



Review Article

## ROLE OF ARTIFICIAL INTELLIGENCE IN DECODING AYURVEDA'S IMPLICIT PRINCIPLES - AN ANALYTICAL REVIEW

Jaynarayan Sharma<sup>1\*</sup>, Aayushi Shrivastav<sup>2</sup>

<sup>1</sup>PG Scholar, PG Department of Roga Nidan Evam Vikriti Vigyana, Ch. Brahm Prakash Ayurved Charak Sansthan, New Delhi, India.

<sup>2</sup>PG Scholar, PG Department of Kaumarbhritya, Patanjali Bhartiya Ayurvedigyan evam Anusandhan Sansthan, Haridwar, Uttarakhand, India.

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### ABSTRACT

Ayurveda, an ancient system of personalized medicine, rests upon foundational elements like the three *Doshas* (*Vata*, *Pitta*, *Kapha*), individual constitution (*Prakriti*), metabolic fire (*Agni*), bodily tissues (*Dhatus*), channels (*Srotas*), and vital energy (*Ojas*). These principles, though well-documented in foundational texts, often resist precise measurement and uniform application in modern scientific contexts. Emerging artificial intelligence (AI) technologies- ranging from predictive algorithms to data structuring frameworks- offer innovative ways to analyse, quantify, and implement these concepts while maintaining their core philosophical framework. This detailed analysis examines contemporary developments (2020–2025) in AI-driven approaches to *Dosha* evaluation, disease pathway modelling, herbal combination strategies, advanced diagnostic methods, treatment recommendation platforms, digital knowledge repositories, training simulations, experimental design enhancement, and production quality controls. Benefits such as improved assessment accuracy, widespread access to customized care, and stronger research validation are balanced against hurdles like limited data resources, conceptual translation difficulties, predictive model limitations, and concerns over knowledge preservation. AI serves as an enhancement tool for the clinician's reasoned approach rather than a substitute, promoting Ayurveda's integration into worldwide health practices.

### INTRODUCTION

Ayurveda integrates physical, psychological, and existential aspects of well-being through dynamic principles governing bodily functions, personal makeup, energy transformation, structural elements, transport pathways, and life force. [1,2] These elements appear prominently in primary sources, detailing their roles, disruptions, and balancing methods, yet their descriptive nature, situational variability, and reliance on expert interpretation hinder consistent empirical evaluation. [1,3] Meanwhile, computational intelligence has reshaped conventional healthcare through

extensive data processing, outcome forecasting, linguistic analysis, and choice refinement.[9] The intersection yields Ayurvedic computational studies, employing digital methods to organize historical insights alongside current patient information.[5,7] Examples range from constitutional typing tools reaching high predictive rates to relational databases connecting thousands of substance-action pairs, mirroring intuitive clinical processes.[2,5] This examination charts AI's contributions to clarifying Ayurveda's established yet elusive ideas, reviewing recent studies to outline implementations, technical bases, results, prospects, constraints, and moral guidelines. Converting descriptive insights into functional systems links Ayurveda's heritage with data-supported modern care, upholding practitioner discernment.[2,3,8]

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## METHODOLOGY

This integrative overview follows structured analysis protocols adapted for nascent cross-disciplinary areas materials derived from biomedical archives, academic search engines, specialized Ayurvedic collections, engineering databases, and key periodicals from 2020–2025.<sup>[1,3,9]</sup> Queries merged technical descriptors (predictive models, text analytics) with domain specifics (constitutional typing, pulse evaluation), producing around 250 distinct entries post-filtering<sup>[5]</sup>.

Selections favored works demonstrating direct computational engagement with Ayurvedic elements or data, alongside broader traditional health applications mentioning Ayurveda; prioritized validated outcomes and innovative frameworks<sup>[4,6]</sup>. Excluded promotional materials, unverified promotions, and unrelated biomedical computations. Extracted elements included technical approaches, input variables, performance metrics, and drawbacks<sup>[5]</sup>. Organized by theme: foundational modelling, evaluation platforms, data systems, learning tools, investigation support, production oversight, advantages/drawbacks/morals.<sup>[6]</sup> Evaluated quality using adapted diagnostic and review standards<sup>[9]</sup>.

### Computational Modelling of Fundamental Principles

#### Constitutional and Balance Evaluation: Objective Typing

Traditional constitution determination-categorizing based on observable physical, behavioural, and functional markers- shows moderate agreement among observers.<sup>[2]</sup> Learning classifiers process combined datasets (hundreds to thousands of cases) using dozens of indicators from body measurements, vital signals, blood markers, temperament scales, and structured surveys<sup>[2,6,14]</sup>.

Various methods perform distinctly: tree ensembles and boundary classifiers achieve strong results for primary types; image processors identify heat signatures from facial features; sequence models track balance shifts over time.<sup>[5,14]</sup> Combined approaches integrate sources for detailed profiles, such as tissue-specific patterns linked to joint metabolic risks.<sup>[5]</sup> Genetic correlations support tailored rejuvenate predictions.<sup>[2]</sup> Visual mapping uncovers variant groupings, expanding type definitions<sup>[5,15]</sup>.

#### Progression Pathways, Causes, and Conditions: Pathway Analysis

Pathogenic sequences- from triggers through element-tissue-channel disruptions to manifestations- form Ayurveda's explanatory model, as in circulatory imbalances from obstruction sites.<sup>[1]</sup> Pattern extraction on records identifies reliable sequences, such as dietary

excesses plus tension yielding fluid stagnation with strong linkage.<sup>[5,6]</sup> Probabilistic diagrams estimate advancement chances based on tissue buildup and intake patterns<sup>[10]</sup>.

Network structures depict progression cycles, highlighting therapy entry points (early cleansing agents, later regulators). Time-series forecasting anticipates phase changes, aiding pre-emptive adjustments. These clarify undocumented conditions as multifaceted channel issues with psychological triggers<sup>[1,5]</sup>.

### Substance Attributes and Combination Strategies

Logical Assembly Substance profiles detail taste, quality, potency, after-effect, and special actions for numerous plants.<sup>[5,7]</sup> Relational frameworks link items, attributes, and uses, grouping blends by balancing traits. Predictive systems pinpoint key factors for specific constitution-imbalance matches, clarifying assembly rationale and guiding novel mixes<sup>[1,2,3]</sup>.

Adaptive optimization refines recipes by balancing normalization and nourishment goals through component adjustments. Chemical modelling confirms actions like calming effects from neurotransmitter influences<sup>[2,3]</sup>.

### Diagnostic and Recommendation Platforms

#### Modernizing Traditional Assessments

Pulse monitoring uses sensors plus signal breakdown for balance signatures (rapid for motion types, slow for stability types) matching expert readings closely.<sup>[2,8]</sup> Tongue evaluation via color/texture decoding signals moisture or heat excess; lesion detectors spot abnormalities. Face analysis flags inflammation markers.<sup>[8]</sup> Fluid/solid spectrometry links clarity to residue levels.<sup>[4]</sup> Integrated processing of visual, tactile, and survey data produces comprehensive profiles with high consistency.<sup>[5]</sup>

#### Recommendation Engines: Enhanced Clinical Logic

Hybrid platforms merge codified guidelines with learned patterns to propose cleansing, dietary, or procedural options tailored to profile, history, and prior effects.<sup>[4,5,15]</sup> Similarity matching draws from comparable cases for regulator-diet pairings in pressure issues<sup>[10]</sup>.

Progression estimators from ongoing data predict complications, prioritizing interventions. Remote platforms deliver behavioural prompts<sup>[4]</sup>.

### Digital Knowledge Systems

#### Structured Frameworks

Computational taxonomies define elements and links, supporting queries like motion-heat conditions affecting fluid paths with cleansing options.<sup>[5,7]</sup>

Compatibility with health standards aids record integration [7].

### Text Analytics

Processors handle classical languages for entity spotting (plants, actions, balances) and pattern networks, deriving insights without direct copying [5,6].

### Learning, Investigation, and Production

#### Applications

#### Training Simulations

Generated scenarios and adaptive feedback build pathway mapping and option selection skills [3,13].

#### Study Optimization

Clustering refines participant grouping; predictions guide adaptive protocols [5,6,10].

#### Quality Oversight

Imaging verifies authenticity; sensing ensures processing standards; tracking predicts needs [10].

### Prospects, Constraints, Morals

**Prospects:** Reliable typing for community programs; broad rejuvenation access; validated approaches [2,4].

**Constraints:** Descriptive-to-numeric gaps; sparse data; opaque predictions.[6,11] **Morals:** Equity risks; heritage rights; genomic privacy [9].

### DISCUSSION

The systematic application of artificial intelligence across Ayurveda's foundational principles represents a transformative convergence of ancient wisdom and contemporary computational capabilities, offering unprecedented opportunities to operationalize concepts that have long remained theoretically explicit yet practically challenging. By transforming qualitative descriptors of *Prakriti*, *Dosha* dynamics, *Samprapti* pathways, and *Dravyaguna* attributes into quantifiable, predictive models, AI facilitates enhanced diagnostic precision, individualized therapeutic planning, scalable preventive strategies, and rigorous scientific validation- bridging the epistemological gap between classical *Shastra* and evidence-based global healthcare paradigms. Particularly promising are AI-driven tools for *Nadi pariksha* digitization, *Prakriti* stratification in clinical trials, knowledge graph-based *Yukti* reconstruction from classical texts, and supply-chain optimization ensuring *Dravya shuddhi*, all of which amplify the Vaidya's clinical acumen rather than supplanting the indispensable human elements of *Satvavajaya*, contextual *Yuktivyukta chikitsa*, and *Guru-shishya* experiential transmission. These advancements position Ayurveda not merely as a complementary system but as a precision medicine framework capable of addressing contemporary challenges like metabolic syndrome (*Prameha*), cardiovascular disorders (*Hridroga*), and psychosomatic conditions through *Tridoshaja* lenses refined by machine learning.

However, realization of this potential demand methodological rigor in dataset curation (standardized *Prakriti* phenotyping, multilingual *Samhita* digitization), algorithmic transparency to preserve *Yukti* interpretability, ethical frameworks safeguarding traditional knowledge sovereignty, and interdisciplinary validation ensuring epistemological fidelity to Ayurveda's *Pramana*-based epistemology. The philosophical primacy of *Svabhavavada* (constitutional uniqueness) and *Hetu-phala* causality must guide AI deployment, preventing reductionism that fragments Ayurveda's holistic unity of *Sharira-trividha-manasa-atma*. Future research trajectories should prioritize large-scale *Prakriti*-stratified longitudinal cohorts integrating *Nadi* bio-signals, genomic correlates, and digital *Pathya* adherence tracking; development of open-source Ayurvedic ontologies for global interoperability; reinforcement learning frameworks for dynamic *Panchakarma* protocol optimization; and blockchain-secured *Rasashastra* quality assurance. Regulatory sandboxes for AI-Ayurveda clinical decision support, coupled with competency frameworks for digital *Vaidya* training, will accelerate safe integration. Ultimately, AI emerges not as a technological disruptor but as a *Shastra-sadhana*- a knowledge instrument amplifying the clinician's discernment while democratizing access to Ayurveda's timeless principles of personalized, preventive, and holistic healing.

### CONCLUSION

This synergistic evolution promises to reposition Ayurveda within the global precision medicine continuum, fulfilling its classical mandate of *Swasthasya swasthya rakshanam* (health preservation) and *Aturasya vikara prashamanam* (disease alleviation) through computational augmentation rather than replacement.

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**\*Address for correspondence**

**Dr. Jaynarayan Sharma**

PG Scholar,

PG Department of Roga Nidan

Evam Vikriti Vigyana, Ch. Brahm

Prakash Ayurved Charak Sansthan,

New Delhi.

Email:

[jay15503797sharma@gmail.com](mailto:jay15503797sharma@gmail.com)

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