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## Ethical consideration & role of AI in Unani system of medicine: An exploration

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### Abstract

Artificial Intelligence (AI) in healthcare refers to applying advanced computational algorithms, machine learning, and data analytics to interpret complex medical data and support clinical decision-making. Ethical considerations include data privacy, algorithm bias, and the need for responsible development and deployment to ensure patient safety and trust in these technologies. The basic principles of Unani medicine include seven principles known as *Umoor e Tabiyah*, which are responsible for the body's constitution and its health, and it is achieved by maintaining the balance in the polar dimension of six essential factors (*Asbab e Sitta Zarooriyah*). *Mizaj* (temperament) is a great tool to treat patients and for assessment of *Mizaj* ten principles (*Ajnas e Ashra*) are mentioned, which aid in the diagnosis and planning of personalized treatment for patients. Likewise, AI also uses subjective parameters like sleep, lifestyle, physical and mental activity, etc., for the interpretation of patient data. Both AI and the Unani system have a holistic approach, which includes the concept of subjectivity and individualism. Therefore, an effort has been made to explore the possibility of incorporating AI in the Unani system of medicine to enhance understanding of the concepts mentioned in the Unani system, like *Akhlat* (humours), *Mizaj* (temperament), *Nabz* (pulse) of different diseases, regulation of *Asbab e Sitta Zarooriyah*, etc., to bring more accuracy and precision in the diagnosis and treatment based on basic Unani principles. Further, the integration of AI will help to digitalize, commercialize, and make the system more acceptable globally.

**Keywords:** Artificial Intelligence, AI in unani system, ethical consideration, unani medicine

### Introduction

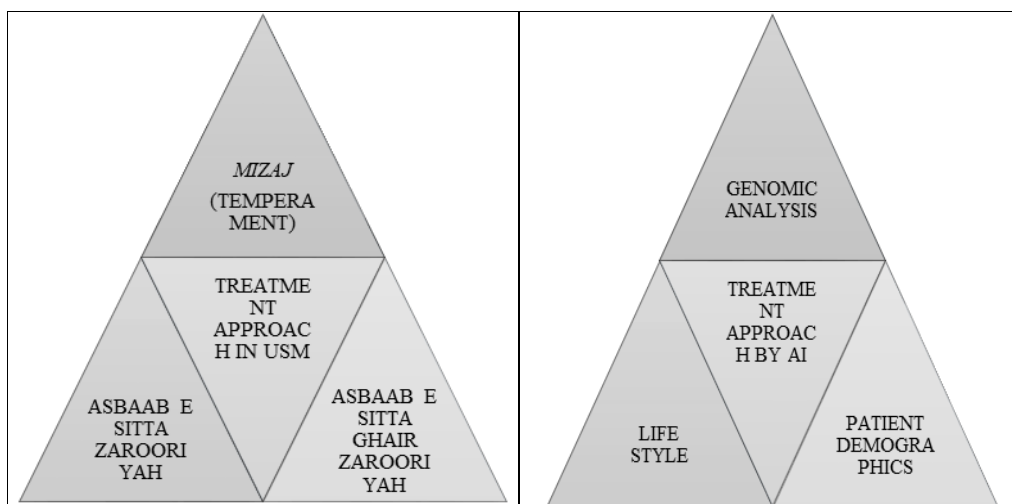
In an era of rapid technological advancements and a heightened focus on patient-centred care, the integration of the Unani System of Medicine (USM) and artificial intelligence (AI) presents an exciting opportunity for the healthcare sector. The World Health Organization (WHO) has recognized USM as an effective alternative healthcare system that meets the population's diverse needs <sup>[1]</sup>. USM offers a holistic approach to health, meaning it addresses physical health and considers mental, emotional, and spiritual well-being <sup>[2]</sup>. This comprehensive perspective can significantly enhance patient outcomes. Additionally, AI has gained considerable traction in recent years due to its potential to transform healthcare practices. Through data-driven decision-making, predictive analytics, and personalized treatment plans, AI can complement the principles of USM, ultimately leading to more effective and tailored healthcare solutions. This synergy has the potential to improve healthcare delivery and patient satisfaction significantly. This article aims to delve into the productive intersection of the Unani System of Medicine (USM) and artificial intelligence (AI), focusing on how the integration of AI technologies can enrich and support the foundational principles of USM. While these areas have unique origins and philosophies, they also share common goals, such as improving patient outcomes, enhancing the quality of care, and fostering overall wellness. Exploring the potential benefits and addressing the challenges of merging these two approaches offers a promising opportunity for advancing health care.

### Unani Medicine

The name Unani, derived from a Greek word 'Ionian', means the knowledge of the states of the human body in health and illness (decline of health). Unani medicine refers to a tradition of Greeco-Arabic medicine which is based on the teachings of *Buqrat* and Roman physician *Jalinoos*

(Galen and developed into an elaborate medical system by Arab and Persian physicians such as *Al Razi* (Rhazes), *Ibn Sina* (Avicenna), *Al Zahrawi*, and *Ibn Nafis*. It is a popular form of traditional medicine widely practised in South Asia and draws on the ancient traditional systems of medicine of China, Egypt, India, Iraq, Persia, and Syria <sup>[3]</sup>. This system is based on the Hippocratic theory of four humours, viz. blood, phlegm, yellow bile, and black bile, and the four qualities of states of the living human body, like hot, cold,

moist, and dry. They are represented as earth, water, fire, and air. The Greek ideas were put by the Arabian physician as seven principles (*Umoor-e-Taba'iyah*) and included elements (*Arkan*), temperament (*Mizaj*), humours (*Akhlat*), organs (*A'aza*), spirit (*Arwah*), faculties (*Quwa*), and functions (*Afa'al*). In this system, it is believed that these principles are responsible for the body constitution and its health, as well as diseased conditions <sup>[4, 5]</sup>.



**Fig 1:** A Comprehensive and multidimensional treatment approach through the lens of USM and AI

The diagnosis is based on the presenting symptoms of a disease. Inspection, palpation, and percussion of different organs are an integral part of the examination of a patient and modification in the six essential factors (*Asbaab e sitta zaruriyah*) that are (1) *Al-Hawa' al-muhit* (atmospheric air), (2) *Al-Makul wa'l-mashrub* (foods and drinks), (3) *Al-Harakat wa'l-sukun al-badaniyah* (physical movement and repose), (4) *Al-Harakat wa'l-sukun al-nafسانيyah* (Mental or psychic movement and repose), (5) *An-Naum wa'l-yaqzah* (sleep and wakefulness), (6) *Al-Istifragh wa'l-ihitbas* (Evacuation and retention) and six non-essential factors (*Asbaab e sitta ghair zaruriyah*), (1) *Al-Bilad* (geographical conditions of the country and town and other related matters), (2) *Al-Masakin* (Residential conditions and related matters), (3) *Al-Sana 'at* (occupation and related matters),

(4) *At-'Adat* (Habits and related matters), (5) *Al-Asnan* (Age and related matters), (6) *Al Ajnaas* (Sex and related matters), (7) *Umur muzadal-tabi'at* (Any other factors antagonistic to nature and bodily health) <sup>[4]</sup>. However, *Muaina-e-Nabz* (pulse examination), *mushahida-e-bol wa baraz* (examination of urine and faeces), and finally assessment of *Mizaj* are the most distinguished tools for the diagnosis of a disease <sup>[6, 7]</sup>.

### Overview of artificial intelligence

AI, a branch of computer science, involves the development of algorithms and computer systems that can perform tasks typically requiring human intelligence, such as problem-solving, decision-making, and pattern recognition <sup>[8, 9]</sup>.

**Table 1:** List of AI-based software advancing the drug discovery and development process <sup>[13]</sup>

Sr. No.	Application AI	AI Method	Description
1.	Drug discovery	Virtual screening	Screening large libraries of compounds for potential drug candidates using artificial intelligence algorithms.
2.	Target identification	Machine learning	Identifying potential drug targets through the analysis of extensive biological datasets.
3.	Drug design	Generative adversarial networks	Creating new drug molecules that are likely to be effective against a specific target.
4.	Toxicity prediction	Machine learning	Evaluating the toxicity of drug candidates.
5.	Personalized medicine	Machine learning	Developing treatments that are specifically tailored to the individual patient.
6.	Clinical trials	Machine learning	Enhancing the design and analysis of clinical trials.
7.	Healthcare data analysis	Machine learning	Analysing patterns in healthcare data to optimize the diagnosis, treatment, and prevention of diseases.
8.	Medical image analysis	Computer vision	Identifying and classifying medical images, including X-rays, CT scans, and MRIs, is critical for diagnosis and treatment.
9.	Natural language processing	Natural language processing	Analysing and understanding medical texts, including patient records and clinical trial data.
10.	Virtual reality	Virtual reality	Developing virtual environments for training, simulation, and therapeutic purposes.
11.	Blockchain	Blockchain B	Securely managing and storing medical records and healthcare data in a decentralized manner.

In healthcare, AI has emerged as a powerful tool with the potential to transform various aspects of the industry, from diagnostics and treatment planning to patient engagement and administrative tasks <sup>[10, 11]</sup>. AI technologies, including machine learning and natural language processing, have already demonstrated their utility in healthcare through applications like medical image analysis, predictive modelling, and Chabot's for patient interactions. These innovations have the potential to reduce diagnostic errors, improve treatment outcomes, and enhance the overall patient experience <sup>[10, 12]</sup>.

However, as AI continues to advance, it is essential to explore its role in supporting the principles of USM, which strongly emphasize individualized care and a holistic view of health. This collaborative approach bridges traditional practices with modern technology, enabling healthcare providers to offer tailored herbal treatments that address both symptoms and constitutional characteristics. This integration marks a significant step in advancing precision in USM, blending traditional wisdom with AI technology for more effective, individualized therapeutic interventions. AI's transformative potential in Unani medicine focuses on its ability to enhance diagnostics, optimize treatment strategies, and advance research methodologies. Equally important is the consideration of ethical implications and regulatory frameworks that will govern its seamless integration into this traditional healing system. This in-depth analysis offers valuable insights into how AI can modernise and elevate the time-honoured wisdom of *Tib-e-Unani*.

### AI-Driven innovations in Unani diagnostics

The incorporation of Artificial Intelligence (AI) into Unani medicine is revolutionizing diagnostic precision by complementing traditional methodologies with advanced computational tools. Traditionally, Unani diagnostics relied on observation, tactile assessments, Pulse diagnosis, and *Mizaj* (temperament) evaluation, where practitioner expertise played a crucial role. AI now enhances these methods by offering objective, data-driven insights, improving accuracy, personalisation, and efficiency in patient assessments <sup>[14-16]</sup>.

### AI-Enhanced Pulse Diagnosis in Unani Medicine

Pulse examination (*Muaina-e-Nabz*) is a fundamental diagnostic tool in Unani medicine <sup>[17]</sup> used to assess *Mizaj* (temperament) based on the rhythmic expansion (*Inbisat*) and contraction (*Inqibadh*) of arteries, which reflect humoral balance and systemic health. AI is revolutionising this process through several advancements:

1. **Machine Learning for Pulse Analysis:** AI-driven machine learning models analyse extensive pulse datasets to identify intricate patterns that may be undetectable by human practitioners. These models enhance diagnostic reliability by accurately classifying pulse types according to *Mizaj* profiles <sup>[18]</sup>.
2. **Wearable Technology for Continuous Monitoring:** AI-integrated wearable devices enable real-time, non-invasive pulse tracking, providing dynamic insights into a patient's physiological state. This facilitates the early detection of imbalances in *Akhlat* (humours) and timely medical interventions.
3. **Standardization of Pulse Readings:** The subjectivity of traditional pulse assessments poses a diagnostic challenge. AI aids in standardization by ensuring

consistent, reproducible interpretations, reducing inter-practitioner variability, and improving overall diagnostic precision.

### AI-Enhanced Visual Diagnostics in Unani Medicine

The Unani system of medicine emphasizes the diagnostic significance of facial features, body colour, and tongue appearance, offering insights into *Mizaj* (temperament) and potential pathological conditions. AI is now refining these observational methods, enhancing diagnostic precision and enabling early disease detection.

- **Facial Recognition & Analysis:** AI-powered facial recognition systems utilize high-resolution imaging and machine learning to assess features such as skin tone, texture, and asymmetries. These tools detect subtle humoral imbalances and systemic disorders while enabling longitudinal health monitoring <sup>[19-21]</sup>.
- **Bodily Colour Assessment:** Classical Unani texts describe body colour as an indicator of dominant *khilt* (humour). AI-driven tools analyse skin tone variations in real time, assisting practitioners in identifying temperament and early signs of imbalance, thereby improving preventive care <sup>[19]</sup>.
- **Automated Tongue Diagnosis:** AI-enabled computer vision examines high-resolution tongue images, assessing characteristics like colour, coating, and moisture. Deep learning models correlate visual patterns with specific health conditions, offering a standardized, non-invasive diagnostic approach <sup>[22, 23]</sup>.

### AI-Enabled Voice Analysis in Unani Medicine

In Unani and AYUSH systems, voice characteristics serve as indicators of health status. AI-driven voice analysis enhances diagnostic precision through:

- **Voice Biomarker Identification:** AI algorithms analyse pitch, tone, amplitude, and speech patterns to detect subtle variations linked to humoral imbalances and mental health conditions.
- **Longitudinal Voice Monitoring:** AI continuously tracks voice changes over time, enabling early identification of health issues before clinical symptoms arise.

### Future Directions in AI-Powered Unani Healthcare

AI-driven personalised health profiles enable individualised treatment plans based on ongoing diagnostics. Genomic integration refines *Mizaj* determination for optimised treatments. AI-powered remote healthcare solutions expand accessibility, especially in underserved areas. Interdisciplinary approaches facilitate the fusion of Unani and modern medical diagnostics, fostering comprehensive patient care <sup>[24]</sup>. The synergy between AI and Unani medicine enhances diagnostic accuracy, enables personalised treatments, supports preventive care, and establishes a data-driven foundation for continuous health monitoring.

### Incorporation of AI in Unani drug discovery and formulation

Classical Unani practitioners relied on empirical knowledge to identify crude drugs, authenticate medicinal substances, and assess clinical efficacy. They meticulously documented methods for compound drug formulations and estimated expiration timelines, yet contemporary Unani scholars face

the challenge of scientifically validating these traditional claims. <sup>[1]</sup> Artificial Intelligence (AI) is now revolutionising Unani drug discovery and pharmaceuticals (*Saidla*) by integrating traditional herbal knowledge with advanced computational techniques, accelerating research, improving efficacy, and enabling innovative product development. Key AI-driven advancements in Unani pharmaceuticals include:

#### AI-powered literature mining and knowledge extraction

1. **Ancient Text Analysis:** AI-driven Natural Language Processing (NLP) extracts key insights from classical Unani texts, identifying medicinal properties, formulation methods, and therapeutic applications. This enables practitioners to structure ancient knowledge systematically, ensuring its relevance in modern drug research.
2. **Cross-referencing traditional knowledge:** AI facilitates the integration of Unani medicinal insights with contemporary biomedical literature, validating classical herbal remedies through scientific analysis and uncovering novel applications of herbal compounds.

#### AI-Driven Optimisation of Unani Herbal Medicine

AI is enhancing herbal efficacy in Unani medicine through predictive modelling, drug discovery, and formulation refinement <sup>[25]</sup>.

#### Predictive modelling for herbal activity <sup>[26-28]</sup>

- AI models analyse compound-target interactions to identify how bioactive compounds in Unani herbs influence biological functions, improving therapeutic applications.
- Machine learning predicts synergistic herb combinations, optimising multi-herb formulations for enhanced efficacy.

#### AI-Powered drug screening & molecular docking

- *In silico* screening accelerates herbal compound evaluation against disease targets, streamlining drug discovery. <sup>[26]</sup>
- Molecular docking simulations predict how herbal compounds bind to proteins or receptors, revealing mechanisms behind Unani formulations.

#### Formulation Enhancement & Optimisation

1. AI optimises bioavailability, improving absorption and delivery methods in AYUSH medicines.
2. Stability modelling assesses environmental effects on herbal formulations, ensuring long-term potency.
3. Personalised medicine adapts formulations based on individual *Mizaj* (temperament) and health data for tailored treatments.

#### AI-Driven standardisation and safety in unani medicine

- AI is transforming the quality control and standardisation of Unani pharmaceuticals by applying scientific validation to traditional methods <sup>[29]</sup>.
- Spectral analysis enables precise herb authentication, detecting adulterants to ensure purity.
- Machine learning ensures batch-to-batch consistency in formulations, maintaining quality across production cycles <sup>[30]</sup>.

#### In toxicity prediction and safety assessment <sup>[31]</sup>

- AI-driven *in silico* screening evaluates potential toxicity in herbal compounds, reducing reliance on animal testing and enabling early identification of risks.
- AI also enhances drug-herb interaction analysis, preventing adverse reactions between Unani formulations and conventional medications.

#### Future advancements include

- AI-optimised clinical trials, improving research efficiency and cost-effectiveness
- AI-driven precision Unani medicine tailors treatments using genetic, lifestyle, and health data.
- Hybrid AI approaches integrating Unani principles with modern pharmaceutical techniques could revolutionise drug discovery.

The incorporation of AI into Unani drug discovery and formulation marks a significant paradigm shift, bridging the gap between traditional medicinal wisdom and modern scientific advancements. Through AI-driven research, Unani Pharmaceuticals can accelerate treatment development, improve efficacy and safety, and establish a more robust evidence-based foundation for herbal medicine.

#### AI-Enhanced patient care and treatment planning in the USM <sup>[7, 8]</sup>

As aforementioned, the Unani system of medicine is based on the Hippocratic theory of four humours and seven principles known as *Umoor-e-Tabiyah*, which are responsible for the body's constitution and its health, as well as diseased conditions. *Mizaj* (Temperament) is a great tool to treat the patient and the specific disease to minimise the adverse reaction and bring more accuracy to the treatment plan. For the assessment of *Mizaj*, there are ten principles (*Ajnaas-e-Ashra*). These are the ten parameters upon which a person is tested and examined. Therefore, the signs and symptoms by which the temperament is diagnosed are classified into the following ten divisions:

1. *Malmas* (Tactile sensation)
2. *Lahm wa Shahm* (Muscles and Fats)
3. *Ash'ar* (Hair of the body)
4. *Laun* (Colour of the body)
5. *Hay'at al a'za* (Stature)
6. *Katfiyat al infi'al* (Quality of passiveness of organs)
7. *Naum wa Yaqza* (Sleep and wakefulness)
8. *Af'al e A'za* (Bodily functions)
9. *Fadhlat e Badan* (Excreta of the body)
10. *Infi'alat e Nafsaniyah* (Psychic reactions)

Therefore, the integration of Artificial Intelligence in patient care and treatment planning is transforming the practice of the Unani system. This technological advancement is enhancing the ability of practitioners to provide personalised, effective, and holistic care while staying true to the foundational principles of these traditional healing systems <sup>[32]</sup>.

The following are ways in which AI is revolutionising patient care and treatment planning in Unani:

#### AI-Powered personalised treatments in Unani medicine <sup>[33, 34]</sup>



- **Advanced Mizaj Assessment:** Machine learning refines *Mizaj* classification by evaluating patient-specific variables, ensuring precise diagnosis of *Sanguinous, Phlegmatic, Bilius, and Melancholic temperaments* for tailored therapies <sup>[35]</sup>.
- **Predictive Treatment Optimization:** AI models leverage historical and real-time patient data to forecast treatment success, assisting practitioners in selecting the most effective interventions <sup>[36]</sup>.
- **Adaptive Treatment Adjustments:** AI systems continuously monitor patient progress, recommending real-time modifications to treatment plans for more dynamic and responsive care <sup>[36]</sup>.

### AI-Enhanced Health Monitoring in Unani Medicine

AI is revolutionizing patient monitoring by integrating wearable technology, predictive analytics, and remote tracking into Unani healthcare.

- **Wearable Device Integration:** AI-powered wearable's continuously track vital signs, sleep patterns, and activity levels, providing real-time health insights for precise Unani interventions <sup>[37]</sup>.
- **Remote Monitoring & Early Intervention:** AI facilitates long-term patient tracking, enabling proactive responses before health issues escalate <sup>[20]</sup>.
- **Predictive Health Alerts:** AI analyses patterns in physiological data, forecasting potential risks and supporting preventive healthcare grounded in Unani principles <sup>[20]</sup>.
- **AI-Driven Innovations in Unani Healthcare:** AI is transforming patient engagement, treatment compliance, health records management, and decision support in Unani medicine, making care more precise and accessible <sup>[38-40]</sup>.

### Enhanced Patient Engagement & Education

- AI-powered Chabot's offer round-the-clock support, guiding patients on Unani treatments, lifestyle adjustments, and Mizaj-based therapies.
- AI tailors educational content, ensuring better patient comprehension and adherence to Unani treatment protocols.

### Treatment Compliance Monitoring

- Smart dispensers track medication adherence, sending reminders and notifying practitioners about patient compliance issues.
- AI-powered lifestyle tracking apps monitor dietary habits and activity levels, reinforcing holistic Unani therapy and motivating adherence to prescribed regimens.

### Integrated Health Records & Longitudinal Analysis

- AI-driven Electronic Health Records (EHRs) integrate diverse patient data sources, offering insights that traditional Unani diagnostics may not detect.
- AI analyses health trends over time, refining Unani treatment strategies and personalized interventions <sup>[41]</sup>.

### Decision Support for Unani Practitioners <sup>[41]</sup>

- AI suggests data-backed treatment protocols, aiding practitioners in optimizing therapies based on patient profiles.

- AI-driven research integration ensures practitioners stay updated with both Unani and modern medical advancements, bridging traditional knowledge with emerging insights.
- AI enhances rare disease identification, refining diagnostic precision in complex cases.

### Future prospects in AI-Driven Unani Medicine

- AI optimizes clinical trials, improving research efficiency in Unani medicine.
- AI fosters integrative medicine, bridging Unani and conventional healthcare for more holistic patient outcomes.
- AI-driven predictive health models assess long-term wellness based on Unani interventions and lifestyle modifications.
- AI-powered global AYUSH networks facilitate knowledge exchange and collaborative treatment approaches among practitioners worldwide.

### Challenges and ethical considerations in AI-Integrated Unani Medicine

While AI enhances Unani medicine, ethical and technical challenges must be carefully managed to ensure responsible implementation. Data standardization is crucial to maintaining holistic diagnostics and scientific rigor. <sup>[42]</sup> Technological adaptation requires AI frameworks that complement Unani methods without compromising traditional practices. Ethical considerations, including transparency and cultural sensitivity, must preserve practitioner-patient trust. <sup>[43, 44, 45]</sup> Regulatory compliance necessitates clear liability guidelines and intellectual property protections for AI-driven Unani treatments <sup>[46]</sup>. Addressing these challenges will allow the AYUSH industry to ethically integrate AI, ensuring precision-driven healthcare while safeguarding traditional wisdom.

### Conclusion

The integration of Artificial Intelligence (AI) into the Unani System of Medicine represents a profound evolution in traditional healthcare. By seamlessly merging ancient healing principles with modern technology, AI enhances diagnostic precision, personalized treatment, and preventive care, while safeguarding the holistic essence of Unani medicine. This convergence fosters research advancements, improved patient engagement, and innovations in herbal therapeutics, strengthening the scientific foundation of Unani healthcare. However, successful implementation requires careful attention to data integrity, bias mitigation, and regulatory frameworks to ensure ethical AI deployment. AI should serve as a complementary tool, enhancing practitioner expertise rather than replacing human insight. A collaborative approach between AI developers, Unani scholars, and policymakers will ensure responsible integration while maintaining authenticity and cultural relevance. Looking ahead, AI will continue to redefine Unani healthcare, creating a future where traditional wisdom and advanced technology coexist to offer accessible, personalized, and evidence-driven medical solutions. Through thoughtful and ethical implementation, AI has the potential to preserve, elevate, and modernize Unani medicine, securing its place in the future of global healthcare.

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## Conflict of Interest

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