Analysis and reflection on the current situation of informatization construction in tertiary TCM hospitals in China

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Abstract. In order to understand and master the current situation of the informatization construction in tertiary TCM hospitals in China, measures to develop the informatization of TCM hospitals were studied and put forward. An online survey on the informatization construction of TCM hospitals in 2018 was carried out through the information system, and effective data of 487 tertiary TCM hospitals for descriptive statistical analysis were collected. The results show that the information infrastructure construction in China's tertiary TCM hospitals is different, with the eastern part being better. The business application information system is based on clinical service. The connectivity of information platforms and the application of new technologies need to be strengthened. The conclusion is that the tertiary TCM hospitals should pay attention to construction of infrastructure and improve awareness of information security, build TCM characteristic system, strengthen system operation and maintenance; as well as attaching importance to application of standards and norms and improve the connectivity of the platform; and importance to the introduction of new technology to facilitate the construction of smart TCM hospitals.

1. Introduction
Informationization of TCM is an important technical guarantee for revitalization, inheritance and innovative development of TCM [1], supporting the construction of TCM service system. In recent years, Substantial progress has been made in the informatization construction of TCM. Competent departments of TCM at all levels have paid more and more attention to informatization construction, and put forward specific and specific requirements for informatization construction in the strategic planning, guiding opinions and engineering projects of the development of TCM. Only by attaching great importance to the construction of hospital informationization can we guarantee the standardization and scientization of hospital management, promote the construction of modern hospital, and steadily stabilize the social and economic benefits of hospital. Based on the 2018 information construction data reported by the tertiary TCM hospitals, this paper analyzes the current situation and existing problems of information construction of China's tertiary TCM hospitals, so as to understand and master the overall level of the informatization construction of TCM hospitals, and provide ideas and references for the research and formulation of the 14th five-year Plan for the informationization development of TCM.
2. Data sources and research methods

2.1. Data sources
Based on the research and design of "questionnaire on the status quo of informatization construction in TCM hospitals", the baseline survey information system was applied to carry out an online survey on the informatization construction of national tertiary TCM hospitals (including integrated traditional Chinese and Western medicine hospitals and ethnic medicine hospitals). The survey statistical time was from January 1, 2018 to December 31, 2018, and a total of 487 tertiary TCM hospitals nationwide were collected 225 in the eastern region, 126 in the central region and 136 in the western region.

2.2. Research contents and methods
The Questionnaire on the Informatization construction of TCM hospitals mainly includes six parts: basic information of hospitals, informatization construction level of hospitals, informatization service level of hospitals, informatization management level, informatization innovation and development, informatization problems and suggestions. This paper mainly studies the hospital information infrastructure, business application information system, information platform construction level, new technology application and other information construction. Based on the baseline survey data, a special database of tertiary TCM hospital informatization construction was established. Excel 2010 and SPSS 22.0 were used to conduct statistical analysis on the collected survey data, and the analysis results were presented in the form of written expression, bar chart, column chart and table.

3. Result

3.1. Information infrastructure construction
The investigation on the infrastructure construction of the tertiary TCM hospital mainly includes the central computer room, server, storage, network bandwidth, etc. In terms of the construction of central computer room, 97.74% of hospitals have self-built central computer rooms, 99.11% in the eastern region, 96.83% in the central region and 96.32% in the western region. 1.44% of hospitals have rented cloud servers for construction. In the self-built central computer rooms, 98.56% of the hospital central computer rooms are equipped with UPS, 100% of the central computer rooms are equipped with UPS, and over 88.5% are equipped with fire prevention equipment, anti-static equipment and lightning protection equipment. In terms of server CPU, 46.00% of the hospitals had 10 ~ 50C CPU, and 8.21% had more than 200C CPU. As for storage equipment, 98.77% of them are specially equipped with storage equipment, of which the storage capacity is 21 ~ 50T, accounting for 32.02%. Only 6 hospitals have a capacity below 1T, distributed in the central and western regions. In terms of network bandwidth, the internal backbone network bandwidth of the hospital is mostly over gigabit, while the external network outlet bandwidth is 47.64% 100M. More than half of the hospitals have set up wireless network, 11.91% of the hospitals are in the process of building, 33.68% of the hospitals have not set up, the eastern region has the highest proportion of hospitals have set up wireless network, reaching 60.89%, and the western region has not set up the hospital reaching 37.50%. Among 487 third-level TCM hospitals, 297 hospitals had branches, among which 281 hospitals had network connection, 264 hospitals had dedicated line connection and 17 hospitals had Internet connection. The network connection bandwidth of 11 ~ 100M accounted for 44.13%, followed by 101M ~ 1G, accounting for 26.69%.

3.2. Business application system construction
In terms of information system construction, the top ten and the bottom ten of 487 hospitals' business application system construction rate are shown in the figure below. The hospital information integration platform, surgical anesthesia management system and critical care management system are the most urgently needed systems, accounting for 49.90%, 39.63% and 38.19%, respectively (Figure 1.2).
Figure 1. The construction rate of the hospital business applications ranked in the top ten.

Figure 2. The construction rate of the hospital business applications ranked in the bottom ten.

Characteristics of TCM and develop innovative application information system mainly use department and system content as shown in the table below, in the investigation of 487 tertiary hospital of TCM, the construction rate is higher in the Information system for treating diseases, accounting for 19.30%, followed by Chinese herbal decoction and quality control system, accounting for 11.70%, and the TCM inheritance and Innovation Service platform and TCM theory innovation support system for the construction of the rate is low(Table 1).

Table 1. The construction of TCM characteristic and inheritance innovative application information system.

| systematic name                          | use department                  | main content                                                                 | Construction rate |
|------------------------------------------|---------------------------------|-------------------------------------------------------------------------------|-------------------|
| Chinese herbal decoction and quality control system | Pharmacy, decocting room, Pharmacy and Pharmacy Department | Information statistics of substitute decoction, process management of substitute decoction | 11.70%            |
| Information system for treating diseases | Department of Physical Examination, Department of Treating diseases, Chinese Medicine Health Management Center | Filing, information collection, status identification, risk assessment, TCM conditioning, health intervention, information entry analysis and statistics | 19.30%            |
| TCM health care system                   | Health massage department       | TCM diagnosis and treatment in rehabilitation Department | 2.46%             |
| Chinese medicine rehabilitation management system | Rehabilitation department, acupuncture rehabilitation Department | TCM education, health care management | 8.42%             |
| Database of Ancient Chinese medicine books | All                             | Weipu periodicals and ancient books literature query statistics | 2.26%             |
| Database of TCM modern literature        | All                             | Wanfang database, Wanfang Medical platform, TCM literature query             | 6.57%             |
| TCM inheritance and Innovation Service platform | National physician hall         | Inheritance of traditional Chinese medicine                                 | 1.85%             |
| TCM theory innovation support system     | Science and education departments and clinical departments | Introduction of new technology                                              | 1.23%             |

3.3. Information platform construction
Among 487 tertiary TCM hospitals, 297 had branches, accounting for 60.99%. Among the hospitals with branches, 78.79% have completed the integration of information system, 19.19% have not achieved the integration of information system in the main branch, 2.02% have achieved the
integration and adopted independent system to exchange information through media (E-mail, disk, USB flash disk, etc.) (Table 2).

**Table 2. Information system integration of main and branch hospitals of tertiary TCM hospital.**

| Information system integration of main and branch hospitals | nationwide amount | eastern amount | middle amount | western amount | rate | rate | rate | rate |
|------------------------------------------------------------|------------------|----------------|---------------|----------------|------|------|------|------|
| Yes, it has been completed                                  | 234              | 114            | 52            | 68             | 78.79% | 79.17% | 73.24% | 81.93% |
| No, some branches are not integrated                        | 57               | 27             | 16            | 14             | 19.19% | 18.75% | 22.54% | 16.87% |
| Yes, using independent systems to exchange information through the medium | 6                | 2              | 3            | 1              | 2.02% | 1.39% | 4.23% | 1.20% |

54.83% of hospitals are interconnected with the local national Health Information Platform (regional Health Information Platform). The proportion of real-time health file invocation, two-way referral and mutual recognition of inspection results among hospitals, communities and health centers in the region based on the platform has been partially realized and fully realized respectively is 45.17% and 9.65%. Among the hospitals without interconnection, 28.54% and 16.63% are not qualified to realize docking and information interconnection and sharing (Table 3).

**Table 3. Interconnection with the local established national health information platform.**

| Interconnection with local established national health information platform | nationwide amount | eastern amount | middle amount | western amount | rate | rate | rate | rate |
|---------------------------------------------------------------------------|------------------|----------------|---------------|----------------|------|------|------|------|
| No, the implementation conditions are not available                       | 81               | 29             | 27            | 25             | 16.63% | 12.89% | 21.43% | 18.38% |
| No, the implementation conditions are available                           | 139              | 49             | 43            | 47             | 28.54% | 21.78% | 34.13% | 34.56% |
| Yes, partially implemented                                                | 220              | 110            | 50            | 60             | 45.17% | 48.89% | 39.68% | 44.12% |
| Yes, it is fully implemented                                               | 47               | 37             | 6             | 4              | 9.65% | 16.44% | 4.76% | 2.94% |

35.93% of the hospitals had never heard of the health information platform of TCM museums, 14.10% of them partially realized and 0.64% of them fully realized the electronic medical record information transfer, two-way referral, remote consultation, remote education and TCM knowledge base between communities and health centers based on the health information platform of TCM museums. Among the hospitals that did not realize interconnection, 52.88% had the conditions and 32.37% did not have the conditions to realize docking and information interconnection and sharing. P < 0.05, there was significant difference. The realization rate and understanding rate of the western region were better than those of the eastern and central regions (Table 4).

**Table 4. Interconnection with health information platform of TCM museum.**

| Interconnection with health information platform of TCM Museum | nationwide amount | eastern amount | middle amount | western amount | rate | rate | rate | rate |
|--------------------------------------------------------------|------------------|----------------|---------------|----------------|------|------|------|------|
| No, the implementation conditions are not available           | 101              | 43             | 29            | 39             | 32.37% | 32.33% | 37.66% | 38.24% |
| No, the implementation conditions are available               | 165              | 72             | 39            | 54             | 52.88% | 54.14% | 50.65% | 52.94% |
| Yes, partially implemented                                   | 44               | 17             | 9             | 18             | 14.10% | 12.78% | 11.69% | 17.65% |
| Yes, it is fully implemented                                  | 2                | 1              | 0             | 1              | 0.64% | 0.75% | 0.00% | 0.98% |
59.55% of hospitals realized data sharing with other medical and health institutions in the region, and 67.66% of hospitals in the eastern region achieved data sharing, which was better than the national level. 43.33% of the data sharing was through the National Health (Regional Health) information platform, followed by 7.39% for point-to-point data exchange. \( P<0.05 \) showed a significant difference.

The utilization rate of the national health information platform in the eastern region was significantly higher than that in the central and western regions (Table 5).

### Table 5. Distribution of data sharing mode in tertiary TCM hospital.

| Distribution of data sharing mode                              | nationwide amount | eastern amount | middle amount | western amount |
|---------------------------------------------------------------|-------------------|----------------|---------------|----------------|
| Fax or Advice                                                 | 22                | 3.11%          | 4.52%         | 8.09%          |
| Point-to-point data exchange                                  | 36                | 13             | 5.78%         | 7.14%          |
| Integrated hospital community system                          | 11                | 2              | 2.26%         | 10.29%         |
| National Health Information Platform                          | 211               | 128            | 28.57%        | 34.56%         |
| health information platform of TCM Museum                     | 10                | 2              | 2.05%         | 2.94%          |
| Data sharing is not implemented                               | 197               | 73             | 32.44%        | 41.18%         |

### 3.4. Application of new technology

In the survey, the application rate of new technologies in tertiary TCM hospitals reached 70.23%. The top three new technologies are cloud computing, mobile Internet and big data, and the lowest one is blockchain, accounting for only 0.41%. SPSS was used for non-parametric test of samples from eastern, central and western regions, and it was found that \( P<0.05 \) shown significant differences. On the whole, the application of new technology in eastern region is better than that in western and central regions. Cloud computing technology applications from high to low are cloud computing security (virtual network security protection), infrastructure resource virtualization (CPU, memory, network, etc.), cloud computing management (virtual server and network equipment management) and cloud storage, accounting for 43.33%, 43.12%, 24.85% and 14.37%, respectively. Big data technology is mainly used in hospital operation, full-text search of clinical cases and other data, and medical insurance control fee management, accounting for 22.18%, 20.12% and 18.69%, respectively. The application rates of chronic disease follow-up management, TCM health consultation and medical insurance fraud detection were low, accounting for 4.72%, 2.46% and 0.82%, respectively. The application rates of hospital operation, TCM syndrome differentiation assistance, TCM health consultation, medical insurance control fee management, medical insurance fraud detection, automatic classification of medical images and BI statements in western China are all higher than those in eastern and central China. The application rates of Internet of Things from high to low are supply room management, high-value consumables, infusion management, medical waste management, automatic sign collection, equipment positioning, and personnel (patient) positioning (Figure 3).

![Figure 3. Application of new technologies.](image)
4. Discuss

4.1. Pay attention to infrastructure construction and strengthen network security awareness

Hospital infrastructure construction is an essential condition for stable and efficient operation of hospital, as well as a basic guarantee to ensure more scientific, standardized and efficient hospital management [2]. The level of information infrastructure construction of the tertiary TCM hospitals surveyed varies. From the perspective of the construction of comprehensive central computer room, server CPU, storage equipment and network bandwidth, the infrastructure construction in the eastern region is superior to that in the central and western regions. It is suggested that hospitals should attach importance to network security construction from top-level design, increase investment in infrastructure, and avoid medical security accidents caused by disaster preparedness or data storage problems. Strengthen the network security leading group and working group construction, improve the network security awareness of hospital information department; developing a sound, targeted and implementable information infrastructure security strategy, including the security of computer room, server, data storage, network, terminal, etc., strengthen inspection and management in daily use, timely maintenance and replacement, to ensure the normal operation of the hospital and information security.

4.2. Develop and apply characteristic system, inherit and innovate TCM cause

To promote and standardize the TCM hospital information construction, improve the level of Chinese medicine hospital informationization, the state administration of traditional Chinese medicine published "standard of hospital information system basic function of traditional Chinese medicine (revised), among them, the hospital of traditional Chinese medicine clinical service and hospital management information system is divided into two parts, part clinical services including clinical services, medical services, pharmacy practice part, hospital management includes medical management, operations management, science and education management, comprehensive service management [3].This survey involves 40 business application information systems. According to the analysis data, 7 of the top 10 tertiary TCM hospital construction systems are clinical service systems, among which 3 are clinical service systems, 1 is medical technology service systems and 3 are pharmaceutical service systems. Of the ten systems ranked in the lowest construction rate, four are scientific and educational management systems. With the mature of information technology and the hospital business process optimization, the construction of information system by charging centered to patient centered, medical personnel as the main service object, the current clinical medical information systems in the continuous construction and development stage, tertiary hospitals as the lead author of the hospital informationization construction, should pay attention to the overall planning, system construction clear hospital long-term development goals, actively introduce can improve staff work efficiency of information system, reducing waste of manpower, financial and material resources. TCM hospital informatization construction should take patient as the center, to establish compliance with characteristics of traditional Chinese medicine diagnosis and treatment of electronic medical records system as the core of TCM [4], based on the TCM clinical diagnosis and treatment process, fully embody the superiority and the characteristic of TCM, consider the TCM clinical habit, positive construction and application of cure not ill, rehabilitation of TCM, Chinese medicine such as tisanes characteristics of TCM information system, innovation of inheritance of TCM development and application.

4.3. Pay attention to the application of standards and specifications to improve the interconnection of platforms

Hospital information platform based on electronic medical records is the hospital internal unification between different business systems integration, and the carrier, the basis of resource integration and efficient operation of hospital informatization involves medicine, teaching and research, people, goods, content and so on various aspects [5], the use of hospital information platform to realize its internal or
with external agencies to share information, connectivity, should first improve standardized consciousness, active docking the existing information system standard code, the ministry of health has launched a number of health information standards, including the basic specification in hospital medical record home page, electronic medical records, health management, basic data sets, basic architecture and data standard electronic medical records, etc., the structure of TCM information has been further improved, and the application of standards is crucial to the long-term operation and interconnection of the hospital information platform. Tertiary hospital of TCM to take advantage of our college information resources, and actively with the local health information platform, the museum of TCM health information platform, to realize hospital important business application system resource sharing and business collaboration, resource platform to not allow hospital construction area of districts and counties to provide virtual platform service [6], solve the problem of "data island" chimney "system". Museum of traditional Chinese medicine health information platform as the embodiment of the characteristics of traditional Chinese medicine, more and more get the attention of hospital administrators, but about 35.93% of the survey of tertiary hospital of TCM still don't understand Chinese medicine hall hospital health information platform, hospital of traditional Chinese medicine and Chinese medicine hall health information platform can achieve interconnectivity of traditional Chinese medicine health care, health, health care, rehabilitation of traditional Chinese medicine health information services such as information sharing, improving the service efficiency of traditional Chinese medicine. Hospital information managers should strengthen the top-level design and the interconnection and interworking with the health information platform of TCM museum while expanding the knowledge field.

4.4. Introducing practical new technology to help the construction of smart TCM hospitals

In September 2019, the diagnosis and treatment measures for the administration of the Internet (try out) ", "Internet hospital management approach (trial)", "remote medical service management standard (trial)", in March 2020, the hospital service classification evaluation standard system "wisdom, and a variety of policy shows that countries are gradually to strengthen the construction of intelligent hospital. During the coVID-19 epidemic prevention and control in 2020, medical services will be combined with cloud computing, big data, Internet of Things, mobile Internet and other new infrastructure construction, which will improve the service level and efficiency of the medical industry and support the all-round management and intelligent medical treatment throughout the diagnosis and treatment process. As a part of smart medical treatment, the demand of smart hospital is increasing day by day. The tertiary TCM hospital has a relatively perfect management mode, advanced information equipment and high-quality human resources. According to the needs of hospital medical treatment, health care, scientific research and education, etc., it should actively introduce and practice new technologies in order to make patient diagnosis and treatment process more convenient, TCM medical service more efficient and medical management more refined. Blockchain technology is open, transparent, traceable and tamper-proof, which is helpful for hospitals to guarantee data security, effectively supervise and manage, and promote the modernization of governance capacity. Hospitals can explore more scenarios of blockchain application and realize functions such as secure flow and authorized access. Cloud computing technology is characterized by large scale, high reliability, strong universality and high scalability, which can help hospitals build medical resource database, carry out personalized and accurate medical treatment and improve comprehensive capabilities. The large volume, diversity, timeliness, accuracy, big value and other characteristics of big data technology can help hospitals process and analyze massive data, extract potential value of data, and improve hospital scientific research level. Internet of Things technology makes use of its intelligence to ensure effective communication in information exchange and communication and improve the efficiency and accuracy of communication between doctors and patients. Mobile Internet technology plays an important role in processing all the information inside hospitals.
5. Conclusions

The tertiary TCM hospital has good resources and advantages in informationization construction, but it still faces many difficulties and challenges in the construction process. The informatization construction of the hospital needs the combination of top-level design and practical application, the integration of solid infrastructure and new information technology, and the combination of traditional Chinese medicine characteristics, put emphasis on the application of standards, coordination and cooperation in various aspects, to promote the informatization development in a purposefully and planned way, and strive to build a smart hospital.

References

[1] Zhao Yu, Wan Changxiu, Zhou Qiong, Xu Qian. Construction of basic data set framework of nursing management information in traditional Chinese medicine hospitals [J]. Journal of medical informatics, 2017, 38(05):39-42.

[2] Wang Song. Analysis on information security status quo and Management Countermeasures of Public TCM hospitals above grade II in Beijing [D]. Chinese Academy of Chinese Medical Sciences, 2019.

[3] National Administration of Traditional Chinese Medicine. Letter of the Office of The State Administration of Traditional Chinese Medicine on solicitation of opinions on The Basic Norms for Informatization Construction of Traditional Chinese Medicine Hospitals (Amendment) (Draft for Solicitation of Opinions) and the Basic Functional Norms for Information System of Traditional Chinese Medicine Hospitals (Amendment) (Draft for Solicitation of Opinions) [Z]. 2019-03-06.

[4] Xiao Yong, Shen Shaowu. Analysis and reflection on the current situation of the informationization construction of grassroots traditional Chinese medicine hospitals [J]. Journal of Chinese medicine information, 2013, 20(01):2-3+10.

[5] Meng Meng, Wang Renhao, Liu Xiao, Qi Xiaolin, Zhu Xingchen, Zhang Yongshuo. The role of hospital informatization construction in the prevention and control of covid-19 [J]. Jiangsu health services management, 2020, 31(07):866-868.

[6] Yi Lingwei. How to break the bottleneck of building the Health Information platform of TCM Museums [J]. China Health, 2019(09):96-97.