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Assessment of Impacts of Public Health Interventions on the SARS Epidemic in Beijing in Terms of the Intervals Between Its Symptom Onset, Hospital Admission, and Notification

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Objectives To assess the impacts of public health interventions on the outbreak of SARS in Beijing by analyzing the intervals between symptom onset, hospital admission and notification of its cases. **Methods** Data of SARS cases reported from the Beijing Municipal Centers for Disease Prevention and Control (BCDC) were collected and analyzed by descriptive epidemiology. **Results** In the early epidemic period, the intervals between the disease onset and the hospital admission seemed irregular, so was the intervals between the hospital admission and the notification. After the middle ten days of April, the intervals turned out to be more regular, and the disordered situation in terms of the hospital admission and the case notification was gradually brought under control. **Conclusions** Public health interventions against SARS has revealed positive impacts on SARS control program in Beijing. The timing and sensitivity of epidemic information reporting systems has been greatly improved in Beijing as a result of successful fight against this disease.

Key words: SARS; Intervals; Interventions; Impacts

INTRODUCTION

Severe acute respiratory syndrome (SARS) is a new infectious respiratory disease caused by a novel coronavirus[1]. The first case of SARS in China emerged in Guangdong Province in November, 2002. At the beginning of March, SARS was imported into Beijing, which was followed by an outbreak of SARS occurred in this municipality and its rapid spread to neighbor provinces and cities including Tianjin, Hebei, Shanxi, Inner Mongolia, etc. The outbreak and spread of SARS inflicted severe damages to people's health and impeded the nation's economic development as a whole. Under a strong leadership of the Party and the State Council, and with involvement of all sectors concerned Beijing launched a war against SARS. Governments at different levels in Beijing adopted a comprehensive strategy focusing on control of sources of infection, timely hospital admission of all identified cases and their safe transfer, classified isolation of all contacts and suspect cases, centralized treatment and personal protection so as to do the utmost to decrease the case fatality rate. Proper treatment of SARS cases to save their lives was emphasized. After SARS reached a peak in April and began to decrease in May, no probable SARS case of SARS was identified in June. By July, the SARS epidemic in Beijing was under effective control.

However, there was no comprehensive or systematic evaluation of the impacts of public health interventions on SARS control during the SARS outbreak in Beijing. This study focused on the symptom onset, hospital admission and notification of SARS patients and the intervals of the three variables in Beijing in order to analyze the impact of public health interventions. This study was to reveal the specific features of an epidemic disease like SARS, and to provide scientific basis for its future control and prevention.

MATERIALS AND METHODS

Data Source

All data of SARS cases were collected from

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daily notification by Chinese Ministry of Health and also from the database of infectious diseases developed by Beijing Municipal Centers for Disease Prevention and Control.

Case Definition

The national Ministry of Health defined the probable and suspected SARS cases according to the following criteria: 1) epidemiologic history (either contact with other SARS patients or exposure to a SARS-affected area); 2) symptoms and signs of fever and respiratory illness; 3) normal or decreased leukocyte counts; 4) chest radiograph abnormalities; and 5) absence of substantial improvement after antibiotic treatment[2] (Table 1).

TABLE 1

Case Definition for Severe Acute Respiratory Syndrome in China on May 3, 2003

Category	Criteria[a]
Probable	1.1+2+4, or
	1.1+2+4+5,or
Suspected	1.2+2+3+4,
	1.1+2+3,or
	1.2+2+4,or
	2+3+4

Note. [a]1. Epidemiologic history. 1.1: having close contact with a patient, or being a member of infected cluster, or having infected other persons; 1.2: Having visited or resided in cities or areas where SARS cases were reported with secondary transmission in two weeks before the onset of the disease. 2. Symptoms and signs of febrile respiratory illness. 3. Normal or decreased leukocyte counts. 4. Chest X-ray changes. 5. Lack of response to antibiotic treatment.

Statistical Methods

The distribution of the date of disease onset, hospital admission, notification and their intervals was described with statistical figures and graphs. Line-bar graphs and box plots were used to show the trend of change and tendency of dispersion.

RESULTS

A total of 2 521 probable SARS cases were collected by the Beijing Municipal Centers for Disease Prevention and Control. Of these cases, 1 279 were males and 1 242 females, accounting for 50.73% and 49.72% respectively. There was no statistical difference in gender. The age of most cases ranged from 20 to 29 years.

Interval Between Disease Onset and Hospital Admission

Fig. 1 shows the number of probable SARS cases and the interval between disease onset and hospital admission (referred to as “interval”). The line in the figure shows the average interval between symptom onset and hospital admission. The figure indicates that in the early stage of SARS outbreak in Beijing (from March to early April), the intervals were extremely irregular with the longest one lasting for 17 days. In late April, the length of interval started to become shorter and averaged 1 day by the end of April. In May the average interval remained quite short, but fluctuated. The average interval was 1-2 days, and the longest interval was 3 days. Then the spread of the disease was brought under control, and the length of the interval fell to zero.

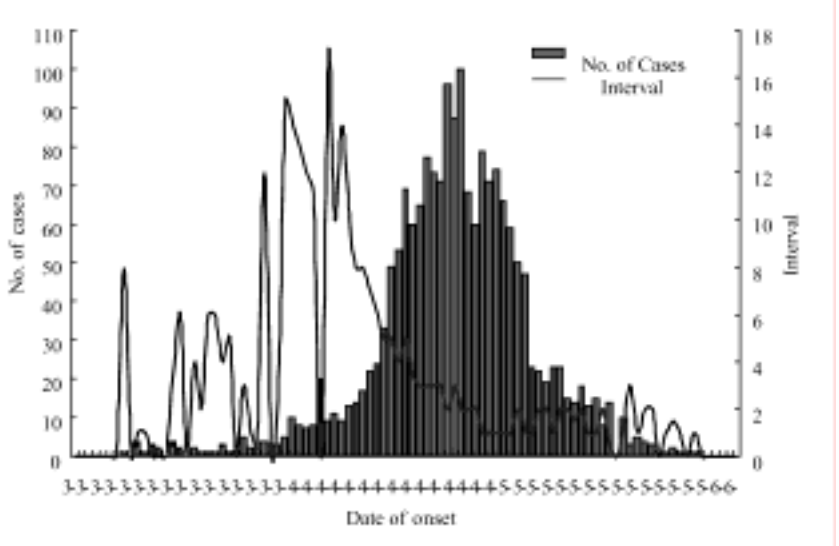

FIG. 1. Distribution of the interval between the onset and admission of probable SARS cases in Beijing.

In accordance with the epidemiological features and the change in number of SARS patients in Beijing, the process of SARS spread was divided into 5 stages: imported stage (from March 1 to March 31), spreading stage (from April 1 to April 15), peak stage (from April 15 to May 5), decreasing stage (from May 6 to May 19) and terminating stage (from May 20). Fig. 2 shows the distribution of the 5 stages. The dispersion was large during the imported and spreading stages. After the peak stage it reduced notably and reached the lowest point in the terminating stage.

Interval Between Admission and Notification

Fig. 3 shows the number of probable SARS cases and the interval between admission and notification (referred to as "notification interval"). The line shows the average notification interval of SARS patients. Before April 13, the notification interval was relatively long, and quite irregular by the end of March. From April 13, the average notification interval never exceeded 1 day and remained 0 for a certain period of time.

Fig. 4 shows the dispersion of the notification int-

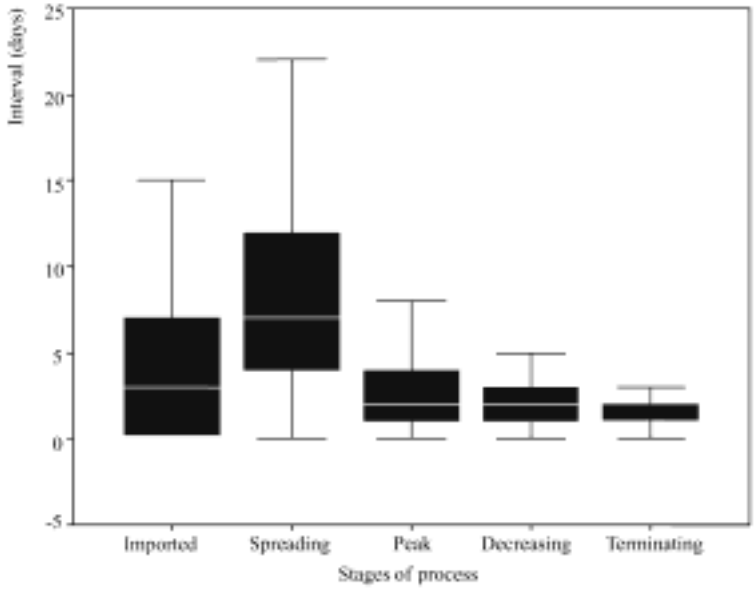

FIG. 2. Interval between symptom onset and hospital admission in 5 different stages of SARS outbreak in Beijing.

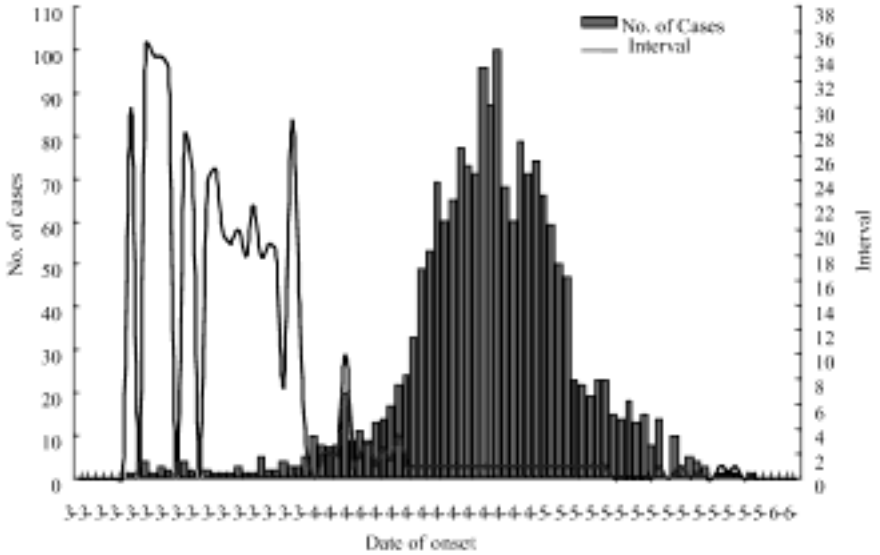

FIG. 3. Distribution of interval between admission and notification of probable SARS cases in Beijing.

erval in the 5 stages. The dispersion was large during the imported stage. After the spreading stage, the notification interval was notably decreasing reaching the lowest point in the terminating stage.

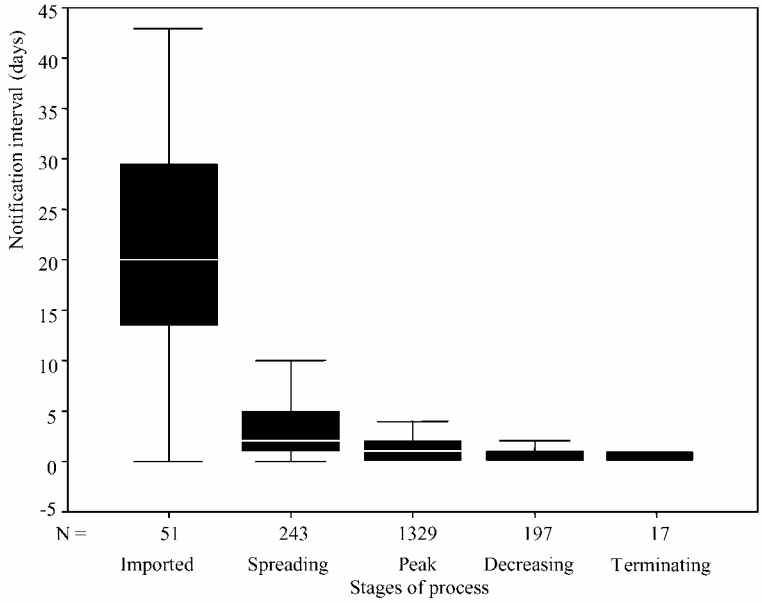

FIG. 4. Interval between admission and notification in 5 different stages of SARS in Beijing.

Interval Between Onset and Notification

Fig. 4 shows the dispersion of the interval between onset and notification in the 5 stages. The dispersion was large during the imported and spreading stages. After the peak period the interval showed a tendency to decrease and reached the lowest point in the terminating stage.

DISCUSSION

From March to June, 2003, the outbreak and spread of severe acute respiratory syndrome (SARS) hit the city of Beijing. The rapid control of this outbreak reflected that the disease prevention and control sectors played a crucial role and achieved positive effects. These achievements could not be made without the participation and support of the public, the community and the governmental sectors concerned. The comprehensive strategies against SARS included control of sources of infection as the key element, quarantine of close contacts as the clue and control of nosocomial infection as the center. By now, the SARS situation has been under complete control.

Impact of Public Health Interventions-Evaluation Based on the Perspective Analysis of the Interval Between Disease Onset and Hospital Admission

The interval between disease onset and hospital admission showed that the medical treatment was provided in a timely manner. Patients who were not isolated during the interval participated freely in different social activities and resulted in the extensive transmission of SARS.

The transmission of the disease could not be controlled unless the patients were admitted to hospitals and isolated timely. If patients failed to be timely isolated and did not receive proper medical treatment, the spreading stage of the disease would continue.

During the early stage of SARS in Beijing (the imported and spreading stages), the number of patients who were not admitted to hospitals in time was relatively large, thus causing the enlargement of SARS infection sources in communities. This also caused the increasing number of patients in the later stage. In mid-April, the government strengthened the control of SARS and public education on its prevention, and therefore the patients' awareness of seeking hospital care was improved. Although the average interval fell to 2 days in the peak period, dispersion was notably decreased. The average interval fluctuated in May, but never exceeded 3 days. This indicated that both hospital staff and the public still had misconception about SARS. However, as the public education and information activities pursued by the government, such misconception was removed gradually.

The above facts showed the positive effect of

public health interventions in guiding SARS suspected and probable cases to seek hospital care. The interventions also achieved great successes in solving the misunderstanding between patients and health care staff, and in preventing some hospitals from refusing SARS patients.

Analysis of the Interval Between Admission and Notification

According to the law on contagious disease, contagious diseases classified as "class A" should be notified on the day of diagnosis. According to the ordinance on response to public health emergence, "vital disease with unknown causes" or "probable public health event" should also be reported. In the early stage of outbreak, SARS was not known well and was not required to be reported. But later with the more understanding of SARS, which may be potential to result in public health emergencies, it was classified as an infectious disease of "class A", and was required to be reported according to the law on contagious disease as well[3].

The timely case notification will help to provide timely diagnosis and treatment. Before April 13 the average notification interval was long and irregular but after that period the interval never exceeded 1 day and stayed zero for a certain period of time. On the one hand, the current report systems failed to identify the symptoms of some unexpected diseases. The possible explanation of such failure might be associated with the fact that health care workers were either insufficiently skilled or less motivated to report diseases with unknown causes or any diseases which might constitute a public health emergency. On the other hand, with the public health interventions being adopted, disease prevention and control institutions in Beijing began to maintain close cooperation with hospitals in their joint fight against SARS. A new and efficient epidemic surveillance and information reporting system was established for public health emergencies. As a result, the information reported could be collected and analyzed in time to control further spread of the disease.

Analysis of Timing and Sensitivity of the Epidemic Information System

The sensitivity of the epidemic information system can be reflected in two aspects. One is that the grassroots units under this system should be sensitive to the unknown events and report them in time, and the other is that the supervising units should respond to the cases reported sensitively in order to make accurate judgments in time. If cases were suspected of any possibility to constitute public health emergencies, they should be treated with special cautions and the public could be alerted as early as possible.

The efficient operation of the epidemic information system was reflected in the time of notification and the quick response to the epidemic.

In all, sensitivity and timing of the epidemic information system in Beijing was greatly improved in the later period of SARS outbreak and remarkable positive progress was made. Notable shortening in the interval between disease onset and notification was a typical example.

Existing Problems

There is still space for improvement in the timing and sensitivity of the epidemic information system in Beijing. Although the spread of SARS in Beijing was finally brought under control, it should be recognized that some problems could have been avoided if surveillance and information reporting system were established earlier. Strong and firm measures and timely reallocation of health resources would help to strengthen this system.

SARS notification remains unsatisfactory The detection of most diseases listed in the law on infectious disease prevention and control depends on clinical ability and skills of medical care workers to make timely diagnosis and report them to authorities concerned. A delayed reporting of SARS and its extensive transmission in Beijing showed that the implementation of the law throughout the nation was rather weak. Disease reporting has not been given serious attention among health care staff.

Recommendations

Strengthening professional training The awareness among health care workers in reporting transmissible or occupational diseases and events such as environment pollution and food poisoning could be raised through professional training and education on laws enforcement in fields of public health. Meanwhile, more attention should be paid to the reporting of problems with unknown causes or public health emergencies. As venture exists in reporting of this kind of diseases, strong ability to process the information and strong responsibility for the society are highly required. To encourage health care workers to raise their professional sensitivity and social responsibility for such events, certain moral and financial motivation may well be established. The efficiency in timing and sensitivity in epidemic reporting will guarantee the formulation and implementation of public health interventions.

Establishment of expert team An independent expert team should be established to perform routine epidemic surveillance and analysis. There

should be a multi-disciplinary and cross-sectoral expert team whose members do not have to be permanent. The participation of multi-disciplinary experts will introduce new technologies to make timely case detection and confirmation. Involvement of all sectors concerned will be valuable to provide a more objective judgment and avoid potential risk of case under-reporting or concealing.

The expert team's work depends on personal knowledge and competence of its individual members. Their proposals on the epidemic analysis and relevant suggestions on epidemic control should be submitted directly to the decision-makers for immediate action. We are confident that through the work of the expert team, the efficiency of disease control will be greatly improved.

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