Epidemiological Characteristics of the Corona Virus Disease 2019 in Shaanxi Province Based on “Internet +” Epidemic Monitoring Cloud Platform

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Abstract. Since the outbreak of the Corona Virus Disease 2019(COVID-19), medical staffs have reported cases of hospital infection of COVID-19, which has greatly affected the physical and mental health of medical staff. In order to effectively avoid the immunization situation and prevent the front-line medical staff from collecting information and reporting on the new coronary pneumonia patients, suspected patients, close contacts and other personnel, the possibility of being infected due to various direct and indirect contacts may arise. Information technology, the establishment of a new cloud monitoring platform based on “Internet +” for coronary epidemic outbreaks, and the realization of “zero touch” operation and “paperless” management of the entire process of information collection, confirmation, review and reporting, which greatly reducing the front-line work. The infection risk and labor intensity of personnel have reduced the workload and improved the efficiency of information collection. At the same time, it has also realized automatic statistics, intelligent statistical description and synchronous sharing of the information.

Keywords: COVID-19; Cloud Platform; Shaanxi Province

1. Introduction
Since late December 2019, a new type of coronavirus pneumonia called Corona Virus Disease 2019 (COVID-19) has spread across the country in Wuhan, Hubei Province, and the epidemic has quickly spread across the whole country [1]. On February 3, 2020, the General Office of the National Health Commission of China issued the “Notice on Strengthening Informationization to Support the Prevention and Control of Pneumonia Epidemics Caused by New Coronavirus Infections”, which requiring the actively adopting direct network reporting methods must be used to support the COVID-19, improve the quality and efficiency of data reporting and reduce the burden of basic statistics reporting [2].

Since the occurrence of COVID-19, nosocomial infections of new coronary pneumonia among medical staffs have been reported [3], which has a great impact on the physical and mental health of
medical staffs. Through isolation, disinfection, personal protection and other infection prevention and control measures, it can effectively act on the source of infection, the route of transmission, and the susceptible population of infectious diseases, which can effectively reduce the risk of transmission and protect the health and safety of medical staffs and patients [4].

In order to respond to the notification requirements of the National Health Commission of China, an epidemic monitoring platform was established based on modern information technology research such as the Internet, cloud computing, and cloud databases. A cross-regional, cross-unit, cross-departmental, multi-disciplinary, and multi-level project team has initially constructed a cloud platform for monitoring the new crown pneumonia epidemic by Xi’an Medical University, Medical School of Yan’an University and Yan’an Municipal Health Committee and many other units at the beginning of the COVID-19 outbreak. The platform was tested in the investigation of the COVID-19 epidemic in Yan’an City, and the confirmed cases of new crown pneumonia published on the official website of the Shaanxi Provincial Health Commission were imported into the platform. In addition, the automatic statistics and intelligent statistics description were tested and the relatively satisfactory results were achieved.

2. Cloud Platform Construction

2.1. Preliminary Preparation
For the purpose of laying the theoretical foundation for the research, literature research methods were used. We have mastered the transmission channels and blocking methods of the new coronavirus, clarified the key points of the monitoring of the new coronary pneumonia epidemic, and clarified the research goals and ideas. Through the brainstorming method and expert consultation method, the key points of the function module setting and function realization of the COVID-19 epidemic monitoring cloud platform have been determined.

2.2. Construction of Cloud Platform Design Process
First, the investigation object completes the structured filling of basic information by scanning the quick response code (QR code); and then the front-line managers modify, supplement and confirm information by scanning the QR code; thirdly, medical experts conduct a comprehensive analysis of the information and put forward processing opinions, and the person in charge of the final observation point reviews and reports the expert opinions. The automatic statistics and synchronous sharing of collected information through cloud database, members of the epidemic prevention and control information management center scan the QR code to enter the cloud platform to review, monitor, retrieve, analyze and report statistical data. At last, members of epidemic prevention and control headquarters at all levels can directly view and automatically count the results by scanning the QR code.

2.3. Development and Design of Cloud Platform Modules
According to the design, the platform includes 6 modules (see figure 1). The investigation object module mainly includes three parts: the basic information registration of the investigation object, the quarantine observation diary record and the release of the quarantine observation registration. The front-line manager module includes the modification, supplementation and confirmation of the basic information of the investigation target by the front-line management personnel, the inspection and supervision of the isolation observation diary, and the confirmation of the release of the isolation observation registration. The medical expert module mainly includes comprehensive judgments on the information submitted by the investigation objects and front-line managers, and suggestions for handling. The person in charge of the observation point module mainly includes reviewing and reporting the processing opinions put forward by medical experts. The epidemic prevention and control information center module reviews, retrieves, analyzes and reports the epidemic information. The epidemic prevention and control command center module is responsible for inquiring and viewing
epidemic statistics and analysis, and making decisions.

![Diagram of epidemic monitoring platform]

**Figure 1.** "Internet +" epidemic monitoring platform

3. Result Analysis of Cloud Platform

3.1. Population Distribution Characteristics

As of February 25, 2020, Shaanxi Province has reported a total of 245 COVID-19 patients, including 133 males and 112 females; the youngest of the patients was 3 years old, the oldest was 89 years old, and the average age was 46.28. Xi'an has the most patients, accounting for 46.5%. The source of infection of patients is mainly imported from the epidemic area, accounting for 31.0%. 52.2% of patients have no history of migration during the epidemic period, followed by 30.6% of patients who came to Shaanxi from the epidemic area. Information about patients’ sociodemographic characteristics is summarized in Table 1.
### Table 1. The population distribution characteristics of COVID-19 cases in Shaanxi province

| Characteristics                  | Number of cases | Composition ratio (%) |
|----------------------------------|----------------|-----------------------|
| **Age**                          |                |                       |
| ~ 12                             | 5              | 2.0                   |
| 12–17                            | 3              | 1.2                   |
| 18–25                            | 17             | 6.9                   |
| 26–30                            | 17             | 6.9                   |
| 31–40                            | 46             | 18.8                  |
| 41–50                            | 66             | 26.9                  |
| 51–60                            | 32             | 13.1                  |
| 61–70                            | 45             | 18.4                  |
| 70~                              | 14             | 5.7                   |
| **Gender**                       |                |                       |
| Male                             | 131            | 53.5                  |
| Female                           | 114            | 46.5                  |
| **Contact with affected areas**  |                |                       |
| Yes                              | 153            | 62.4                  |
| No                               | 92             | 37.7                  |
| **Isolate before diagnosis**     |                |                       |
| Yes                              | 112            | 45.7                  |
| No                               | 133            | 54.3                  |
| **Migration history**            |                |                       |
| No                               | 129            | 52.7                  |
| Coming to Shaanxi from epidemic areas | 76          | 31.0                  |
| Returning to Shaanxi from the epidemic areas | 19    | 7.8                   |
| Coming to Shaanxi through the epidemic areas | 8   | 3.3                   |
| Coming to Shaanxi from non-epidemic areas | 8  | 3.3                   |
| Returning to Shaanxi from non-epidemic areas | 7 | 2.9                   |

3.2. Geographical Distribution Characteristics

According to the classification statistics of the area where the patients were onset, 114 cases lived in Xi’an at the time of onset, accounting for 46.5%, followed by Hanzhong and Ankang. In addition, another 12 patients were in Wuhan at the time of onset.

### Table 2. The geographical distribution characteristics of COVID-19 patients in Shaanxi province at the time of onset

| Areas                        | Number of cases | Composition ratio (%) |
|------------------------------|----------------|-----------------------|
| Xi’an                        | 114            | 46.5                  |
| Hanzhong                     | 25             | 10.2                  |
| Ankang                       | 22             | 9.0                   |
| Weinan                       | 14             | 5.7                   |
| Xianyang                     | 14             | 5.7                   |
| Baoji                        | 12             | 4.9                   |
| Tongchuan                    | 8              | 3.3                   |
| Yan’an                       | 7              | 2.9                   |
| Shangluo                     | 6              | 2.4                   |
| Wuhan                        | 12             | 4.9                   |

3.3. Time Distribution
Since the first COVID-19 case diagnosed on January 23, the number of confirmed cases has gradually increased in Shaanxi Province. The cumulative number of confirmed cases had increased to 245 as of February 20, and there were no new cases from February 21 to 25. Since February 12, the number of confirmed cases has gradually decreased, and the cumulative number of cured cases has gradually increased. As of February 25, the number of newly confirmed cases, the cumulative number of confirmed cases, the cumulative number of cured cases, and the number of existing confirmed cases in Shaanxi Province are shown in Figure 2.

![Figure 2](image-url)  
*Figure 2. The distribution of the COVID-19 epidemic situation in Shaanxi Province (as of February 25, 2020)*

4. Discussion

4.1. Analysis of the Overall Situation of the Epidemic in Shaanxi Province

Shaanxi Province has reported a total of 245 COVID-19 cases as of February 25, 2020. The epidemic situation is generally at a lower level of prevalence compared with Guangdong, Hubei and other places[5, 6]. In terms of age distribution, the cases were mostly concentrated in people aged 30 to 70, and especially between 41 to 50 years old, which accounted for 26.9%; and there were more men than women (the proportion of female patients is 46.5%), which is consistent with the relevant domestic reports[7].

As for the migration history of cases during the epidemic period, 47.3% of the confirmed cases were imported cases, accounting for almost half of the total number, and the initial stage of the epidemic was dominated by imported cases [8]. From the perspective of geographical distribution, Xi’an has the most confirmed cases. As the capital city of Shaanxi Province, the number and frequency of people traveling to and from Wuhan were higher than other cities, so the number of confirmed cases is relatively large [9, 10].

With the strengthening of prevention and control efforts and treatment capabilities, the number of newly confirmed cases and the number of existing confirmed cases both increased first and then decreased. While the cumulative number of cured cases continued shows an upward trend, which is consistent with the trend in other parts of the country [11-13]. It can be seen that the corresponding prevention measures taken by Shaanxi Province were appropriate and effective, and the epidemic prevention and control has achieved a positive development trend.
4.2. Effect Analysis of Cloud Platform
The use of the cloud platform has realized the paperless management of the entire process of epidemic investigation. The establishment of the “Internet +” epidemic monitoring cloud platform has changed the traditional management model of information registration, review and reporting in the form of paper versions. From basic information registration to information confirmation, review, reporting and invocation, it has realized paperless management of the whole process [14]. Front-line workers scan the QR code to enter the platform and complete information modification, confirmation, review, and report, and personnel from the epidemic prevention and control information center review and analyze data by entering the cloud database.

“Zero contact” has been realized during the information collection in the whole process of epidemic investigation. The method of scanning code registration information can avoid the indirect contact brought by the traditional information registration mode such as sharing computer, paper, pens and other office supplies, as well as the indirect contact brought by the transmission of paper documents[15]. The realization of “zero-touch” information collection in the whole process of epidemic investigation, which can effectively avoid cross-infection between the staff and the inspection objects.

The use of cloud platform [16] realizes automatic statistics and intelligent statistics description of data. The traditional management model requires statistics and reporting of various data level by level, which has slow statistics and high error rates. During the construction of this platform, we always adhere to the concept of structured management and "Internet +" thinking [17]. The collected data can realize automatic statistics and intelligent statistical description, and appear in the query terminal in the form of reports and statistical descriptions, which fully reflects the modern information technology has the advantages of fast, accurate, efficient and flexible [18].

5. Conclusion
During the epidemic prevention and control period, the “Internet +” epidemic monitoring platform can achieve certain practical effects. Due to the coverage of front-line managers were not comprehensive enough, it is impossible to conduct a comprehensive analysis of the use effect and satisfaction of these people. In order to establish a set of epidemic prevention and control monitoring cloud platform with simple operation and complete functions, which can realize “zero-touch” information collection and “paperless” process management, our team plans to gradually improve in the next stage and conduct in-depth analysis of the effect and satisfaction of front-line managers.

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