INTERNATIONAL JOURNAL OF UNANI AND INTEGRATIVE MEDICINE

E-ISSN: 2616-4558
P-ISSN: 2616-454X
www.unanijournal.com
IJUIM 2025; 9(3): 21-27
Impact Factor (RJIF): 6.59
Peer Reviewed Journal
Received: 17-07-2025
Accepted: 20-08-2025

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Digital health tools in Unānī medicine: Possibilities and challenges

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DOI: https://doi.org/10.33545/2616454X.2025.v9.i3a.376

Abstract
The integration of digital health tools with *Unānī* medicine presents a transformative opportunity to preserve, modernize, and expand this centuries-old system of healing for the needs of contemporary healthcare. Rooted in Greco-Arabic traditions and enriched by the works of Hippocrates, Galen, and Avicenna, *Unānī* medicine is based on the principles of *Mizāj* (temperament), *Akhlāt* (humours), and holistic health restoration. Its philosophy emphasizes balance, prevention, lifestyle modification, and dietary regulation, which align closely with the current global shift toward preventive, personalized, and precision medicine. Recent digital health innovations—including artificial intelligence (AI), electronic health records (EHRs), telemedicine, mobile health (mHealth) applications, clinical decision support systems (CDSS), and wearable monitoring devices offer powerful tools to transform *Unānī* practice, education, and research. However, despite these advances, challenges such as regulatory gaps, technical limitations, digital illiteracy, and lack of data standardization persist, while globalization, patents, intellectual property, and biopiracy pose additional concerns for *Unānī* medicine. To achieve global recognition, it is essential to modernize this traditional system through advancements in science and technology. By integrating traditional knowledge with modern innovations such as AI-driven diagnostics and telehealth platforms, *Unānī* medicine can transform into a more scientific, accessible, and patient-focused system. Keeping this view in this paper explores the potential and pitfalls of digitizing Unānī medicine, offers current innovations, challenges, and possibilities for ethical, inclusive, and effective integration of *Unānī* with digital health platforms.

Keywords: Digital health tools, *Unānī* medicine, artificial intelligence, electronic health records, telemedicine, traditional knowledge

Introduction
Unānī medicine is one of the most ancient and philosophically rich systems of healing known to mankind. Its origins are traced to the Greek physician Hippocrates (460-370 BC), whose doctrine that disease arises from natural causes rather than supernatural forces laid the foundation for rational medicine [1].

The *Unānī* system is grounded in the theory of the four humours—blood (*Dam*), phlegm (*Balgham*), yellow bile (*Safra*), and black bile (*Sawda*)—and the concept of *Mizāj* (temperament). Treatment is not limited to alleviating symptoms but seeks to restore balance, strengthen the body's innate healing capacity, and prevent recurrence [2]. This holistic approach aligns closely with modern concepts of preventive and personalized medicine, which emphasize early detection, risk assessment, and lifestyle modification as strategies for long-term wellness. *Unānī* physicians have long recognized the role of diet, sleep, exercise, emotional health, and environmental factors as integral components of diagnosis and treatment [3].

In today's context, where non-communicable diseases account for the majority of global morbidity and mortality [4], the philosophy of *Unānī* medicine holds renewed importance. At the same time, the 21st century has witnessed a rapid transformation in healthcare, driven by technological innovation and the rise of digital ecosystems. *Unānī* medicine, with its rich heritage and personalized approach, now stands at a pivotal juncture—facing both the challenge of modernization and the opportunity for global integration [5].

By adopting digital health tools such as electronic health records (EHRs), telemedicine platforms, mobile health applications, wearable devices, artificial intelligence (AI), and data-sharing systems, immense potential exists to strengthen *Unānī* practice.

Their adoption could enhance clinical accuracy, deliver individualized care at scale, and expand access to healthcare, particularly in underserved regions [5]. These innovations are reshaping the delivery of healthcare worldwide and provide an unprecedented opportunity for *Unānī* medicine to become more scientific, organized, and globally accessible—while remaining rooted in its holistic traditions.

A significant milestone was reached in July 2025, when the World Health Organization (WHO) acknowledged India's leadership in applying AI to traditional medicine by publishing its first technical roadmap, *Mapping the Application of Artificial Intelligence in Traditional Medicine* [6]. This global recognition highlights not only India's pioneering role in integrating technology with AYUSH systems—Ayurveda, Yoga, *Unānī*, Siddha, and Homeopathy—but also underscores the international potential of *Unānī* medicine in the digital era. The release of this roadmap provides a policy-level framework that can guide further investment, research collaboration, and capacity-building initiatives focused on digital health integration in *Unānī* medicine [7].

India has already laid substantial groundwork for this transformation. Institutions such as the Central Council for Research in *Unānī* Medicine (CCRUM) and the National Research Institute of *Unānī* Medicine (NRIUM) have undertaken initiatives to develop standardized treatment guidelines, digitize classical manuscripts, and establish electronic databases of *Unānī* formulations [8].

Unānī medicine, empowered by digital technology, offers a promising bridge between ancient wisdom and modern science. This review aims to examine the scope of such integration, highlighting existing digital innovations, challenges, and potential frameworks to ensure that *Unānī* medicine evolves in harmony with modern technology while preserving its rich history and traditional values.

History and Evolution of *Unānī* Medicine

Unānī medicine has a long and fascinating journey that begins in ancient Greece. The story starts with Hippocrates (460-370 BC), often called the "Father of Medicine," who first introduced the idea that health depends on the balance of four basic fluids or humours—blood (Dam), phlegm (*Balgham*), yellow bile (*Safra*), and black bile (*Sawda*). When these humours are in harmony, a person remains healthy; when they are out of balance, disease appears. Hippocrates stressed careful observation of patients, accurate diagnosis, and trust in the body's natural ability to heal, which was a major shift away from superstition and magical cures [9].

Centuries later, Galen (129-216 AD), a famous Greek physician, expanded on Hippocrates' ideas. He gave detailed descriptions of anatomy, explained how organs worked, and classified diseases according to which humour was disturbed. Galen's (*Jalinus*) books became the main source of medical knowledge in Europe and the Middle East for more than a thousand years [10].

When the Greco-Roman world declined, this valuable knowledge was preserved and greatly enriched by Arab and Persian scholars during the Islamic Golden Age (8th-13th centuries). They translated Greek texts into Arabic, added their own discoveries, and developed new treatments. The most influential figure of this era was *Ibn Sina* (Avicenna, 980-1037 AD), whose famous work *Al-Qanun fi al-Tibb* (The Canon of Medicine) combined Greek knowledge with his own clinical observations and became one of the most widely used medical books in history. Other great scholars, like al-Razi (Rhazes) and *Ismail Jurjani*, also made important contributions. Together, their work came to be known as *Tibb-e-Unānī*—or "Greek Medicine"—showing both its Greek roots and Islamic development [11].

Unānī medicine entered India as early as the 8th century and reached its peak during the Delhi Sultanate and Mughal periods. The Mughal rulers supported the system by building hospitals (*Dar-ul-Shifa*), training physicians (*Hakims*), and translating medical texts into Persian. Over time, *Unānī* absorbed Indian herbs and local health practices, becoming a unique Indo-Islamic medical tradition [12].

Under British rule, *Unānī* medicine declined as Western medicine took centre stage, but dedicated reformers like Hakim Ajmal Khan fought for its revival. They established institutions, wrote books, and worked to include *Unānī* in modern education, keeping the tradition alive. [13] Today, *Unānī* medicine is officially recognized in India under the Ministry of AYUSH, with more than 200 colleges, research institutes like CCRUM, and a network of hospitals and dispensaries serving millions [14].

Unānī medicine's focus on diet, lifestyle, and natural remedies fits well with today's growing interest in preventive and holistic healthcare. Its concept of *Mizāj* (temperament) is similar to modern personalized medicine, which tailors' treatment to each individual. With the help of digital health tools, *Unānī* medicine is ready to meet the needs of the 21st century—bridging the wisdom of the past with the technology of the future.

Global Context and International Recognition

Traditional medicine is experiencing a renaissance globally, with increasing demand for complementary and alternative healthcare systems. According to the WHO, nearly 80% of the global population uses some form of traditional medicine [15, 16]. In this context, *Unānī* has the potential to become a recognized contributor to global health if it successfully integrates digital technologies.

India has taken significant steps in this direction by creating initiatives such as the Ayush Grid [17, 18], the National AYUSH Morbidity and Standardized Terminologies Electronic Portal (NAMASTE), and the Traditional Knowledge Digital Library (TKDL) [19]. These projects digitize medical records, enable telemedicine, and protect intellectual property from biopiracy [20]. Globally, organizations such as the European Society of Integrative Medicine and the US National Centre for Complementary and Integrative Health (NCCIH) are increasingly open to dialogue about integrating systems like *Unānī* with mainstream healthcare.

The recognition of India's AI-led initiatives in traditional medicine by the WHO in 2025 further strengthens *Unānī*'s international credibility [21]. Such acknowledgment provides an opportunity to align *Unānī* with global digital health strategies, ensuring it remains relevant in the future healthcare landscape.

Digital Innovations in *Unānī* Medicine

The digital revolution is transforming healthcare worldwide, and the Unānī medicine—grounded in the principles of humoral balance, temperament (Mizāj), and holistic care—

is actively adapting to this change. Emerging technologies such as electronic health records (EHRs), telemedicine, mobile health applications, artificial intelligence (AI), clinical decision support systems (CDSS), online learning platforms, and knowledge repositories like the Traditional Knowledge Digital Library (TKDL) are playing a pivotal role in standardizing practices, improving accessibility, enhancing patient outcomes, and ensuring that Unānī medicine remains relevant in the age of precision healthcare.

1. **Electronic Health Records (EHRs):** EHRs are one of the cornerstones of digital health, and their adoption within *Unānī* medicine has the potential to transform patient care. Traditionally, patient data in *Unānī* clinics has been recorded manually in registers or notebooks, which are often vulnerable to damage, loss, or inconsistent documentation [22]. An EHR is designed to store and manage health-related information securely and efficiently. It is used by healthcare providers to document, retrieve, and analyse a patient's medical data over time. These records not only store routine data such as diagnosis, treatments, and follow-up details but also include U*nānī*-specific elements like *Mizāj* (temperament), *akhlāt* (humours), and *tabayit* (natural states or innate power). Integrating EHRs into *Unānī* practice has greatly improved patient data handling and treatment monitoring. For example, an *Unānī* physician in Hyderabad has created a custom digital system that classifies patients according to their humoral imbalances, aiding in more accurate herbal treatment planning. This system not only improved diagnostic accuracy but also enabled practitioners to identify population-level patterns, such as seasonal variation in certain diseases or the most common *mizāj* among their patients [23]. The data also served as a valuable resource for research, allowing the clinic to publish evidence-based studies and improve its therapeutic protocols [24].
2. **Telemedicine:** Telemedicine has emerged as an essential tool for extending *Unānī* medicine beyond the walls of the clinic, particularly in rural and underserved areas. The COVID-19 pandemic accelerated the adoption of telemedicine across all medical systems, including *Unānī*, and demonstrated its ability to maintain continuity of care under challenging circumstances. Through teleconsultations, *Unānī* practitioners were able to assess symptoms, prescribe herbal formulations, and provide dietary and lifestyle guidance without requiring patients to travel. This was particularly valuable for chronic conditions like indigestion, arthritis, or stress-related disorders, which benefit from regular monitoring and adjustments to therapy. Government-based platforms such as AYUSH Sanjivani played a pivotal role in enabling these services. The platform enabled patients to consult *Unānī* physicians' online, receive e-prescriptions, and have medicines delivered through connected pharmacies [25, 26].
3. **Mobile Health (mHealth) Applications:** Mobile health applications are another powerful tool that can transform patient engagement in *Unānī* medicine. Apps are being designed for *Mizāj* assessment, personalized diet planning, treatment reminders, and self-monitoring of health parameters. Since *Unānī* medicine places a strong emphasis on preventive care, lifestyle modification, and regimental therapy (*Ilaj bit Tadbeer*), apps that encourage daily compliance can have a profound impact. For example, an mHealth app could allow users to answer a series of questions about their physical, mental, and behavioural traits, after which it determines their dominant *Mizāj*. Based on this, the app could provide tailored dietary recommendations (e.g., warm soups for a cold temperament), exercise suggestions, and reminders for sleep hygiene or detox therapies such as *Dalk* (massage) or Hammam (steam bath). Existing apps like AYUSH Kavach and Namaste Yoga already integrate elements of traditional medicine into digital platforms, but there is a need for dedicated *Unānī* apps that combine diagnostics, treatment tracking, and patient education [27, 28].
4. **Artificial Intelligence (AI):** AI is transforming *Unānī* medicine by introducing data-driven tools that enhance diagnosis and treatment accuracy, personalization, and efficiency. Traditionally, *Unānī* diagnosis relies on the subjective assessment of *Mizāj* (temperament), *akhlāt* (humors), lifestyle, seasons, and psychosomatic factors by experienced hakims. AI systems, however, can analyse vast datasets, detect patterns, and support clinical decision-making with greater precision and consistency. The integration of AI brings objectivity to *Unānī* practice while preserving its holistic principles [24, 28].
5. **Clinical Decision Support Systems (CDSS):** Building on Electronic Health Records (EHR) and Artificial Intelligence (AI) technologies, a 2023 preprint describes CDSS platforms being developed to assist practitioners in diagnosis and treatment planning. A typical CDSS takes patient data—symptoms, *Mizāj* classification, past medical history—and uses algorithms to suggest possible diagnoses and treatment protocols based on classical *Unānī* literature. These tools provide probable diagnoses and *Unānī* treatment suggestions by utilizing modules such as decision trees, deep learning, and natural language processing (NLP) to enhance diagnostic consistency and accessibility. For example, a prototype developed by Indian researchers used deep learning to analyse symptom clusters and identify temperament-linked treatments, particularly in chronic female disorders. Such systems are particularly valuable for early-career practitioners who may not have decades of experience. They act as a "digital mentor," guiding decision-making and reducing the likelihood of error. In the long run, CDSS can also serve as a tool for generating real-world evidence by comparing recommended treatments with patient outcomes and feeding this information back into the system for continuous learning [28].
6. **Online Education and Certification:** Another significant area of digital innovation is online education. The demand for *Unānī* medicine training is increasing not only within India but also among international students who wish to learn about holistic healthcare systems. E-learning platforms now offer virtual lectures, case-based discussions, and even simulation-based learning modules that allow students to practice diagnostic reasoning. Online certification programs have made *Unānī* education more accessible by offering short courses to healthcare professionals, researchers, and interested learners around the world. They also provide continuing medical education (CME)

for registered practitioners, helping them stay updated on new research, changes in pharmacopeia, and the use of digital tools.

7. **Traditional Knowledge Digital Library (TKDL):** The Government of India's Traditional Knowledge Digital Library (TKDL), launched in 2001 under a joint project by the Council of Scientific and Industrial Research (CSIR) and the Ministry of AYUSH, is a pioneering example of digitally preserving and promoting ancient classical *Unānī* formulations to prevent biopiracy and enable global accessibility. The library has digitized more than 100,000 formulations from Ayurveda, Yoga, *Unānī*, Siddha, and Homoeopathy systems, translating them into five international languages and making them available to patent examiners worldwide. This initiative has prevented numerous cases of biopiracy, where multinational corporations attempted to patent medicinal uses of plants or formulations that were already described in classical texts. By protecting intellectual property, TKDL not only preserves cultural heritage but also opens doors for legitimate collaboration between *Unānī* researchers and pharmaceutical companies for new drug discovery [29, 30].

Challenges in Digitizing Unānī Medicine

Regulatory and Policy Ambiguity

Many countries lack clear frameworks for the digital practice of traditional medicine. Cross-border telemedicine may violate national drug laws, and online sales of Unānī formulations may face import restrictions. Formal recognition of *Unānī*'s digital tools is often missing from health policy. The absence of a uniform digital regulatory system for traditional medicines leads to confusion about legality and safety, especially in online consultations and sales [31].

Digitization and Accessibility

A major hurdle is the lack of digitized classical *Unānī* literature and ancient knowledge. Many ancient manuscripts remain untranslated or unavailable online, limiting their reach. For example, the extensive works of Avicenna, *Jurjāni*, and Zakriya Razi are still not fully digitized, making it difficult to integrate *Unānī* knowledge into modern digital platforms.

Data Quality, Validation, and Interoperability

Digital translation of ancient texts risks inaccuracies. Variability in *Mizāj* classification and diagnostic terms across institutions makes standardization difficult. A major barrier is the lack of standardized digital taxonomies and ontologies for Unānī concepts, which hinders interoperability with mainstream health information systems such as SNOMED-CT (Systematized Nomenclature of Medicine-Clinical Terms) or ICD-11(International Classification of Diseases) [32].

Quality Assurance and Standardization

The growth of online markets has made it harder to ensure the quality and authenticity of *Unānī* formulations. Without proper regulations, counterfeit and low-quality products—like imitation versions of the well-known '*Majun*'—are easily sold online, posing risks to consumer health and trust [33].

Tech Integration with Traditional Systems

Merging *Unānī* principles with modern diagnostic tools and electronic health records is complex. Developing AI-driven tools based on *Unānī* diagnostics requires a nuanced understanding of both ancient theory and modern technology [34].

Education and Public Awareness

Limited public knowledge, misconceptions, and lack of awareness hinder wider adoption of *Unānī* practices. Online educational programs, webinars, and courses can help bridge this gap. Digital platforms are beginning to address this need by offering structured learning on traditional medical systems [33].

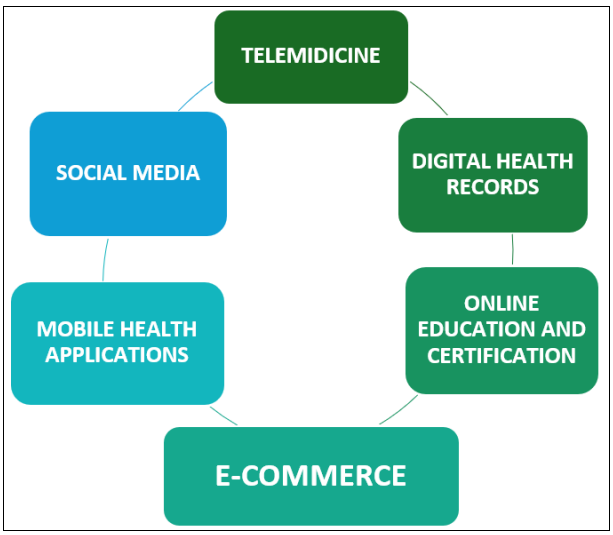
Lack of Research and Funding

Compared to modern systems, *Unānī* lacks substantial funding for digital health research. Limited academic interest in IT-*Unānī* integration has slowed innovation. Without robust digital infrastructure, CDSS tools or mobile health apps remain in pilot phases [17].

Innovation and Scientific Validation

Unānī medicine lacks sufficient modern research to support its clinical claims. This affects its credibility within the global medical community. Collaborative studies—such as those exploring the anti-inflammatory effects of 'Sharbat-e-Deenar'—highlight the need for more evidence-based research [35].

Emerging Opportunities and Future Directions



1. **Telemedicine:** Remote consultations via video calls, mobile apps, and web platforms enable *Unānī* physicians to reach patients in distant areas, reducing travel time and ensuring continuity of care, particularly for elderly and chronically ill patients [36,37].
2. **Artificial Intelligence (AI):** AI-based tools can assist practitioners in diagnosis, *Mizāj* (temperament) assessment, predicting treatment outcomes, recommending herbal formulations, and digitizing classical texts, thereby enhancing scientific validation and personalized care [38].
3. **Online Education & Certification:** E-learning platforms offering webinars, training modules, and certification courses make *Unānī* knowledge widely accessible, improving educational quality and professional competency among students and practitioners [39].
4. **Digital Health Records (EHRs):** Electronic health records allow storage of patient histories, monitoring of long-term outcomes, support for evidence-based research, and provision of structured case studies for medical students and researchers [36, 40].
5. **Mobile Health Applications**: Apps based on *Unānī* principles can deliver health tips, treatment reminders, diet charts, and lifestyle advice, empowering users to manage their health and follow personalized regimens [41].
6. **Research & Collaboration Platforms:** Digital ecosystems enable seamless sharing of clinical data, collaborative trials, and comparative studies, strengthening the scientific foundation and global credibility of *Unānī* medicine [42].
7. **Social Media Outreach**: Platforms like YouTube, Instagram, Facebook, X (Twitter), and Telegram provide opportunities for practitioners to share health tips, success stories, and live sessions, increasing public awareness and acceptance of *Unānī* medicine [43].
8. **E-Commerce for *Unānī* Products:** Online marketplaces expand the reach of *Unānī* medicines and wellness products worldwide, providing consumers with detailed information, reviews, and secure access to authentic formulations [44].
9. **Wearables & Remote Monitoring:** Devices such as smartwatches and fitness bands can track vitals, sleep, and digestion, offering insights into temperament imbalances and guiding lifestyle adjustments in line with *Unānī* principles [45].
10. **Integration with AYUSH Digital Platforms:** Participation in government digital health missions like ABDM (Ayushman Bharat Digital Mission) ensures visibility of *Unānī* practitioners in national registries and strengthens continuity of care through digital health IDs [46].
11. **DICOM & Medical Imaging:** Advanced imaging tools like MRI, CT-Scan, USG, and X-ray can be integrated into *Unānī* hospitals, making diagnosis more precise and improving clinical outcomes when combined with traditional approaches [47].
12. **Digital Publishing of Classical Texts:** Ancient manuscripts by scholars such as Ibn Sina and Al-Razi can be digitized, translated, and annotated, making centuries-old *Unānī* wisdom globally accessible for modern education and research [19].
13. **AI Diagnostics & Ayur genomics:** Combining genomics, machine learning, and temperament-based assessment can enhance predictive, preventive, and personalized healthcare within the *Unānī* framework [19, 34].
14. **Public-Private Partnerships:** Collaboration between AYUSH bodies, universities, and tech companies can generate funding, create digital tools, and accelerate innovation, helping *Unānī* medicine adapt to the demands of modern healthcare [48].

Conclusion

Digital health tools offer an unprecedented opportunity to revolutionize *Unānī* medicine. By aligning its personalized, holistic philosophy with modern technologies like AI, telemedicine, and EHRs, *Unānī* medicine can position itself as a relevant and credible healthcare system for the 21st century. However, the path forward requires addressing regulatory gaps, standardizing data, ensuring ethical AI use, and expanding digital literacy among practitioners and patients. A coordinated strategy involving policymakers, researchers, technologists, and *Unānī* practitioners will

ensure that *Unānī* medicine not only retains its unique identity but also contributes significantly to the global digital health revolution.

Conflict of Interest
Not available

Financial Support
Not available

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How to Cite This Article
Luqman F, Shahid M, Zubair M, Fatima G, Tahir M, Siddiqui ZA Digital health tools in Unānī medicine: Possibilities and challenges. International Journal of Unani and Integrative Medicine. 2025;9(3):21-27.