

Transforming *Panchakarma* with AI: The Future of Precision Ayurveda

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Abstract

Panchakarma is a key element of Ayurvedic medicine with proven benefits for prevention and treatment. Various *Panchakarma* procedures rely on the skill, physical strength and consistency of the therapists. Variations in the way therapists perform their manual techniques can affect the clinical outcome of the treatment being provided. The introduction of automation and robotics into the practice of *Panchakarma* is a new avenue that has the potential to address these limitations; offering greater precision, reproducibility, safety and operational efficiency. Some examples of possible innovations include robotic massage systems that can replicate the standardized massage techniques used in Ayurveda, automated massage tables that are equipped for *Swedana* therapies such as *Pottali Swedana*, AI (Artificial Intelligence) driven dispensing systems that can provide controlled dosing of oil to the patient during *Abhyanga* treatments, and sensor-laden monitoring systems that can continuously monitor the physiological parameters of the patient and allow for real-time modification of their treatment. Integration of AI with conventional *Panchakarma* can help in maintaining the authenticity of Ayurvedic therapies while improving standardization, accessibility, scalability and quality of care. This can help in modernizing *Panchakarma* without losing its basic therapeutic principles.

Key-Words: *Ayurveda, Panchakarma, Detoxification, Artificial Intelligence, Robotic*

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Introduction

Panchakarma is the main therapy used in Ayurveda to purify and rejuvenate the body. It is performed in five important ways; *Vamana*, *Virechana*, *Basti*, *Nasya* and *Raktamokshana*, depending on the person's constitution and types of diseases [1].

Vamana is a form of therapeutic vomiting that aims to eliminate excess *Kapha dosha* through the upper gastrointestinal tract. This is used to treat several illnesses, including chronic cough, obesity, skin disorders and conditions associated with vitiated *Kapha dosha* [2].

Virechana is a form of controlled purging that aims to remove aggravated *Pitta dosha* through the lower gastrointestinal tract. This treatment method is commonly used to treat *Pitta* disorders such as acidity, jaundice, liver disorders and various inflammatory conditions, etc [2].

Basti is the most powerful way to reduce vitiated *Vata Dosha*, there are two primary types of *Basti*: *Niruha Basti* uses medicated decoctions, while

Anuvasana Basti uses medicated oils. *Basti* is commonly utilized for treating neurological problems, musculoskeletal disease, arthritis, constipation and numerous degenerative conditions [1].

Nasya is another approach of *Panchakarma* which involves administration of medicated preparations through the nasal route. According to Ayurveda, the nose is the entry point to the head. Therefore, nasal administration is highly effective in treating numerous disorders in the head, neck, and upper respiratory tract. *Nasya* is indicated for the treatment of sinusitis, headaches, cervical spondylosis, Bell's palsy and a wide range of psychiatric and neurological disorders [1, 2].

Panchakarma procedures are fully reliant on the skill set of the people providing the therapy and their ability to physically endure the tasks [1-3]. Ayurveda is more widely recognized across the globe, there is a pressing need for developing standardized and reproducible therapeutic protocols

that can be achieved using modern technology. Other forms of therapy (physiotherapy, rehabilitation and wellness medicine) have undergone tremendous advancements through use of robotics, automation and sensor-based technologies which have improved the accuracy, consistency and monitoring of patients, whereas the field of *Panchakarma* has yet to see the benefits of any substantial advancements due to a lack of integration into modern technology [3-5].

Need of Modernization

Panchakarma is performed as a labor intensive process, which limits the ability of the practice to function efficiently and provide treatment on a large scale. In high-volume settings where there are limited amounts of trained professionals (therapists), there will also be limited options. The following problems are associated with the uniformity and consistency of *Panchakarma* procedures:

- ✚ Massaging with the same pressure is very difficult throughout the treatment period.
- ✚ Providing the same duration of time for treatment is practically not possible.
- ✚ Maintaining a constant flow of medicated oil during treatment is very difficult.
- ✚ Maintaining the same temperature of the medicated oil throughout the therapy is also problematic.

All of these factors contribute to the inability to ensure reproducible and consistent outcome of *Panchakarma* therapies. Thus AI-assisted *Panchakarma* protocols must be explored and developed in a manner that complements and supports skill sets and knowledge of trained Ayurvedic practitioners and also provide them with an improvement in precision and standardization of therapies [5, 6].

Benefits of Combining AI and *Panchakarma*

Combining AI with Ayurveda can greatly improve the way health care is delivered and the way clinical decisions are made, and to enhance educational and research opportunities. AI works together with the knowledge of Ayurveda practitioners to provide them with additional support from advanced data analysis and digital technology. AI will help practitioners with accurate diagnosis because it can analyze data from many sources (clinical data, demographics, and lifestyle) to determine complex patterns that may not be easily identified through traditional means of diagnosis. AI can assist practitioners with determining *Prakriti*, predicting disease, selecting treatment, and monitoring outcomes, thereby supporting precision in diagnosis and enhancing the provision of individualized patient care. AI-enabled educational tools and platforms can greatly expand opportunities

to educate and develop professional skills in the field of *Panchakarma* [6, 7].

FUTURE PERSPECTIVES OF AI ASSISTED PANCHAKARMA

The integration of AI with practice of *Panchakarma* may help greatly in modernizing this ancient system of Ayurveda. Modern technologies enhance skills and abilities of therapist; therefore, enabling Ayurveda practitioners to provide more standardized, reproducible, patient-centered care while adhering to the classical principles and integrity of Ayurveda [5]. **Table 1** depicted some possible futuristic approaches of AI-assisted *Panchakarma* procedure that can improve therapeutic outcome with patient safety.

Table 1: Possible futuristic approaches of AI-assisted *Panchakarma* procedure

<i>Panchakarma</i> Procedure	AI-Assisted Applications
<i>Vamana</i>	✓ AI tools can analyze patient parameters to determine eligibility for <i>Vamana</i>. ✓ Biosensors can monitor heart rate, blood pressure, oxygen saturation, respiration, and ECG during therapy. ✓ AI automatically may record the number of <i>Vega</i>, estimates fluid loss, and generates standardized digital procedure reports to improve safety.
<i>Virechana</i>	✓ AI recommends the appropriate purgative drug and dosage based on bowel habits and disease condition. ✓ AI assisted devices can monitor hydration, electrolytes and blood pressure before, during, and after therapy.
<i>Nasya</i>	✓ AI-assisted computer vision evaluates patient positioning, while image analysis assesses nasal anatomy before treatment. ✓ Intelligent delivery systems can administer medicated oils with precise volume and pressure.
<i>Basti</i>	✓ AI-guided infusion systems regulate flow rate, temperature, pressure, and

Panchakarma Procedure	AI-Assisted Applications
	delivery volume. ✓ AI sensors can monitor retention time, body position, abdominal pressure and compliance.

Artificial Intelligence and robotics will reshape the methods used to facilitate *Panchakarma* by enabling accurate treatments using standardized methods while providing safety for patients undergoing treatment. Artificial intelligence supported programs (Figure 1) can increase patient participation/engagement and adherence to treatment plans [6].

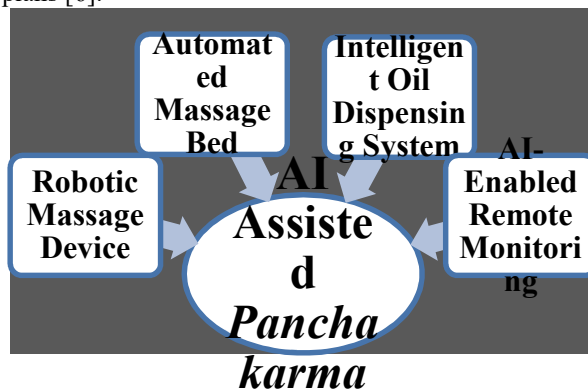


Figure 1: Futuristic options of AI Assisted Panchakarma Procedures

Robotic massage device, automated massage bed, intelligent oil dispensing system and AI-enabled remote monitoring are some of the possibilities that can be integrated with *Panchakarma* system to improve therapeutic outcomes of ancient procedures [6-8].

Robotic Massage Device

Using a robotic massage device may provide the ability for precise replication of the methods used by Ayurvedic practitioners when providing the *Abhyanga* massage. The massage device will utilize programming for articulated robotic arms so that they can connect to various sensors measuring force, pressure, and range of motion which will allow the robot to use the same amount of pressure, stroke length, rhythm, and direction during the massage provided by the practitioner. In addition, the sensors located on the robotic arm will provide real-time feedback that will permit continuous monitoring of skin elasticity, muscle stiffness, and comfort level of the patient receiving the massage enabling to adjust the massage parameters for each individual patient.

Incorporating a thermally controlled delivery system for the medicated oils used during the massage, temperature of the oil may be

maintained within the specified treatment range throughout the entire procedure improving both the absorption of the oil, effectiveness of the treatment, and comfort level of the patient while reducing the physical stresses placed on the practitioner preparing, performing, and completing the massage and improving the quality of the massage delivered.

Automated Massage Bed

Automated massage bed could be created that has heating elements which could regulate an accurate and consistent temperature during *Swedana* treatments. Mechanized applicators would be able to deliver heated herbal bolus applications for *Pottali Sweda* treatments with controlled pressure, time, and movement patterns. Continuous monitoring by infrared temperature sensors or thermal imaging systems will help to eliminate any possibility of overheating or burning the skin during treatment, as well as provide a more consistent temperature throughout the duration of the treatment. Regulating temperature and duration by automation will promote consistency of therapy results, increase safety for patients, and reduce variability of results due to operator error.

Intelligent Oil Dispensing System

An automated oil dispenser will provide accurate dosage of medicated oils during therapies including *Abhyanga* and *Shirodhara*. Computerized controlled dispensers with calibrated nozzles provide regulation of rate of flow, quantity, temperature, and method of application according to established protocols for treatment. An automated oil dispensing system would provide a continuous, uninterrupted flow of medicated oil at the pre-determined temperature and rate during *Shirodhara* treatment to produce maximum relaxation of the central nervous system and maximum therapeutic effectiveness. AI software may also provide customization of oil delivery on a patient specific basis, utilizing variables such as *Prakriti*, *Vikriti*, age, and intended therapeutic goals.

AI-Enabled Remote Monitoring

Throughout the course of a therapy session, advanced biosensors can be integrated into equipment used in *Panchakarma* to continuously measure and analyze physiological parameters such as the patient's heart rate, blood pressure, respiratory rate, level of oxygen saturation, body temperature, skin conductance, and levels of stress-related biomarkers via real-time data acquisition. Using artificial intelligence and machine learning algorithms to evaluate the performance of the autonomic nervous system during therapy, these real-time parameters will also serve to assess the level of relaxation and overall physiological adaptation experienced by the patient during therapy.

Challenges

- ✓ Human touch is important to the physical, psychological, and emotional wellbeing of the patient. Therefore, robotic systems need to be developed as a complement to the Ayurvedic practitioners' competencies rather than replacing direct human interaction.
- ✓ Another potentially difficult challenge will be the ability to deliver individualized *Panchakarma* therapies based on the patient's *Prakriti*, *Vikriti* and the patient's stage of disease, age, and all other patient-specific parameters.
- ✓ The capital cost of initial set up, technical complexities, infrastructure requirements, and ongoing maintenance costs associated with the robotic systems may create barriers to the adoption of such technologies, especially in smaller Ayurvedic hospitals or traditional clinics.
- ✓ In addition, patient acceptance, trust, and ethical issues related to automated therapy procedures will require appropriate education, transparent communication, and demonstration of clinical value.

Recommendations to Conquer Limitations

AI assisted *Panchakarma* systems should undergo a comprehensive process of validation engineering analysis, regulatory approval and good quality controlled clinical trials to determine the effectiveness, reliability, and cost effectiveness of AI assisted *Panchakarma* systems. In addition to the need for these systems to be validated prior to widespread implementation, proper use and operation will depend heavily upon the availability of trained practitioners who are able to operate, oversee, and maintain these systems [5-7].

Focus for future research in this area should include prototyping, developing sensors for integration, creating AI-based decision support systems, validating robotic *Panchakarma* systems through multicenter clinical studies, and cooperative research projects involving Ayurvedic practitioners, biomedical engineers, robotics specialists, computer scientists, and healthcare researchers [6-8].

Conclusion

Integrating artificial intelligence (AI), robotics, and automation into *Panchakarma* is a significant development for the future of improving standardization, precision, efficiency, and access to Ayurvedic healthcare while preserving the core fundamentals of Ayurvedic healing. Technologies such as robotic massage systems, automated oil dispensers, intelligent *Swedana* platforms, and real-time patient monitoring systems can maintain

consistency and minimize therapist burnout, improve patient safety, and provide objective documentation of clinical outcomes. However, many barriers exist to the incorporation of these technologies into routine clinical practice, including the need to maintain the therapeutic effect of human contact, individualized AI treatment protocols, high cost, complicated technology, secure regulatory approval and clinical validation. These technologies are intended to work as intelligent support tools to augment the skills of Ayurvedic practitioners and inform evidence-based practices rather than displacing them.

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