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Review

Chinese Medicine in the Management of New and Emerging Infectious Diseases

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ABSTRACT

Emerging infectious diseases are an important problem in medicine, and many continue to pose a global threat. However, the management of new and emerging infections is usually difficult due to a lack of knowledge and tools to address the problem. The use of Chinese medicine to manage new and emerging infectious diseases, however, has attracted significant attention. This brief article summarizes and discusses the use of Chinese medicine in the management of new and emerging infectious diseases.

1 Introduction

Infection is an important problem in contemporary medicine. There are many pathogens, including parasites, bacteria, viruses and fungi, which can cause disease in humans. Sometimes, new infections caused by previously non-pathogenic organisms occur and become new problems in medicine. A single case report can signal the outbreak of a new and emerging infection, and often serves as a warning to anticipate future outbreaks [1], which is an important problem in contemporary medicine, with many infections continuing to pose a global threat. Within the past decade, several outbreaks of new and emerging infectious diseases have occurred. Examples include Zika virus infection, swine flu, bird flu, Middle East respiratory syndrome (MERS), and severe acute respiratory syndrome (SARS). Managing these new emerging infectious diseases has become a widely discussed issue in medicine, and there have been several attempts to find the most effective treatment and management strategies.

The management of new and emerging infection(s) is usually difficult due to a lack of knowledge and available tools to address the problem. In the initial stages of disease emergence, medical personnel are usually aware of the nature of the infection. However, it takes considerable time to conduct rigorous disease

investigation and confirm the exact cause of the new emerging infection [2]; even more time is usually required for the development of diagnostic and therapeutic tools [2]. Searching for new therapies against new emerging infections is a critical step in management strategies. The use of Chinese medicine in this regard has become an interesting avenue of investigation. In this brief article, the use of Chinese medicine in the management of new emerging infectious diseases is summarized and discussed.

2 Chinese Medicine as a New Tool for Fighting Infectious Disease

Chinese medicine is actually a valuable derivative of Asian wisdom. Given its long history, Chinese medicine has been successfully used in the management of several diseases, including infections, for many thousands of years. There is little doubt that Chinese medicine is a source of "hidden gems" for the management of several diseases. In modern medicine, a representative example of applied Chinese medicine in the management of emerging infection is the case of classical drug-resistant malaria. Malaria is a prevalent tropical mosquito-borne infection that is common in several tropical countries around the world. The use of classical quinine antimalarial drug has been recommended for decades. Nevertheless, due to poorly controlled drug use in many developing tropical countries, the emergence of drug-resistant malaria has occurred [3]. The problem was initially encountered in Southeast Asia [3], and the search for a new drug became an important issue. Finally, the success in finding a new drug against classical antimalarial drug-resistant malaria was based on the reappraisal of a Chinese medicine regimen. "*Artemisinin* (Qing Hao Su, 青蒿素)" is a traditional Chinese herb with proven antimalarial activity [4], and is effective against classical antimalarial drug-resistant malaria. In fact, the new antimalarial drug, artemisinin, was successfully developed from *Artemisinin* (Qing Hao Su, 青蒿素) [5]. Presently, artemisinin is the drug of choice for management of classical drug-resistant malaria in tropical medicine [6]. The classical example of *Artemisinin* (Qing Hao Su,青蒿素) leaves little doubt that Chinese medicine can play a significant role in the management of new and emerging infectious diseases.

3 Chinese Medicine for the Management of New and Emerging Infectious Diseases

As mentioned, an increased role for Chinese medicine in the management of new and emerging infectious diseases can be anticipated, and some reports describing its use have already been published.

3.1 Chinese medicine for emerging influenza

There are many new emerging cross-species influenza infections. In the past few years, the typical emerging influenzas are usually a serious zoonotic influenza that repeatedly occurs, with bird flu being a well-known example. As an avian-related disease, control of poultry farming is the current standard of practice against bird flu due to the lack of effective antiviral therapy, which makes the management of emerging bird flu problematic. Applications for Chinese medicine have, however, been found in this context. Chang et al. [7] noted that "Traditional Chinese Medicine de novo derivatives may be suitable candidates of dual-targeting drugs for influenza". The authors also noted the use of standard modern Chinese medicine databases as a basic tool for new Chinese medicine-based drug discovery against new and emerging influenzas [8].

Of several Chinese medicine regimens, the use of the edible bird's nest (EBN) has been widely proposed for its possible effectiveness against new and emerging influenzas, and its utility has been extensively studied. Haghani et al. studied the "*in vitro* and *in vivo* mechanism of immunomodulatory and antiviral activity of EBN against influenza A virus infection [9]. Immunomodulation via cytokine induction due to EBN has been reported [10]. Haghani et al. [11] commented on "the potential of EBNs as supplementary medication or alternative to antiviral agents to inhibit influenza infections".

In addition to EBN, the efficacy of ginseng against emerging influenza has also been intensively studied. In an experimental animal study, Dong et al. [12] found that "treatment of mice with *ginsenosides* (Ren Shen Zao Dai, 人参皂甙) protected the animals from lethal 2009

pandemic H_1N_1 infection and lowered viral titers in animal lungs", and concluded that "the interference in the viral attachment process subsequently minimizes viral entry into the cells and decreases the severity of the viral infection" [12].

Interestingly, the use of Chinese medicine for the management of influenza is currently a common practice. At present, Lian Hua Qing Wen capsule (LQC) is a common Chinese medical preparation containing flavonoids, phenylpropanoids, anthraquinones, triterpenoids and iridoids, and is widely used to treat viral influenza [13, 14].

3.2 Chinese medicine for SARS

SARS is another important emerging viral infection caused by a coronavirus (CoV), and leads to severe respiratory disease. To date, there is still no effective antiviral drug against SARS. There have been many recent reports describing Chinese medicine regimens for the management of SARS. Wen et al. [15] studied "Traditional Chinese medicine herbal extracts of Cibotium barometz, Gentiana scabra, Dioscorea batatas, Cassia tora, and Taxillus chinensis" and found that the extract could inhibit SARS-CoV replication.

LQC has also been used to treat and manage an outbreak of SARS [13]. According to the SARS crisis, Leung analyzed the role of Chinese medicine and reported that "the results revealed positive but inconclusive indications about the efficacy of the combined treatments using Chinese medicine as an adjuvant" [16]. The author also reported that "positive effects using adjuvant herbal therapy included better control of fever, quicker clearance of chest infection, lesser consumption of steroids and other symptoms relief" [16].

3.3 Chinese medicine for Zika virus infection

Zika virus infection is a current problem globally. It can induce severe neurological complications and cause abnormalities in infants born to infected mothers. The disease is widespread in several tropical countries and there have been many imported cases to non-tropical countries. The Zika virus can be transmitted by a mosquito vector and, therefore, is difficult to control; the disease can also be sexually transmitted, and management using an antiviral drug is currently not an option. A role for Chinese medicine in treating Zika virus infection has been investigated. The first imported case of Zika virus infection in China was successfully managed with the concurrent use of Chinese medicine [17].

4 Future Perspectives

The utility of Chinese medicine in the management of new and emerging infectious diseases in the future has become an important question. Chinese medicine has, to a large extent, been modernized, and systematic knowledge and education have been established. As a junction between new and classical wisdom, modernized Chinese medicine can be a useful tool in the management of health problems. Standard pharmacological studies investigating traditional Chinese medicine (TCM) regimens will lead to new answers and solutions to new emerging infections. With the use of new technologies, such as biochemio informatics and medical nanotechnology, searching for new drugs based on classical Chinese medicine and the development of new formulations of Chinese medicine-based drugs can be expected in the near future (Table 1).

Newly developed digital computational databases have facilitated the search for appropriate candidates for further drug studies and development, and the subsequent integration of biochemio informatics is anticipated. Focusing on the use of biochemio informatics, the role of a digital online in silico approach for the characterization of active ingredients in Chinese medicine formulations and prediction of further drug-target interactions can be performed, which can help support standard *in vitro* and *in vivo* studies. Subsequently, pharmacogenomics can also be helpful in assigning newly developed drug alternatives to an appropriate target group. International collaboration in new drug research and discovery will become important to the future success of modernized Chinese medicine in the management of new and emerging infections [18].

Table 1 Computational technologies in digital Chinese medicine for searching for new drug search and fighting new and emerging infectious diseases

Computational technology	Usefulness
Computational database	Collection of data
	Clinical pharmacological resources
	Toxicological resources
	Disease classification system
Bioinformatics	Pharmacogenetic investigation
	Microbial genetic investigation
	Molecular visualization
	Molecular interaction docking
	Interaction expression analysis

5 Conclusion

Research on digital Chinese medicine is a systemic project of substantial size and complexity. Stratifying it into clinical branches can reduce its difficulty and shorten the time required, in turn speeding up academic research on the modernization of TCM. It is hoped that synergistic development of the ophthalmic syndrome differentiation system and digital Chinese medicine can provide new perspective into the digital development of other clinical TCM branches.

Table 2 Chinese medicines applied against new and emerging infectious diseases

Phase	Clinical science	Medical science
Diagnosis	History and symptomatic data collection	Laboratory investigation
	Chinese medicine clinical examination	Disease surveillance system
	Western medicine clinical examination	
	Disease classification	
Treatment	Chinese medicine regimen	Microbiological monitoring
	Western medicine regimen	Pharmacological monitoring
	Clinical monitoring	Pathological monitoring
		Toxicological monitoring
Prevention	Preventive Chinese medicine regimen	Pharmacological monitoring
	Preventive Western medicine regimen	Toxicological monitoring
Research	Standard clinical trial	Medical quality engineering
		Medical bioengineering
		Biochemioinformatics
		Nanotechnolology

Competing Interests

The author declares no conflict of interest.

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中医药治疗新型急性传染病

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【摘要】急性传染病是医学中的一个重要问题，许多仍然构成全球威胁。 但是，由于缺乏解决问题的知识和工具，对新发感染及其管理通常更加困难。本文简要总结并讨论了中医药在治疗新型急性传染病中的应用，以期为临床提供参考。

【关键词】中医；急性；传染病；预防；治疗