TCM+AI: Ancient yet young science, the convergence of traditional wisdom and technological development

Yonghong Liu

School of Automation, Wuhan University of Technology, Wuhan, China

Abstract

This paper systematically explores the strategic position and cultural value of traditional Chinese medicine (TCM) as a unique medical system. By comparing the differences in cultural models between TCM and Western medicine, this paper analyzes the philosophical basis of "harmony between man and nature" and the value orientation of "people-oriented" in TCM. Combined with the comparison of three groups of techniques: minimally invasive surgery/acupuncture, stethoscope/pulse diagnosis, and braces/cupping, it clarifies the scientific connotation of TCM. Take artemisinin winning the Nobel Prize as an example to demonstrate the achievements of modernizing TCM, propose the integrated development model of "AI+TCM", and finally present the scale of the TCM hospital service system through national statistical data. The article points out that TCM will achieve a new round of leaps with the support of scientific and technological innovation.

Keywords: Traditional Chinese medicine, Western medicine, AI-TCM

1. Introduction

As an indispensable medical system in the world, traditional Chinese medicine (TCM) has a long history of development but has evolved slowly, in sharp contrast to Western medicine. This difference essentially stems from the distinct cultural patterns of the two civilizations: TCM adopts a "snake-like advancement" strategic approach emphasizing the holistic view, while Western medicine relies on scientific and technological means to achieve precise impact. Despite the different paths, both serve the common goal of human health. Currently, TCM is at a critical period of modernization transformation and needs to explore its unique value through technological innovation. This article analyzes from the dimensions of cultural philosophy, technical comparison, and modern cases to discuss the development path and innovation possibilities of TCM in contemporary society.

2. A Comparison of the development characteristics of TCM and Western Medicine

In the globalized medical landscape, TCM, as a medical system with a profound historical heritage,

has a distinct development trajectory that contrasts sharply with Western medicine. In the world, TCM is a major category of medicine that cannot be ignored. Its development has a long history, but the pace of development has been very slow; in contrast, Western medicine is exactly the opposite, that is, it has a short development history but a very fast development speed. TCM has accumulated practices over thousands of years and has formed a theoretical system centered around classics such as "*The Yellow Emperor's Inner Classic*" and "*On Febrile and Miscellaneous Diseases*". Its development is like the convergence of rivers, emphasizing the inheritance of experience and the construction of the holistic view, and the evolution rhythm is more stable. Western medicine, relying on the rapid rise of the modern scientific revolution, achieved “leap-type” development through breakthroughs in fields such as anatomy and microbiology. Its innovation speed is like exponential growth, emphasizing standardization and verifiability.

As a Chinese, it is inevitable to com into contact with TCM, which permeates people’s daily lives and is beneficial to the body. This leads people to mistakenly believe that TCM is merely a common practice. However, the actual situation is quite the opposite. Traditional Chinese medicine plays a dominant role in terms of experience, but it also prompts us to study the laws and diversity of its effects.

3. Two different cultural patterns

The fundamental difference between TCM and Western medicine lies in the difference of cultural models. In fact. TCM is both an ancient science and a cultural paradigm. From its strategic vantage point, TCM employs “snake slithered” to address human diseases, and emphasize the coordination of the human body system. In contrast, western medicine’s weakness in medical research lies in its holistic perspective. However, Western medicine also represents a cultural model that utilizes scientific methods to directly tackle human ailments, and achieve precise intervention.

However, scientific research requires that in the field of medicine, neither TCM nor Western medicine should be given undue emphasis. Although there are differences in their cultural models, such differences should not be regarded as the root cause of opposition but rather as an indication of the diverse development of medicine. To be fair, the controversy over TCM - the issue of its scientific nature - if there is no definite conclusion at present, will eventually be resolved soon. As for the cultural role of TCM, the reasons are sufficient. The uniqueness of TCM lies in the overall thinking of Chinese civilization it carries, which provides an important supplement to modern medicine. Indeed, the achievements of TCM are abundant. It has uniqueness and adds color to our dull life and healthy body.

4. The contemporary interpretation of the philosophical foundation of TCM

The philosophical thought embodied by TCM is "harmony between heaven and man", which means the harmonious unity of the human body and nature. Specifically, based on the theory of Yin-Yang and Five Elements, the key viewpoint is that the key to human health lies in the balance of Yin and Yang. This theoretical system is closely integrated with the ancient simple dialectical

thought, and through thousands of years of inheritance, has formed unique diagnostic and treatment methods (see [**4**]), such as the four diagnostic methods of "observation, auscultation and olfaction, inquiry, and palpation", and acupuncture treatment methods. During diagnosis and treatment, attention is paid to the interrelationships of various systems in the human body, and a systematic analysis of physiological, psychological and social environmental factors is conducted, such as analyzing symptoms, tongue coating, pulse conditions, climate and other information to classify diseases into different types for treatment, and considering individual differences. This approach is like the educational philosophy of "teaching according to individual aptitude".

5. The value orientation of TCM

TCM is not merely a medical system; it is also a cultural phenomenon that embodies the essence of Chinese culture. The most interesting aspect is that TCM has a humanistic approach. For instance, ancient physicians such as Sun Simiao proposed the concept of "Great Doctor with Pure Integrity", which requires practitioners to possess noble moral character and excellent medical skills. This indicates that in the culture of TCM and herbal medicine, there is a value orientation of "putting people first", which is consistent with the current scientific development concept.

6. Three sets of technical comparisons and insights

6.1. Minimally invasive surgery and acupuncture

Take "minimally invasive surgery" as an example (see Figure 1(a)). I will summarize it in one sentence. This advanced surgical method has significant advantages over traditional open surgery and greatly improves surgical safety and patient experience. As a comparison, "acupuncture" (see Figure 1(b)) can actually be called "minimally invasive surgery", but it should be noted here that the needle used for infusion only reaches the blood vessels or muscles and serves as an injection mechanism, while acupuncture is different. Its function is to stimulate specific acupoints and directly regulate the body's qi and blood. In this sense, acupuncture is also minimally invasive surgery. The former is "a tiny incision" which can also be regarded as "a small thread", while the latter is "a point". The former has a "high-tech" feel and is completed with the assistance of precise instruments such as laparoscopes and endoscopes, and through the display screen, surgical operations can be effectively reduced in terms of tissue damage and intraoperative bleeding. The operation of acupuncture involves professional techniques and tools, and requires precise mastery of the location of the acupoints and the insertion technique. And the "insertion technique" can be learned through AI machine learning.

(a) **(b)**

Figure 1. (a): Minimally invasive surgery and (b): Acupuncture

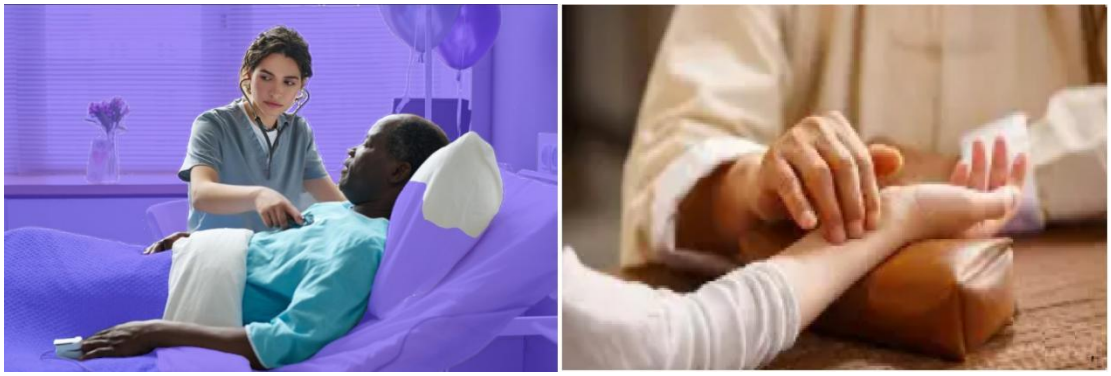
6.2. Stethoscope and pulse-taking

Modern medicine originated with the invention of the stethoscope (see Figure 2(a)). Since its application in clinical practice in 1817, there have been continuous improvements in its appearance and sound transmission method, but the basic structure has remained relatively unchanged, mainly consisting of the sound-receiving part (chest piece), the transmission part (rubber tube), and the sound-receiving part (ear piece). From acoustic stethoscopes to electronic stethoscopes, there have been developments such as camera-equipped stethoscopes, Doppler stethoscopes, and Bluetooth stethoscopes, etc.

Pulse-taking, also known as pulse diagnosis (see Figure 2(b)), was pioneered by Fan Yu, and it was the earliest diagnostic technique used in China. In ancient times, there were three-part nine-meridian diagnostic methods, including the diagnosis of the Ren Meridian, the Cunkou Meridian, and the Fu Yang Meridian, as well as the Cunkou Meridian diagnosis method, etc. Later generations mainly relied on the Cunkou Meridian diagnosis method and classified it based on the position, frequency, characteristics, and form of the pulse, such as the 24 Meridians (from "*The Pulse Classic*"), 27 Meridians (from "*The Pulse Formula of Binhu*"), 28 Meridians (from "*The Correct Eye of the Doctor*"), 30 Meridians (from "*The Essentials of Diagnosis for Doctors*"), 32 Meridians (from "*The Three Wonders of Diagnosis*"), etc. The current practice mostly follows the 28 Meridians (see [**3**]). Pulse diagnosis is a diagnostic method used by TCM to feel the patient's pulse with their fingers, to perceive the image of the pulse movement, in order to understand the condition and determine the disease syndrome. The formation of the pulse pattern is directly related to the beating of the heart, the smoothness of the pulse channel, and the balance of qi and blood. The blood vessels in the human body run through the entire body, connecting the internal organs, reaching the skin surface, circulating qi and blood, and flowing continuously. Therefore, the pulse pattern can reflect the overall condition of the internal organs, vital energy, and spirit of

the entire body.

The common feature of stethoscopes and pulse-taking is that they serve as windows for observing or identifying changes in internal functions, providing important evidence for diagnosing diseases. In fact, they both rely on the same physical principles.



(a) **(b)**

Figure 2. (a): Stethoscope and (b): Pulse-taking

6.3. Braces and cupping therapy

Dental orthodontics, commonly referred to as "braces" (see Figure 3(a)), is medically known as orthodontic treatment. It involves the use of various types of orthodontic appliances (such as braces) to correct abnormal tooth alignment, malocclusion, and dental arch imbalance, which are all types of dental and jaw deformities.

The cupping therapy uses negative pressure to adhere to the skin (see Figure 3(b)), stimulating the dilation of local capillaries, accelerating blood flow, and promoting metabolism. It helps to eliminate blood stasis and reduce edema. It is suitable for the recovery after sports injuries or injuries caused by falls and impacts. The warm effect produced by the adhesion can disperse internal cold and dampness, alleviate joint pain and muscle stiffness caused by wind-cold, such as shoulder periarthritis and cervical spondylosis. Applied to meridians and acupoints (such as back-Yu meridians, Zusanli), it can regulate the circulation of qi and blood, improve internal organ functions, and has certain auxiliary effects on chronic fatigue, insomnia, and digestive disorders.

Westerners are only familiar with teeth straightening, but not with cupping therapy. If westerners believe that braces can have a corrective effect, they would also accept cupping therapy, as it is scientifically sound. Although their physical principles are different, they both fall under the category of physical treatment methods.

(a) **(b)**

Figure 3. (a): Braces and (b): Cupping therapy

6.4. Revelations

The three sets of technical comparisons reveal the complementarity of TCM and Western medicine:

(i) Minimally invasive surgeries and acupuncture, although performed differently, both achieve regulatory functions through minimal intervention.

(ii) Stethoscopes and pulse-taking both monitor changes in internal functions based on physical principles.

(iii) Braces and cupping therapy, both being physical therapies, reflect the differences in the acceptance of treatment techniques among different cultures.

7. Moving towards modern medicine: A famous example of TCM

Tu Youyou [**1**], the Nobel Prize winner in Physiology or Medicine in 2015, discovered and extracted artemisinin (chemical formula: $C_{15}H_{22}O_5$) from Artemisia annua. It is an endoperoxide of the sesquiterpene lactone, and this drug can effectively reduce the mortality rate of malaria patients. In fact, it has been used in China to treat malaria for more than two thousand years. The extraction solvent for artemisinin is ether, with an inhibition rate of 100%, instead of being extracted by boiling water. Tu Youyou is the representative of the Beijing Institute of Traditional Chinese Medicine, who discovered anti-malaria Chinese herbal medicines. In 1975, the chemical structure of artemisinin was determined by X-ray diffraction method. The *Chinese Science Bulletin* published the first paper on the chemical structure and relative configuration of artemisinin in 1977. Different from previous anti-malaria drugs, the main mechanism of action of artemisinin against malaria is to interfere with the functions of the membrane mitochondria and other structures of the malaria parasite. It first acts on the food vacuole membrane, the outer membrane, and the mitochondria, and then acts on the nuclear membrane and the endoplasmic reticulum, and has a certain impact on the chromatin in the nucleus. Eventually, it leads to the complete disintegration of the parasite structure, rather than relying on interfering with the folic acid metabolism of the malaria parasite. Wang et al. synthesized chemical probes based on the chemical structure of artemisinin using chemical proteomics technology in 2015, accurately identified 100+ protein targets of artemisinin in the malaria parasite, and determined that the activation of artemisinin depends on the large amount of heme generated in the malaria parasite.

8. TCM+AI: Exploration of modernization paths

The success of artemisinin has verified the feasibility of modernizing TCM. It can be said that AI + TCM is a brand-new scientific field (see Figure 4). Although no foreign research teams are participating in the competition, it should not be forgotten that there are Western medicine as a reference coordinate. Whether it is TCM or Western medicine, their common goal is to continuously improve the treatment effect, making it both cost-effective and successful in curing diseases, and providing high-quality services to patients. Since TCM has accumulated a large amount of data and experience, this provides a very good intelligent platform for AI. What we will present not only includes macroscopic qualitative aspects, but also microscopic quantitative aspects. Therefore, on the one hand, we will invent and create new scientific instruments and equipment to meet the research needs of TCM; on the other hand, we will use scientific methods or means to develop TCM, opening up a channel with Western medicine, just like artemisinin (chemical formula: $C_{15}H_{22}O_5$). Through AI, we will achieve a perfect combination of TCM and Western medicine, fully developing their respective specialties, and better benefiting all mankind.

Figure 4. AI-TCM intelligent agent (Produced by AI)

9. National data

According to the statistics from the National Bureau of Statistics (NBS): In 2023, there were 5,053 TCM hospitals in China, with 35.0897 million inpatient visits and 679 million outpatient visits. In the integrated Chinese and Western medicine hospitals, there were 4.199 million inpatient visits and 92 million outpatient visits. The number of high-tech research and development institutions for the manufacturing of Chinese patent medicines was 809, and the output of Chinese patent medicines was 235,180 tons, with 12,200 tons of Chinese patent medicines exported in [**2**].

We haven't yet touched upon rural health centers and street health centers. In this field, there is no

effective method that can be successfully exported to other countries. Of course, it will take time before Westerners also accept TCM. But as long as we enhance the scientific research in this field, it won't take long before we can make a leap based on this foundation.

10. Concluding remarks

As an "ancient yet young science", TCM is making innovative breakthroughs through the application of modern technology. By strengthening the research on the integration of traditional and Western medicine and improving the standardization system of TCM, it will make greater contributions to the cause of human health. With the empowerment of new technologies such as AI, TCM is expected to achieve modernization transformation while maintaining its characteristics, and usher in a new stage of development.

References

[1] Youyou T. The discovery of artemisinin (qinghaosu) and gifts from Chinese medicine. *Nat*. *Med*. **17**, 1217-1220 (2011)

[2] National Bureau of Statistics. National Data on Services Provided by Traditional Chinese Medicine Hospitals in 2023.

[3] Fan Q. Pulse classic. Beijing: China Pharmaceutical Publishing House. 45-78 (2010)

[4] Simao S. Thousand gold prescriptions. Shanghai: Shanghai Ancient Books Publishing House. 112-135 (2008)