new era of innovation and effectiveness.

The synergy between Artificial Intelligence (AI) and Agadtantra, India's ancient toxicology science, is poised to revolutionize the field. By harnessing AI-driven computational modeling, researchers can simulate intricate biological processes, such as xenobiotic ADME, to predict toxicity and optimize pharmaceutical development. Advanced machine learning algorithms facilitate the analysis of vast toxicological datasets, uncovering patterns and trends that inform risk

assessment and safety protocols. Moreover, AI-powered predictive toxicology, QSAR analysis, and high-throughput screening accelerate the identification of potential toxins, while toxicogenomics and systems toxicology provide nuanced insights into toxin-cell interactions<sup>8</sup>. By leveraging these AI-driven innovations, researchers can develop safer, more efficacious therapeutics, enhance environmental risk assessment, prior prediction of adverse drug reactions (ADRs) and ultimately ensure a healthier future.

The integration of Artificial Intelligence (AI) with Roga Nidan, the diagnostic cornerstone of Ayurveda, is transforming the ancient science's diagnostic methodologies. AI-powered tools, such as digital history taking and Nadi Tarangini Yantra, enable comprehensive data collection and accurate pulse diagnosis. Moreover, AI-driven algorithms can analyze complex patterns in patient data, facilitating early disease detection, personalized treatment plans, and enhanced clinical decision-making. Differential Diagnosis: AI's analytical capabilities can aid in differential diagnosis, considering multiple possibilities and presenting likely diagnoses based on Ayurvedic principles. AI-assisted diagnostic platforms can process vast amounts of medical information, identify potential health risks, and suggest targeted interventions. The convergence of AI and Roga Nidan has also led to the development of advanced diagnostic modalities, including:

1. Machine learning-based pattern recognition systems for disease identification.
2. Predictive analytics for forecasting patient outcomes.
3. Natural Language Processing (NLP) for analyzing medical texts and extracting relevant information. By leveraging AI, Ayurvedic practitioners can provide more accurate, efficient, and effective patient care, ultimately strengthening the foundations of this ancient yet timeless medical science<sup>9</sup>.

#### Department of Swasthavritta

1. AI-powered tools can provide personalized daily routines based on an individual's lifestyle, preferences, and Ayurvedic constitution (Prakruti). This includes tailored recommendations for Wake-up and sleep times, Exercise and physical activity, Relaxation techniques and stress management, Nutrition and diet planning
2. Customized diet plans can be generated using AI, ensuring optimal nutrition and well-being. AI can analyze an individual's - Nutritional needs, Health goals, Ayurvedic principles, Food preferences and allergies.
3. Technical tools can facilitate survey studies, enabling researchers to collect comprehensive data on: Lifestyle habits, Health outcomes, Ayurvedic practices.

#### Department of Kayachikitsa and Panchakarma

1. AI can assist in identifying effective Kayachikitsa treatments based on patients' unique conditions and Ayurvedic diagnoses. AI can analyze: - Patient symptoms and medical history, Ayurvedic diagnosis and treatment principles, Treatment outcomes and efficacy
2. AI-powered automation can streamline Panchakarma procedures, enhancing efficiency and consistency. AI can assist with: Snehana (oleation), swedana (sudation) procedures, Vamana (emesis) , virechana (purgation) procedures and Basti (enema) procedures A.I may also check the Samyak, Hina, Mithya and Atiyoga of these Karma, even though it must be confirmed clinically.
3. Online consultations can be facilitated using AI-enabled platforms, expanding access to Ayurvedic expertise. AI can assist with Patient registration and data collection, Ayurvedic diagnosis and treatment planning, Follow-up consultations and treatment monitor.

It's been a great opportunity for physicians and patient both because at any time and at any place patient may connect his or her doctor which even gives him power to fight against diseases the concept of Satvavijaya<sup>10</sup> is applied here. Counselling is a major part of treatment. Traditionally Doctors used to make a different file of a single and it was a big problem to preserve the data for a long time and whenever patient comes for a follow up searching his or her file was a big task. To solve this problem today just by clicking once all the data related to that patient comes at first.

#### Department of Kriya and Rachna Shaarir

1. 3D Modules for Physiology and Anatomy: Interactive 3D models can simplify complex physiological and anatomical concepts, enhancing learning and understanding. Advanced study of

complex human anatomy and physiology can be understood by the help of technical innovations.

2. Assessment Tools: AI-developed tools can evaluate an individual's Prakruti, Satva, and Saar<sup>11</sup>, providing insights into their unique characteristics and health tendencies. An A.I tool has already been generated in the “ Desh ka prakruti parikshan”<sup>12</sup> format.

#### Department of Shalya and Shalakya

1. Surgical Enhancements: AI can improve traditional surgical methods by analyzing data, optimizing techniques, and reducing complications. Several surgical and parasurgical procedures can be learned by developing simulations based on the Yogya Sutriyam Adhyaya of Sushruta Samhita<sup>13</sup>. Procedures which are still unexplored and not in practice can also be practiced after studying that on simulation. Robotic surgeries can also be performed instead of using robots as surgeons they can be used as assistants during surgery. Specialised tools can also be generated to do post Operative procedures.
2. Ayurvedic Anesthetic Drugs : AI-assisted research can uncover new insights into Ayurvedic anesthetic drugs, enhancing their efficacy and safety.
3. Shalakya Diagnosis and Treatment: AI can support diagnosis and treatment planning for Shalakya specialties. Kriya Kalpa are exclusive procedures in shalakya.

#### Department of Prasuti Tantra and Bal Roga

1. Data Analysis: AI can collect and analyze data on infant mortality, morbidity, and birth rates, identifying trends and areas for improvement.
2. Targeted Interventions: AI-driven insights can inform targeted interventions, addressing specific health issues like malnutrition in vulnerable populations.

#### Challenges

Opportunities and challenges goes hand in hand everything which has merits also has demerits so it becomes very important to look after the limitations and challenges. The integration of Artificial Intelligence (AI) with Ayurveda poses numerous challenges, including data limitations such as lack of standardized and comprehensive Ayurvedic databases, limited availability of high-quality, labelled data for training AI models, and difficulty integrating Ayurvedic concepts with modern medical data. Additionally, the complexity of Ayurvedic principles, such as codifying subtle and nuanced concepts like “Prakriti” (individual constitution), quantifying subjective experiences and qualitative assessments, and replicating human touch and empathy in patient-physician interactions, poses significant hurdles. Technological limitations, including AI's limited capability to interpret complex, context-dependent Ayurvedic texts, dependence on algorithms and data quality, potentially leading to biased outcomes, and inability to replicate the human labour required to prepare medicines in an authentic way, also exist. Practical challenges, such as integrating with existing healthcare systems and electronic health records, ensuring data privacy and security, addressing regulatory and ethical considerations, and overcoming cultural and linguistic barriers, must also be addressed. Furthermore, lack of expertise, including limited collaboration between Ayurvedic experts and technologists, need for multidisciplinary teams to develop effective AI solutions, risk of misunderstanding complex Ayurvedic concepts, and potential technical errors, unemployment, and reduction of human skills, In the preparation of medicine – As hands are told as the best among the Yantra <sup>14</sup>it require more human labour to prepare a medicine in an authentic way which is not practically possible. Many a times one has to work in a team to prepare a medicine despite Ayurveda says that Bhava is must to prepare a medicine Which should be collected after Swastivachan and during the preparation also the intention of the maker should be pure it increases the efficacy of the medicine but if A.I is in lead then these factors are usually avoided, many a times A.I mislead a doctor as it may show different voice. Patient seems to be healthy on video but may have fever or may have dry skin etc, are also significant challenges that must be acknowledged and overcome to effectively harness AI in enhancing Ayurveda.

#### CONCLUSION

The integration of Artificial Intelligence in Ayurveda marks a significant milestone in the evolution of this ancient science. By harnessing AI's potential, Ayurveda practitioners can Enhance diagnostic accuracy and treatment efficacy, Personalize healthcare plans tailored to individual needs, Streamline labour-intensive

processes and optimize resource allocation, Expand access to Ayurvedic expertise through online consultations, Uncover new insights into Ayurvedic principles and treatments. Moreover, AI-driven research can Validate Ayurvedic concepts and treatments through data analysis, Identify novel applications for traditional Ayurvedic remedies, Facilitate collaboration between Ayurveda and modern medicine. As Acharyas have encouraged scholars to explore other sciences, AI and technical integration can further enrich Ayurveda's relevance and effectiveness. Embracing AI can Revitalize Ayurveda's role in modern healthcare, Foster a new generation of Ayurvedic researchers and practitioners, Demonstrate Ayurveda's potential for preventive and curative healthcare. However, it's crucial to address the challenges and limitations of AI in Ayurveda, ensuring Rigorous testing and validation of AI-powered tools, Continuous training and updates for AI systems, Ethical considerations in AI-driven decision-making, Collaboration between Ayurvedic experts and AI developers. Ultimately, the harmonious blend of Ayurveda's timeless wisdom and AI's cutting-edge technology can Transform the future of healthcare, Revitalize traditional knowledge, Improve the lives of millions worldwide. By embracing this revolutionary synergy, Ayurveda can reclaim its rightful place as a leading system of medicine, enhancing human well-being and promoting global health. A.I can never take a lead and it can not replace Doctors it can only be an assistant.

## REFERENCES

1. Ghanekar Govind Bhaskar, Sushruta Samhita: Sutrasthan Sanskrit text with Ayurveda rahasya Deepika Hindi Commentary; Chapter 6; Shloka 2, page – 27. New Delhi; Meharchand Lachhmandas publications; 2008.
2. Dwivedi L. Charaka Samhita: Vimansthana text with Ayurveda Deepika Hindi Commentary; chapter 8; Verse 76, page-905, Varanasi : Chowkhamba Krishnadas Academy publications; 2021.
3. Shrimadbhagwad geeta. Chapter – 11. Verse 32
4. Dwivedi L. Charaka Samhita: Sutrasthan Sanskrit text with Ayurveda Deepika Hindi Commentary; chapter 1; Verse-15, page-15, Varanasi : Chowkhamba Krishnadas Academy publications; 2021.
5. Dwivedi L. Charaka Samhita: Vimansthana text with Ayurveda Deepika Hindi Commentary; chapter 8; Verse - 3 , page- 866, Varanasi : Chowkhamba Krishnadas Academy publications; 2021.
6. Daniel L, Lakshmi AV. Revolutionizing Ayurvedic Herbiology, Drug Discovery and Drug Development Supported by Artificial Intelligence. Ayushdhara [2024]; Issue: [346]. ISSN: 2393-9583 (Print), 2393-9591 (Online). DOI <https://doi.org/10.47070/ayushdhara.v1i16.1859>
7. Singh B, Crasto M, Ravi K, Singh S. Pharmaceutical advances: Integrating artificial intelligence in QSAR, combinatorial and green chemistry practices. Intelligent Pharmacy. 2024;2:598-608. Doi: 10.1016/j.ipha.2024.05.005.
8. Singh AV, Chandrasekar V, Paudel N, Laux P, Luch A, Gemmati D, et al. Integrative toxicogenomics: Advancing precision medicine and toxicology through artificial intelligence and OMICs technology. Toxicology. 2023;463:114784.
9. Shastry KA, Shastry A. An integrated deep learning and natural language processing approach for continuous remote monitoring in digital health. Decision Analytics Journal. 2023;8:100301.
10. Dwivedi L. Charaka Samhita: Sutrasthan Sanskrit text with Ayurveda Deepika Hindi Commentary; chapter 13; Verse-, page-, Varanasi : Chowkhamba Krishnadas Academy publications; 2021.
11. Dwivedi L. Charaka Samhita: Vimansthana text with Ayurveda Deepika Hindi Commentary; chapter 8; Verse-94 , page-917, Varanasi : Chowkhamba Krishnadas Academy publications; 2021.
12. Prakruti Parikshan – NCISM [Internet]. [cited 2024]. Available from: (<https://prakrutiparikshan-ncism.com/>).
13. Ghanekar Govind Bhaskar, Sushruta Samhita: Sutrasthan Sanskrit text with Ayurveda rahasya Deepika Hindi Commentary; Chapter-9 ; page- 52. New Delhi; Meharchand Lachhmandas publications; 2008.
14. Ghanekar Govind Bhaskar, Sushruta Samhita: Sutrasthan Sanskrit text with Ayurveda rahasya Deepika Hindi Commentary; Chapter 7; Shloka 2, page-35. New Delhi; Meharchand Lachhmandas publications; 2008.