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The response of the government's emergency system to the novel coronavirus disease 2019 (COVID-19) outbreak in China: a retrospective comparative study
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Abstract:

Summary

Background

Since the novel coronavirus disease 2019 (COVID-19) emerged in Wuhan city and then rapidly spread throughout China, the practices of the government’s emergency response and management of medical system to prevent the COVID-19 was vitally crucial. However, the studies about China’s emergency management of COVID-19 prevention and control were scarce. We aimed to explore the government’s emergency response practices to COVID-19 prevention by comparing with H7N9 avian influenza (H7N9) in China.

Methods

A qualitative comparative study was conducted in the study, by using a set of 6 key time nodes selected from international literature to form a frame of reference for the comparative analysis of the emergency response to H7N9 (2013) in Shanghai and COVID-19 (Wuhan city) prevention and control in China.

Findings

1) The hospital reporting speed—the first case report to the local CDC, for H7N9(2013) in Shanghai and COVID-19 in Wuhan city was 6 and 19 days, respectively. 2). The pathogen inspection speed—the period from case reporting to technically confirming and re-checking pathogens, for COVID-19 was much quicker than that in H7N9(2013) in Shanghai (12days vs. 31days). 3). The government responding speed—from re-checking pathogens to the local government’s emergency response, for H7N9 (2013) in Shanghai and COVID-19 in Wuhan was 4 and 15 days, respectively. 4) The total emergency disposal time of local government was 5 days longer in COVID-19 in Wuhan city than H7N9 avian influenza (2013) in Shanghai (46 days vs. 41 days).

Interpretation

From H7N9 to COVID-19, the speed of detecting unknown pathogens greatly improved
in China, whereas the hospital reporting of epidemics and decision-making by government of Hubei province was significantly slow, which might be an important influential factor of the outbreak of COVID-19. Improving the emergency management could lessen the adverse social effects of the emerging infectious disease and public health crisis in the future.
The response of the government's emergency system to the novel coronavirus disease 2019 (COVID-19) outbreak in China: a retrospective comparative study

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Contributors:
TZ, WS and LL designed the project, carried out data processing, performed data analysis, and wrote the manuscript. YW, GB, RD and QW edited the article. All authors contributed to the comment and revise the draft.

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Keywords: COVID-19; Emerging infectious diseases; H7N9; Emergency management; China
Introduction

In the past 20 years, China has suffered many public health crises caused by infectious disease outbreaks, such as severe acute respiratory syndrome (SARS) in 2003, H1N1 flu pandemic in 2009, and H7N9 avian influenza in 2013, which caused serious impacts on health, economy and even global security. (1-3) These critically challenged the health emergency management systems in many countries, especially in developing countries including China. (4, 5) In late December 2019, the novel coronavirus disease in 2019 (hereinafter referred to as COVID-19) emerged in Wuhan city, China, and then rapidly spread worldwide. (6) On January 3rd, 2020, the Chinese government notified the World Health Organization (WHO) of the epidemic. (7) Prior to March, 5th, 2020, China had reported 80,409 confirmed cases of COVID-19 and 3,012 deaths. (8)

COVID-19 and H7N9 are emerging infectious diseases share some similarities (Table 1). First, they all began in China (current statement); the first COVID-19 patient was identified in Wuhan in 2019, and human H7N9 influenza infection first emerged in Shanghai in 2013. Second, they both can be transmitted by people who are just mildly ill or even pre symptomatic. (3, 9) Third, they all caused worldwide alarm. But it is obvious that the prevention and control effect of H7N9 epidemic in China is better, which was mainly confined to China in 2013, even compared to the COVID-19, viral strength push H7N9 to behave more dangerous (case fatality ratio of COVID-19 is about 1%(10), lower than H7N9).

Evidence indicated that effective emergency management played an important role in reducing the adverse impacts of all public health emergencies. (11) The efficiency depends on three speeds: the speed at which the hospital perceives the case and reports it to the CDC(hospital reporting speed), the speed at which the CDC organizes the laboratory to detect and re-check the pathogen(pathogen inspection speed), and the speed at which the government implements the emergency response once the pathogen is known(government responding speed). On January 30, The World Health Organization (WHO) declared a Public Health Emergency of International Concern on January 30. (12)Since then, China established and strengthened national and local surveillance systems and emergency responses to prevent and control COVID-19. (13)

In the present study, we aimed to explore and compare the key time node of government’s emergency response to COVID-19 and H7N9 prevention and control in China by using a qualitative retrospective study.

Table 1. Characteristics of the H7N9 virus and COVID-19 in China.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>H7N9</th>
<th>COVID-19</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country of Origin</td>
<td>China</td>
<td>China</td>
</tr>
<tr>
<td>First case in China</td>
<td>February,2013 in Shanghai</td>
<td>December 2019 in Wuhan</td>
</tr>
<tr>
<td>Viral genome</td>
<td>Negative-senses segmented RNA</td>
<td>Positive single -strand RNA</td>
</tr>
<tr>
<td>Pathogen Identification</td>
<td>CDC, China, March 29th,2013</td>
<td>CDC, China, January 7th,2020</td>
</tr>
<tr>
<td>Human-to-human transmission</td>
<td>Limited</td>
<td>Yes</td>
</tr>
<tr>
<td>Genesis/Source</td>
<td>Domestic Poultry</td>
<td>Not Clear</td>
</tr>
<tr>
<td>Diagnosed in China</td>
<td>Real-time PCR</td>
<td>Real-time qPCR</td>
</tr>
<tr>
<td>Vaccines in China</td>
<td>Lack</td>
<td>Lack</td>
</tr>
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</table>

Methods

Data collections

The disposal process of H7N9 avian influenza in Shanghai in 2013 came from the author's social field investigation. These findings were reported in the published literature. (14) The disposal process of Novel Coronavirus pneumonia in Wuhan in 2019 came from the academic literature, announcements from WHO report,(3), government official websites (National Health Commission of the People's Republic of China, Chinese Center for Disease control and prevention, Health commission of Hebei Province, Wuhan Municipal Health Commission etc. ) and reports from credible media (CCTV, People's Daily, CBN, YiMagazine, etc. ).

Comparative analysis

We compared the entire process from the detection of the first case to the launch of the emergency response of COVID-19 in Wuhan city and H7N9 avian influenza (2013) in Shanghai. The 6 key time
nodes during the period from the detection of first case to the initiation of emergency response of the
COVID-19 and H7N9 epidemic were comprehensively evaluated. They were as following: the
hospitalization of the first case, the report from the hospital to local Center for Disease Control and
Prevention (CDC), the laboratory identification of the pathogen, the technical re-check of the pathogen,
the national confirmation of the pathogen, and the launch of emergency response of the local government.

We compared and evaluated three crucial periods including the hospital reporting speed, pathogen
Inspection speed and government Responding speed. And we accumulated days at each time node with
a fixed basis method, using the time point of hospitalization of the first case as the benchmark. The time
from detecting the first case to the report of the first death was also analyzed in the study.

Results
After sorting out the government’s emergency response process of Shanghai H7N9 avian influenza
and Wuhan COVID-19, we organized the Disposal timeline of important events (Table 1 and Figure 1).
We found that the whole process of COVID-19 took 46 days, which was 5 days slower than that of H7N9
avian influenza, mainly because the improvement in the detection speed of pathogens was offset by the
delay in hospital reporting and government decision-making. And the delay of hospital reporting was
more serious than that of government decision-making. The details are as follows.

Hospital Reporting Speed
H7N9 avian influenza (2013)
The first case was hospitalized in the Fifth People's Hospital of Shanghai affiliated to Fudan
University, on February 21st, 2013, and subsequent 2 cases were admitted. (15, 16) The doctor on duty in
the emergency observation room noticed that there was a paternity relationship between the follow-up
case and the first case and thought that there was a possibility of aggregative infectious diseases. So,
in the early morning of February 26th, 2013 at 1:10 a.m., he reported to the Dr. Shen Ying in hospital
on duty, who is also the chief of infection department of the hospital, is sensitive and professional. He
thinks that the above situation is in line with the possibility of clustered unexplained pneumonia, and
immediately calls the leader in charge of the hospital. Subsequently, the hospital started expert
consultation and took isolation and protection measures. At 2:30 a.m. of the same day, the hospital
reported to the chief administrative official of the local CDC by telephone and requested to start
epidemiological surveying and sampling. (17)

COVID-19 (2019)
Wuhan Municipal Health Administration announced on January 11th, 2020 that the first confirmed
case of novel coronavirus pneumonia occurred on December 8th, 2019. (17) A paper published in The
Lancet also reported that the first case occurred on December 1st, 2020. (18) Based on the principle of
caution, this article used December 8th, 2019 as the onset time of the first case of the epidemic and
considered that this case was hospitalized at that time. On the morning of December 26th, 2019, Dr.
Zhang Jixian, a doctor from Hubei integrated hospital of traditional Chinese and Western medicine in
Wuhan, found the abnormality of a couple’s lung CT and the abnormality of their son's CT. so in the
same day, hospital reported 4 abnormal cases (include another case) to the District CDC(19).

The hospital reporting speed for H7N9(2013) in Shanghai and COVID-19(2019) in Wuhan was 6
and 19 days, respectively.

Pathogen Inspection speed
H7N9 avian influenza (2013)
The CDC at the local place of the hospital conducted epidemiological surveying and sampling at
4:00 a.m. on February 26th, 2013, and informed the hospital at 10:30 a.m. that adenovirus, syncytial
virus, Legionella, H1N1, highly pathogenic avian influenza, mycoplasma and seasonal influenza were
all negative for the pathogen identification. The hospital then sent the samples to P3 Laboratory of
Shanghai Public Health Clinical Center. On March 22nd, Shanghai Public Health Clinical Center
preliminarily confirmed the pathogen as a new type of avian influenza virus. On March 29th, 2013, the
National Center for Disease Control and Prevention (CDC) isolated a new type of avian influenza virus
from samples collected from patients.

COVID-19 (2019)
The CDC at the local place of the hospital was unable to identify the pathogen on December 26th,
2019, and then sent samples to various testing institutions, including Shanghai Public Health Clinical
Center, and the Chinese Academy of Sciences (Wuhan Virus Institute), etc. The novel coronavirus and
the complete genome sequence had been identified by various testing institutions from December 30th,
2019 to January 5th, 2020. (20) On January 7th, 2020, the National Center for Disease Control and
prevention isolated a new type of coronavirus from samples collected from patients. (21)

The pathogen inspection speed for H7N9(2013) in Shanghai was 31 days, and for COVID-19 (2019) in Wuhan was 12 days.

**Government Responding Speed**

**H7N9 avian influenza (2013)**

On March 31st, 2013, the National Health Administration confirmed that the pathogen was a new type of avian influenza virus. On April 2nd, 2013, the government of Shanghai launched a level-three response to public health emergencies.

**COVID-19 (2019)**

On January 8th, 2020, novel coronavirus was confirmed as the new pathogen by the National Health Administration. On January 22nd, 2020, the government of Hubei province launched a level-two response to public health emergencies. (22)

The government responding speed, for H7N9(2013) in Shanghai and COVID-19(2019) in Wuhan was 4 and 15 days, respectively.

We compared the entire government’s emergency response process of Shanghai H7N9 avian influenza in 2013 and Wuhan COVID-19 in 2019. From the first patient detection to local government’s emergency response, H7N9 avian influenza took 41 days, and COVID-19 took 46 days. In details, on Hospital reporting speed, COVID-19 was 13 days slower than that of H7N9 avian influenza, on pathogen inspection speed, COVID-19 was 19 days faster than that of H7N9 avian influenza, on government responding speed, COVID-19 was 11 days slower than that of H7N9 avian influenza; (Figure 2).

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<tr>
<td>1)</td>
<td>On February 21&lt;sup&gt;st&lt;/sup&gt;, the Fifth People's Hospital Affiliated to Fudan University (Shanghai) admitted a case</td>
<td>On December 8&lt;sup&gt;th&lt;/sup&gt;, as confirmed by the Wuhan Health and Medical Commission on January 11&lt;sup&gt;th&lt;/sup&gt;, (In the Lancet paper, Wuhan's first new coronavirus case was on December 1&lt;sup&gt;st&lt;/sup&gt;)</td>
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<td>2)</td>
<td>On February 26&lt;sup&gt;th&lt;/sup&gt;, the Fifth People's Hospital Affiliated to Fudan University (Shanghai) submitted a report to the District CDC and requested for an epidemiological investigation</td>
<td>On December 26&lt;sup&gt;th&lt;/sup&gt;, Hospital of Integrated Traditional Chinese and Western Medicine (Wuhan) reported 4 abnormal cases to the District CDC</td>
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<td>3)</td>
<td>On March 22&lt;sup&gt;nd&lt;/sup&gt;, P3 Laboratory of Shanghai Public Health Clinical Center initially identified it as a new avian influenza virus</td>
<td>On January 5&lt;sup&gt;th&lt;/sup&gt;, a novel coronavirus was initially identified by various institutions including Shanghai Public Health Clinical Center</td>
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<tr>
<td>4)</td>
<td>On March 29&lt;sup&gt;th&lt;/sup&gt;, the National CDC isolated a new type of avian influenza virus from patients' samples</td>
<td>On January 7&lt;sup&gt;th&lt;/sup&gt;, the National CDC isolated a novel coronavirus from patients' samples</td>
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<tr>
<td>5)</td>
<td>On March 31&lt;sup&gt;st&lt;/sup&gt;, the National Health Administration confirmed that the pathogen was a new type of avian influenza virus</td>
<td>On January 8&lt;sup&gt;th&lt;/sup&gt;, the novel coronavirus was confirmed by the National Health Administration</td>
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<td>6)</td>
<td>On April 2&lt;sup&gt;nd&lt;/sup&gt;, Shanghai launched a level-three response to public health emergencies</td>
<td>On January 22&lt;sup&gt;nd&lt;/sup&gt;, Hubei Province launched a level-two emergency response to public health emergencies</td>
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Figure 2. Comparison of 3 critical speed between H7N9 (2013) in Shanghai and COVID-19 in Wuhan.
Discussion

To our knowledge, this was one of the few studies conducted in China to compare the strength and weaknesses of public health emergency management to COVID-19. In this retrospective comparative analysis, the speed of detection unknown pathogens had improved significantly from H7N9 to COVID-19, whereas the time of epidemic reports from certain hospitals to local CDC, and government decision-making of Hubei province was significantly slow.

In this study, we mainly explored three speeds that influence the efficiency of emergency management to public health emergencies. During the emergency response process for H7N9 avian influenza (2013) in Shanghai, the most time-consuming stage was to technically identify and re-check the pathogen. The technical identification of pathogen cost 24 days, and the re-check cost 7 days, which accounted for 76% of the whole emergency process. By contrast, the time of technical identification and re-check the pathogen in COVID-19 was significantly reduced with just 12 days, accounted for 26% of the whole emergency process.

The improvement of laboratory technical capacity had saved 19 days for the emergency disposal time of COVID-19, whereas the total disposal time was 5 days longer than those in H7N9 avian influenza. The main reason might that the decrease in the reporting speed of certain hospitals, as well as the local government reaction. Compared with H7N9 avian influenza, the time interval for the hospital case reporting to the local CDC was later for 13 days (18 days v. s. 5 days) during the emergency response of COVID-19 prevention and control in China. Further, the reaction speed of local government launching emergency management was 15 days for COVID-19, 11 days longer than that in H7N9 avian influenza.

Let's assume a scenario: If we combined the hospital reporting speed and government responding speed of H7N9, as well as the COVID-19 pathogen inspection speed, the entire epidemic control will take less than 22 days. And Hubei Province could thus actually launch an emergency response on December 30th, which meant there were about 27 cases in Hubei Province and the number of close contacts was about 1350 by early March in 2020. The Wuhan Infectious Diseases Hospital alone had 350 beds, which was enough to achieve full admission. The local CDC also had sufficient capabilities to screen and isolate all patients in close contact.

For the overall disposal time of the emergency process of COVID-19, which is 5 days longer than that in H7N9(2013) in Shanghai. The reasons behind might be the speed of Wuhan hospital reporting and government responding to the COVID-19 epidemic constrained by objective conditions. 1) At the beginning stage of epidemic, H7N9 seemed to show larger threats, it had been only 7 days between the first case detection and the first report of death (On February 28th, 2013, the first death occurred; As for COVID-19, this time length was 32 days instead, On January 9th,(19) forced local medical institutions and disease control departments to speed up and took actions. 2) Due to under-reporting of cases given challenges in data collection, shortage of testing kits and reagents in Hubei province. Furthermore, the local medical supplies, beds, facilities in short supply, exacerbated if lockdown preventing supplies from reaching hospitals.

This study has several potential limitations. Firstly, the assessment coverage stays at the city level, lacking the comparison between the national level and the grass-roots level. The grass-roots level is the first gateway of public health emergency, and the effective measures and emergency response taken by the grass-roots level are important periods of emergency response. Second, we used 6-time nodes to evaluate the process of the government’s emergency response, which is relatively narrow for evaluating epidemic of major infectious diseases. Finally, the data is based on China official and authoritative reports, coupled with retrospective study, which inevitably had limitations.

Conclusions

From H7N9 to COVID-19, the detection speed of unknown virus pathogen has been greatly increased in China. However, the time of epidemic reports from certain hospitals to local CDC, and the decision-making by the government in Hubei Province was significantly slow, which might be one of the vital influential factors of the outbreak and widespread of COVID-19. These matters need to be addressed urgently to prepare for public emergency management for the prevention and control of emerging infectious diseases in China and international community in the future.

Conflict of interests

The authors declare no competing financial interest.

Acknowledgement

This study was supported by the National Natural Science Foundation of China (Nu:71874033) and Key project of Philosophy and Social Science Research of the Ministry of Education (Nu:15JZD029)
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On December 8th, as confirmed by the Wuhan Health and Medical Commission on January 11th. (In the Lancet paper, Wuhan’s first new coronavirus case was on December 1st)

On December 26th, Hospital of Integrated Traditional Chinese and Western Medicine (Wuhan) reported 4 abnormal cases to the District CDC

On January 5th, a novel coronavirus was initially identified by various institutions including Shanghai Public Health Clinical Center

On January 7th, the National Health Administration confirmed that the pathogen was a new type of avian influenza virus

On January 8th, the novel coronavirus was confirmed by the National Health Administration

On January 9th, the first death occurred

On January 22nd, Hubei Province launched a level-two emergency response to public health emergencies

On February 26th, the Fifth People’s Hospital Affiliated to Fudan University (Shanghai) submitted a report to the District CDC and requested for an epidemiological investigation

On February 28th, the first case to the death occurred

On February 21st, the Fifth People’s Hospital Affiliated to Fudan University (Shanghai) admitted a case

The hospitalization of the first case

On March 29th, the National CDC isolated a new type of avian influenza virus from patients’ samples

On March 31st, the National Health Administration confirmed that the pathogen was a new type of avian influenza virus

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On March 31st, the National Health Administration confirmed that the pathogen was a new type of avian influenza virus

On April 2nd, Shanghai launched a level-three response to public health emergencies

The time period from the detection of the first patient to local government’s emergency response is 41 days and 46 days.
Figure 2. Comparison of 3 critical speeds between H7N9 (2013) in Shanghai and COVID-19 in Wuhan.

- **Hospital reporting speed**: 13 days slower
- **Pathogen Inspection speed**: 19 days faster
- **Government responding speed**: 11 days slower

2013 Shanghai H7N9

2019 Wuhan COVID-19

41 days

46 days

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