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"Harnessing AI For Ayurveda: Systematic Insights Into Diagnostics, Drug Discovery, And Personalized Care"

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Abstract -Ayurveda, one of the oldest holistic medical sciences, is gaining renewed global relevance in the 21st century. However, its reliance on practitioner-dependent, subjective diagnostic methods has hindered its scalability and international acceptance. This review provides a chronological literature survey of Artificial Intelligence (AI) integration into Ayurveda, examining developments from conceptual frameworks to modern research automation. Beginning with pre-2015 feasibility studies and the emergence of Ayurgenomics, the paper traces the evolution of AI applications in Prakriti classification, Vikriti quantification, therapeutic personalization, and drug discovery. Further, it highlights emerging technologies such as Agent-Based AI Systems (AAIS) and predictive health analytics that promise to redefine Ayurveda as a global, data-driven science. Critical challenges—including data scarcity, model interpretability, and ethical governance—are also analyzed. The review concludes that the fusion of Ayurveda and AI, termed "Ayurveda Intelligence," represents not just modernization but a paradigm shift in healthcare delivery and research automation.

Keywords-Ayurveda, Artificial Intelligence, Machine Learning, Prakriti, Vikriti, Diagnostic Standardization, Predictive Analytics, Drug Discovery, Ayurveda Intelligence.

Introduction

Ayurveda has been practiced in India for over 3,000 years, focusing on the balance between the body, mind, and spirit. Its foundational concepts of Prakriti (constitution) and Doshas (Vata, Pitta, Kapha) form the basis of personalized medicine. While effective, Ayurveda's heavy reliance on qualitative and subjective assessments, such as Nadi Pariksha (pulse diagnosis) and Jihva Pariksha (tongue examination), creates barriers for standardization.

On the other hand, Artificial Intelligence (AI) and Machine Learning (ML) excel in handling complex datasets, pattern recognition, and predictive modeling. Their integration into Ayurveda offers the potential to transform diagnostic methodologies, enhance drug discovery, and ensure global scalability.

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This review takes a chronological approach, examining key milestones and the gradual progression from conceptual frameworks to real-world applications and future trajectories.

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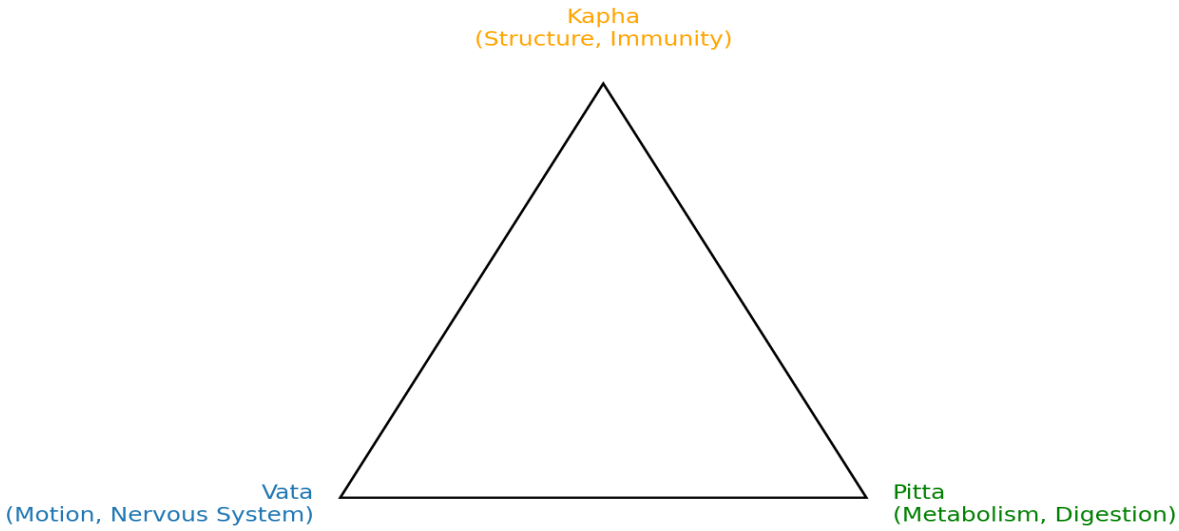
Ayurvedic Foundations and the Standardization Challenge

A. The Tridosha Theory

The Ayurvedic framework is centered on the Tridoshas:

- Vata (motion and activity),
- Pitta (metabolism and transformation),
- Kapha (structure and stability).

An imbalance in these Doshas leads to specific health disorders. AI models must capture these imbalances in quantifiable terms for global clinical validation.



(Tridosha model diagram).

B. Prakriti and Vikriti

Prakriti: the fixed constitution, akin to a genetic blueprint.

Vikriti: the dynamic state of imbalance influenced by diet, stress, and lifestyle.

The duality of Prakriti (static) and Vikriti (dynamic) forms the foundation of AI applications—first in classification, then in real-time monitoring.

C. Subjectivity and Standardization Barriers

Diagnostic subjectivity limits reproducibility. Without quantifiable data, international recognition of Ayurveda remains restricted. AI therefore becomes a strategic necessity, not merely an academic experiment.

Chronological Literature Survey of AI in Ayurveda

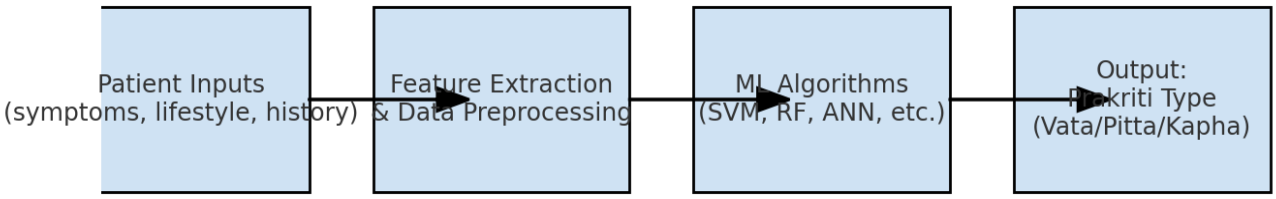
A. Early Feasibility Studies (Pre-2015)

Research emphasized philosophical compatibility between Ayurveda and modern computation. The concept of Ayurgenomics —mapping Ayurvedic Prakriti with genomic markers — emerged, laying a strong foundation for computational modeling.

B. Mid-2010s: Machine Learning for Diagnostic Standardization

The mid-2010s marked a shift toward practical AI models for Prakriti classification. Algorithms such as Decision Trees, Random Forests, Support Vector Machines, KNN, Naïve Bayes, and Artificial Neural Networks were tested.

Random Forest models consistently achieved superior accuracy. Decision Trees provided interpretability, making them attractive for clinical adoption. Decision Trees provided interpretability, making them attractive for clinical adoption.

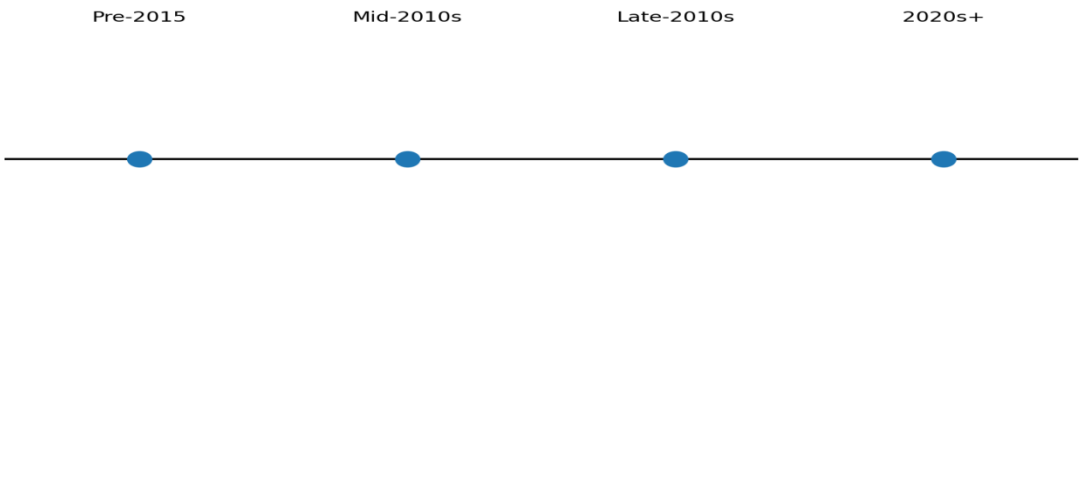


(AI pipeline for Prakriti classification).

A major advancement was the digitization of Nadi Pariksha using devices like Nadi Tarangini. These devices converted subtle pulse patterns into quantifiable waveforms, which AI analyzed for Vikriti monitoring.

C. Transition: From Classification to Quantification

This period marked the critical transition. While classification identified static Prakriti, quantification of Vikriti enabled real-time monitoring of patient health.



(Chronological timeline diagram).

IV. Applications in Therapeutics and Drug Development

- **Personalized Treatment Regimens**

AI integrates patient lifestyle, genomics, and environment to create dynamic treatment plans. For example, obesity management (Sthoulya) benefits from real-time monitoring of Dosha imbalances and adjustment of dietary or Panchakarma interventions.

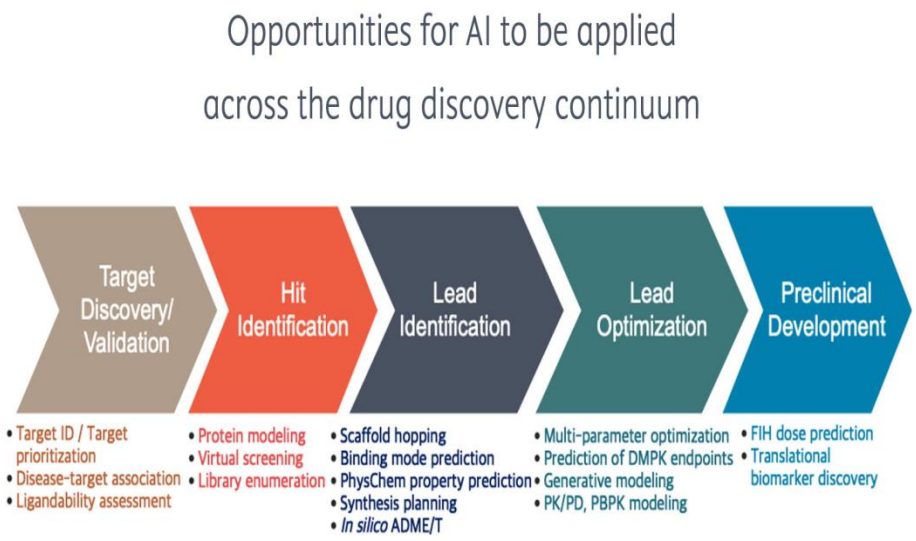
- **B. AI in Drug Discovery**

AI accelerates herbal research: Predicting herb-drug interactions.

Optimizing polyherbal formulations and mining health datasets using deep learning.

- C. Supply Chain and Quality Control

AI combined with Blockchain ensures transparency, traceability, and regulatory compliance. Techniques like hyperspectral imaging and fraud detection using NLP enhance authenticity.

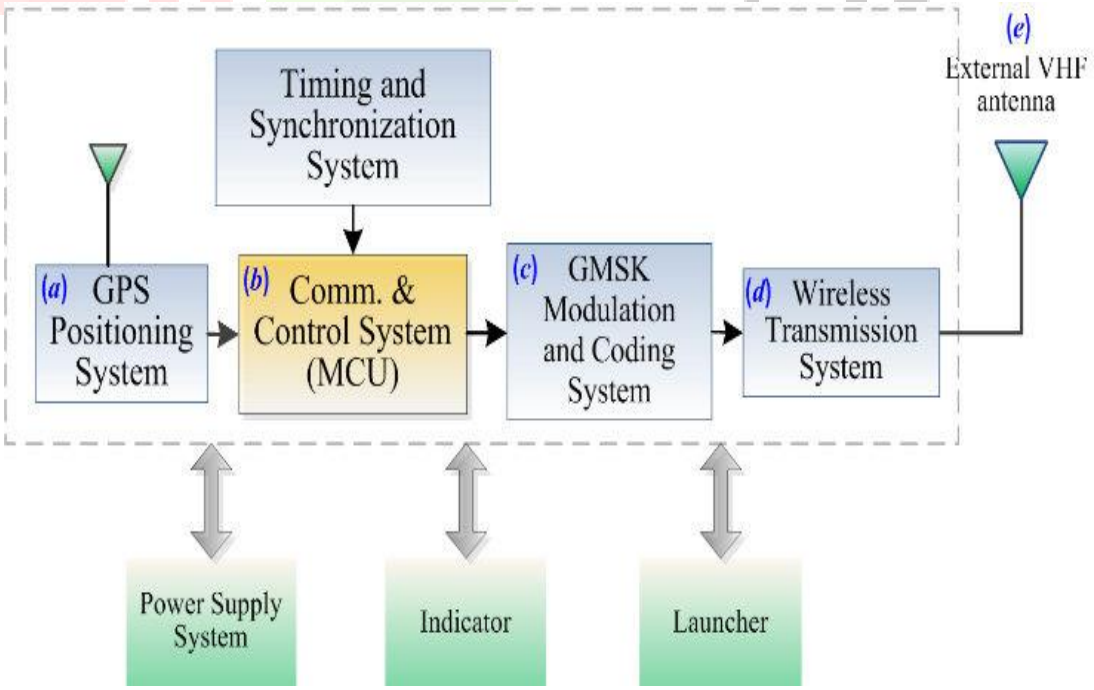


(AI in drug discovery and supply chain).

Emerging Technologies and Future Directions

A. Agent-Based AI Systems (AAIS)

AAIS represent a qualitative leap—AI functions as a researcher capable of designing, testing, and refining herbal formulations autonomously.



(AAIS Schematic).

B. Predictive Health Analytics

AI-powered analytics forecast diseases before onset by combining Prakriti profiles with dynamic Vikriti monitoring.

C. Knowledge Management

AI digitizes Ayurvedic texts, making ancient wisdom globally searchable and structured.

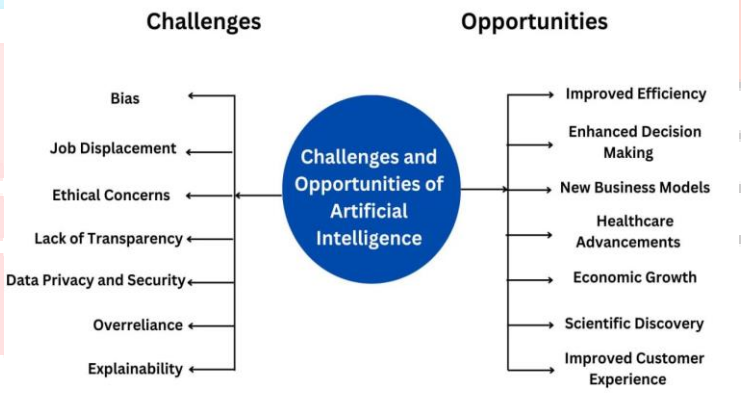
Challenges and Ethical Issues

A. Data Integrity and Scarcity: The lack of large, high-quality, digitized datasets poses a significant limitation.

B. Black Box Problem: Complex neural networks hinder trust due to non-transparent decision-making.

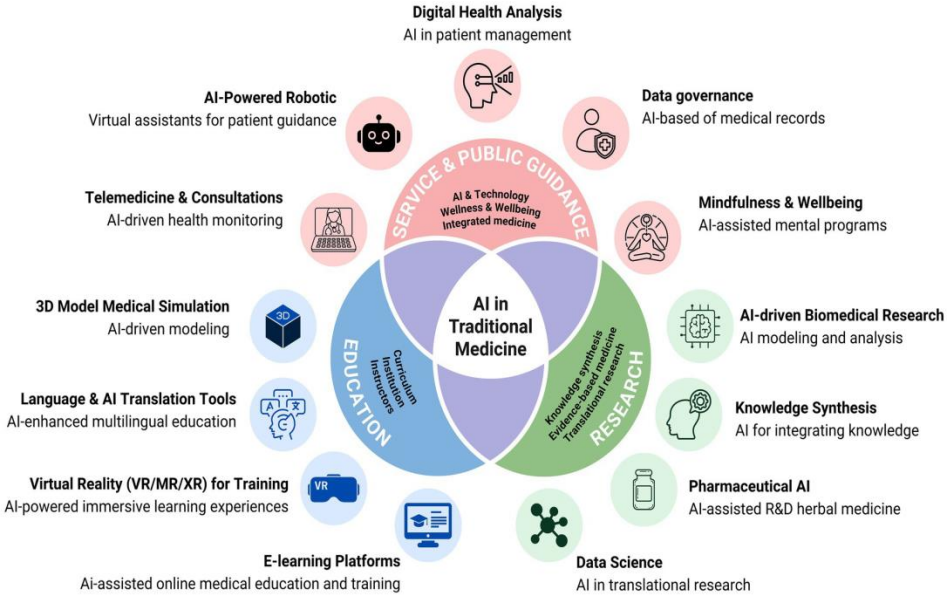
C. Ethical and Governance Concerns: Safeguarding patient privacy, ensuring practitioner oversight, and preventing algorithmic misuse are essential.

D. Paradox of Personalized Data: AI requires large datasets, but Ayurveda emphasizes individuality. Solutions like federated learning balance personalization with statistical robustness.



(Challenges vs. Opportunities).

Conclusion: The integration of AI into Ayurveda represents a monumental step—transforming it into Ayurveda Intelligence Chronologically, the journey evolved from conceptual discussions and Ayurgenomics to diagnostic standardization, therapeutic personalization, drug discovery, and now research automation.



(Vision map of Ayurveda Intelligence).

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