A Novel Coronavirus Outbreak: A Teaching Case-Study

Student's Guide

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Abstract

Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV). Coronavirus disease 2019 (COVID-19) is an infectious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It was first identified in December 2019 in Wuhan, Hubei, China, and has resulted in an ongoing pandemic. Common symptoms include fever, cough, fatigue, shortness of breath, and loss of smell and taste. While the majority of cases result in mild symptoms, some progress to acute respiratory distress syndrome (ARDS) possibly precipitated by cytokine storm, multi-organ failure, septic shock, and blood clots. The time from exposure to onset of symptoms is typically around five days, but may range from two to fourteen days.

This case study stimulates the trainees to consolidate their knowledge and improve their public health practices to detect, timely respond to threating pandemics and control/prevent them. Case studies allow trainees to build competencies in analyzing and interpreting data in order to make decisions on containing similar public health threats with consideration of the political context. The case study is designed for the training of intermediate and advanced Field Epidemiology trainees; it can be administered in 6 hours.

Keywords: Coronavirus, Epidemic, Novel Virus

How to Use the Case Study?

General instructions: This case study should be used as adjunct training material for intermediate/advanced level FETP residents to reinforce the concepts taught in prior lectures. The case study is ideally taught by a facilitator in smaller groups of about 6-8 participants. Participants take turns reading the case study, usually one paragraph per student. The facilitator guides the discussion on possible responses to questions. It is important that facilitators encourage discussion and critical thinking, rather than emphasize a focus on the "correct" answer, as discussion questions do not have a single "correct" response. The facilitator may use flip charts or other display methods to illustrate certain points. Additional instructor's notes for facilitation are coupled with each question in the instructor's guide to aid facilitation.

Audience: This case study was developed for field epidemiology residents. However, other health care workforce working in the national and sub-national departments of epidemiology and public health surveillance whose formal training may be as medical doctors, nurses, environmental health officers, veterinary or laboratory scientists who work in public health-related fields, can be trained on this case study.

Prerequisites: Before using this case study, participants should have received lectures on disease surveillance, detection and control of outbreak.

Materials needed: Flash drive, flip charts, markers, computers with MS Excel and Epi Info

Level of training and associated public health activity: intermediate and advanced FETP–Outbreak investigation

Time required: 6 hours

Language: English

Goal of Case Study: The goal of this case study is to consolidate the knowledge and improve practices of the participants to detect, response to and control/prevent threating pandemics.

Learning Objectives: By the end of the teaching session, participants will be able to:

1. State the case definition of suspected, probable and confirmed cases of novel respiratory virus infection
2. Identify and apply IHR guidelines for the preparedness and response to international spread of diseases
3. Calculate and interpret important epidemiological characteristics, demographic and clinical indicators of novel respiratory virus infection
4. Describe the surveillance settings during a novel virus outbreak
5. Discuss how to implement preventive and infection control measures under the One Health approach
6. Create a public health communication plan for multiple audiences at the national and regional levels
7. Establish a coordination mechanism with relevant stakeholders within the country, region and worldwide

Introduction

The People's Republic of China (PRC), in East Asia is the world's most populous country, with a population of around 1.428 billion in 2017. China covers approximately 9,600,000 square kilometers with population density of 149.93 people per square kilometer [1]. About 17% of the population were 14 years old or younger, 70% were between 15 and 59 years old, and 13% were over 60 years old. The population growth rate for 2018 is estimated to be 0.46% [1]. By 2015, less than 3.1% of the Chinese population lived below the international poverty line of US$1.9 per day [2].

The People's Republic of China is divided into 22 provinces, five autonomous regions (each with a designated minority group), and four municipalities—collectively referred to as "mainland China"—as well as the special administrative regions (SARs) of Hong Kong and Macau. Geographically, all 31 provincial divisions of mainland China are grouped into six regions: North China, Northeast China, East China, South Central China, Southwest China, and Northwest China.

Since the late 1990s, China's national road network has been significantly expanded through the creation of a network of national highways and expressways. In 2018, China's highways had reached a total length of 142,500 km (88,500 mi), making it the longest highway system in the world; and China's railways reached a total length of 127,000 km by 2017. By the end of 2018, China's high-speed railway network reached a length of 29,000 km, representing more than 60% of the world's total. By October 2014, there were 81 such bridges and tunnels. The railways strain to meet enormous demand particularly during the Chinese New Year holiday, when the world's largest annual human migration takes place. In 2013, Chinese railways delivered 2.106 billion passenger trips, generating 1,059.56 billion passenger-kilometers and carried 3.967 billion tons of freight, generating 2,917.4 billion cargo tons-kilometers. There were approximately 229 airports in 2017, with around 240 planned by 2020. With rapid expansion in civil aviation, the largest airports in China have also joined the ranks of the busiest in the world. In 2018, Beijing's Capital Airport ranked second in the world by passenger traffic. Since 2010, the Hong Kong International Airport and Shanghai Pudong International Airport have ranked first and third in air cargo tonnage. China has over 2,000 river and seaports, about 130 of which are open to foreign shipping. In 2017, the Ports of Shanghai, Hong Kong,

Shenzhen, Ningbo-Zhoushan, Guangzhou, Qingdao and Tianjin ranked in the Top 10 in the world in container traffic and cargo tonnage.

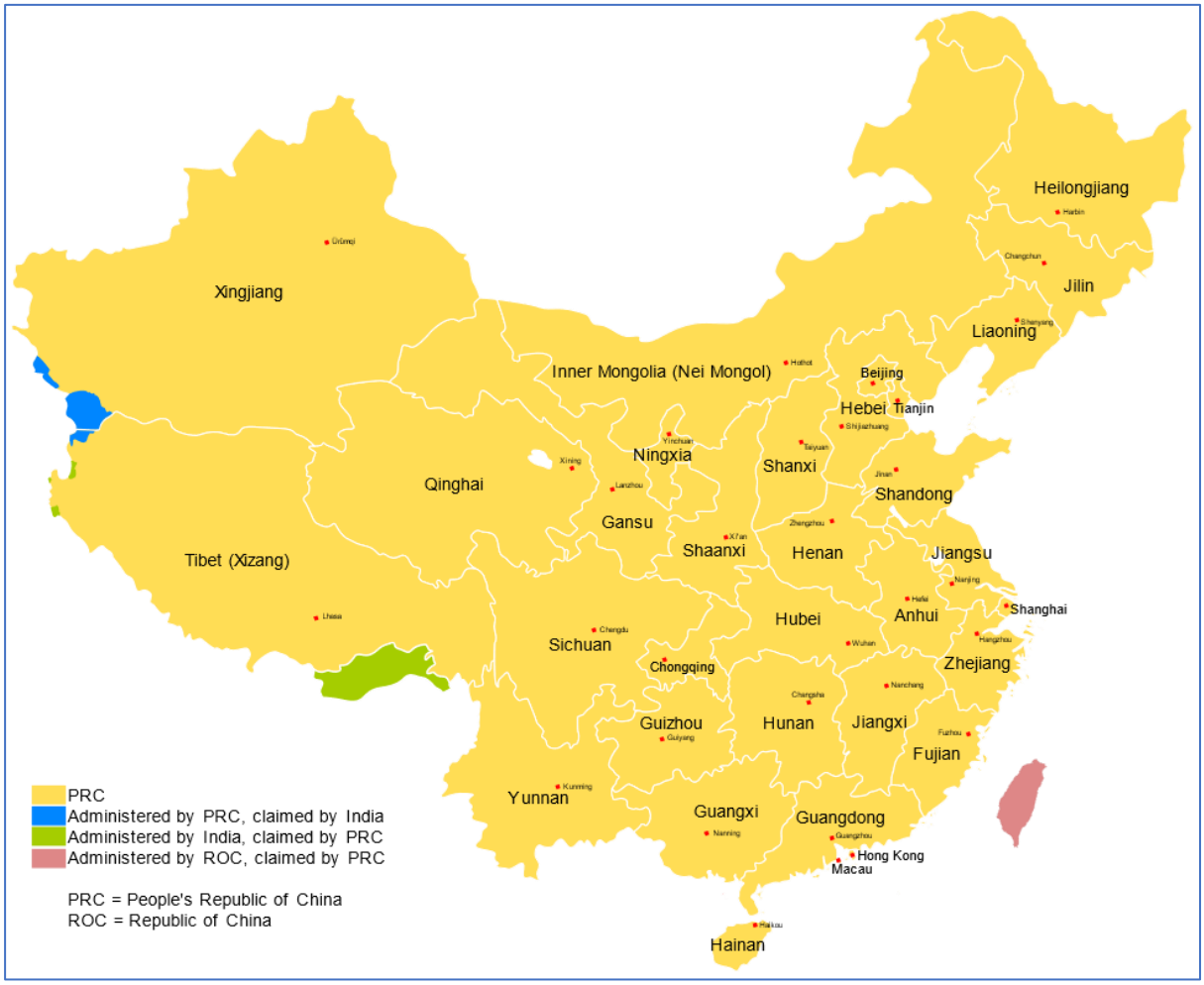

Figure 1: China map (From: Wikimedia Commons)

Water supply and sanitation infrastructure in China face challenges due to rapid urbanization, as well as water scarcity, contamination, and pollution. About 36% of the rural population in China still did not have access to improved sanitation. There are around 1,944 municipal wastewater treatment plants across China's city/urban regions and 1,599 municipal wastewater treatment plants across China's counties, accounting for daily processing capacities of 140 and 29 million cubic meters respectively.

The National Health and Family Planning Commission, together with its counterparts in the local commissions, oversees the health needs of the Chinese population. An emphasis on public

health and preventive medicine has characterized Chinese health policy since the early 1950s. Diseases such as cholera, typhoid and scarlet fever, which were previously rife in China, were nearly eradicated by the Patriotic Health Campaign. After economic reforms in 1978, the health of the Chinese public improved rapidly. Healthcare in China became mostly privatized and experienced a significant rise in quality. In 2009, the government began a 3-year large-scale healthcare provision initiative, the campaign resulted in 95% of China's population having basic health insurance coverage. In 2011, China was estimated to be the world's third-largest supplier of pharmaceuticals, but its population has suffered from the development and distribution of counterfeit medications.

China has several emerging public health problems, such as respiratory illnesses caused by widespread air pollution, hundreds of millions of cigarette smokers, and large population and densely populated cities. In recent years, China was challenged by 2003 outbreak of SARS, and in 2010, air pollution caused 1.2 million premature deaths in China.

Question 1. With such a profile, what is the risk of developing an outbreak of viral respiratory disease in China? Explain the main vulnerability and capacity factors that contribute to this outbreak

Part 1: The Story

On 31 December 2019, the WHO China Country Office was informed of cases of pneumonia of unknown etiology (unknown cause) detected in Wuhan City, Hubei Province of China. From 31 December 2019 through 3 January 2020, a total of 44 case-patients with pneumonia of unknown etiology were reported to WHO by the national authorities in China. During this reported period, the causal agent was not identified. On 11 and 12 January 2020, WHO received further detailed information from the National Health Commission China that the disease was associated with exposures in one seafood market in Wuhan City.

Part 1 questions:

Question 2. What are the possible causes of this condition?

Question 3. Is this an outbreak or an epidemic? Why?

Question 4. What additional data sources are needed at this stage of the event?

Public health authorities in China decided to implement case-based surveillance to enhance the surveillance system.

Question 5. What variables should they consider?

Question 6. What are the features that make case-based surveillance of good quality?

Question 7. What indices that could be generated from case-based surveillance?

Following notification of cases of pneumonia of unknown cause in Wuhan, China on 31 December 2019, a novel coronavirus (COVID-19) was identified as the cause by Chinese authorities on 7 January.

Question 8. What is a novel virus?

Question 9. Public health authorities in China classified cases into probable, suspected, and confirmed cases as the two groups require different approaches. State the case definition of the each?

Question 10. Preliminary data indicate that the incubation period for COVID-19 ranges from 2 to 14 days. Why is it important to know the incubation period?

Fact sheet 1

Coronaviruses (CoV) are a large family of viruses that cause illness ranging from the common cold to more severe diseases such as Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV).
Coronaviruses are zoonotic, meaning they are transmitted between animals and people. Detailed investigations found that SARS-CoV was transmitted from civet cats to humans and MERS-CoV from dromedary camels to humans. Several known coronaviruses are circulating in animals that have not yet infected humans.
The first identified case of MERS occurred in 2012 in Saudi Arabia, and the outbreak was primarily contained in the Arabian Peninsula. However, there was a larger outbreak in the Republic of Korea in 2015, transmitted by someone who had visited Saudi Arabia, the UAE and Bahrain. There were approximately 186 cases and 36 deaths from this outbreak.

Part 2: Methods

As news of the outbreak spread globally, neighboring countries and elsewhere heightened their surveillance to quickly detect potential new cases of the virus. More people infected with COVID-19 were identified in China, and cases were exported to other countries. This was not entirely unexpected given the volume of travel between Wuhan and other countries. Given the initial link between cases and a live animal market, as well as other coronaviruses that have animal reservoirs, an animal source seems the most likely primary source of the outbreak, with some human to human transmission occurring.

Part 2 Questions:

Question 11. Describe steps and type of surveillance system that need to be activated to detect and respond to such an outbreak in China? Do you need to apply the same steps and type in your country? Why? If yes, how?

The Emergency Committee convened on 22 and 23 January 2020 under the International Health Regulations (IHR 2005), and decided that it was not appropriate to declare the COVID-19 outbreak in China a public health emergency of international concern (PHEIC) given the disease's spread and the control efforts undertaken by the PRC.. The WHO Director General accepted this advice. "Make no mistake," commented Dr Tedros, "This is an emergency in China, but it has not yet become a global health emergency. It may yet become one". The Emergency Committee on the novel coronavirus (COVID-19) under the International Health Regulations

Fact sheet 2

In May 2005 the World Health Assembly adopted the revised International Health Regulations (IHR). On June 15, 2007, IHR entered into force and are binding on 194 States Parties.

The purpose and scope of IHR is to prevent, protect against, control and provide a public health response to the international spread of disease and to establish a single code of procedures and practices for routine public health measures.

The benefits to the Member States include; improved surveillance system, effective detection and quick response to public health risks, use of modern communication tools and have access to global resources.

The IHR has identified core capacity requirements that countries must have to detect, report and respond to risks in general, and to those at international ports, airports and land crossings.

"Public Health Emergency of International Concern" (PHEIC) means an extraordinary event which constitutes a public health risk to other States through the international spread of disease, and potentially requires a coordinated international response. If two or more of the four basic criteria are identified, the IHR Focal Point is obliged to report the event to WHO as a PHEIC.

*more details in the readings annexes

(IHR 2005) was reconvened on 30 January. WHO declared the outbreak to be a public health emergency of international concern.

Question 12. On what basis do you think the WHO declared that it is PHEIC?

Question 13. What are the consequences of declaring the status of PHEIC on China, and other countries? What measures need to be activated and/or introduced?

Question 14. What are preventive measures regarding travel around the world?

Question 15. What specific measures to be considered at the points of entry?

Question 16. What would be the impact of such travel bans?

Many countries started the operations of Voluntary evacuations of their citizens from China, with some started quarantining their citizens upon arrival to their home country.

Question 17. Why countries may decide to evacuate their citizens? What are the arrangements need to accompany the evacuation process?

The leader of the surveillance team at the airport called you at 2:30 am to inform you about two arrivals who meet the definition of suspected cases.

Question 18. What actions will you take? Would you announce the updates to the public? Why? If yes, how?

The director of the Epidemiology department requested to collect samples from the two arrivals and send the samples to the lab.

Question 19. What samples are needed to be collected? From where should the samples be collected?

Question 20. Describe the process of handling the samples from the collection till they arrive to the lab? Specify the safety methods and Personal Protection Equipment needed in this case?

Question 21. What considerations should be taken into account at the receiving lab and what are the common laboratory test/s done to confirm the presence of novel corona viruses?

Question 22. What is the role of media at this level to increase awareness and decrease panic

Part 3: Results

A small study of 99 cases observed at Wuhan Jinyintan Hospital, 49 had been exposed to the seafood and animal market believed to be at the center of the outbreak. The average age was 55.5 years and most (67) were men. Fever and cough were the most common symptoms. Seventeen patients developed acute respiratory distress syndrome and 11 of them died of multiple organ failure; 31 of the 99 had been released from the hospital by 25 January.

Question 23. What's the case fatality rate in Wuhan Jinyintan hospital? What does it tell?

By January 31, China has reported 15,238 suspected cases and 9,720 cases were confirmed. The reported deaths due to the outbreak is 213 deaths and 1,527 severe cases. 106 cases were confirmed outside of China in 19 countries in 4 contents.

Question 24. In reference to Table 1, draw the epidemic curve for the total cases at the international level till February 1st?

Question 25. Using the same data draw two additional epidemic curves for new daily cases reported from China and another for cases reported outside China. What are the differences between the two curves? Explain

Table 1. Countries with reported confirmed cases of COVID-19 , Jan 21 to Feb 1, 2020

	1/21	1/22	1/23	1/24	1/25	1/26	1/27	1/28	1/29	1/30	1/31	2/1
China	446	579	581	846	1300	2000	2800	4600	6100	7800	9800	12000
Thailand	0	0	4	4	4	5	5	14	14	14	19	19
Japan	0	0	1	1	3	3	4	6	7	11	15	17
Singapore	0	0	0	1	3	4	4	7	7	10	16	16
Australia	0	0	0	0	3	4	4	5	7	7	9	12
Republic of Korea	0	0	1	2	2	2	3	4	4	4	11	12
Malaysia	0	0	0	0	0	3	4	4	4	7	8	8

Germany	0	0	0	0	0	0	0	1	4	4	6	7
USA	0	0	1	1	2	2	5	5	5	5	6	7
Viet Nam	0	0	0	2	2	2	2	2	2	2	2	5
France	0	0	0	0	3	3	3	3	4	5	6	6
Canada	0	0	0	0	0	0	1	2	3	3	3	4
UAE	0	0	0	0	0	0	0	0	4	4	4	4
Italy	0	0	0	0	0	0	0	0	0	0	2	2
Russia	0	0	0	0	0	0	0	0	0	0	2	2
UK	0	0	0	0	0	0	0	0	0	0	2	2
Spain	0	0	0	0	0	0	0	0	0	0	0	1
Sweden	0	0	0	0	0	0	0	0	0	0	1	1
Sri Lanka	0	0	0	0	0	0	0	1	1	1	1	1
Nepal	0	0	0	0	1	1	1	1	1	1	1	1
Philippines	0	0	0	0	0	0	0	0	0	1	1	1
India	0	0	0	0	0	0	0	0	0	1	1	1
Cambodia	0	0	0	0	0	0	0	0	0	1	1	1
Finland	0	0	0	0	0	0	0	0	0	1	1	1

Till February 1st, all deaths due to the corona outbreak were reported in China. The summary of deaths is shown in Table 2

Table 2: Summary of total deaths from COVID-19 worldwide

Date	Deaths
21-Jan	9
22-Jan	17
23-Jan	25
24-Jan	41
25-Jan	56
26-Jan	80
27-Jan	106
28-Jan	132
29-Jan	170
30-Jan	213
31-Jan	259

Question 26. Draw the curve for the total deaths worldwide till February 1st?

Question 27. Calculate the fatality rate? Compare the calculated case fatality rate (CFR) to those of SARS, MERS-COV, and measles?

Question 28. The Transmission Rate (R0) for COVID 19 is estimated at between 1.5 to 3.5. How is it calculated? What does this rate mean?

Part 4: Discussion

EMPHNET, has invited the FETP Directors and Technical Advisors in the EMR region to discuss the current threat and provides technical recommendation to MOHs. You are assigned as the facilitator of this meeting

Question 29. What strategic objectives for response would you suggest for the audience to discuss and recommend to MOHs in the regional levels?

In response to the epidemic, WHO has released some guidelines and tools, two of them are; the "Household transmission investigation (HTI) protocol for 2019-novel coronavirus (COVID-19) infection" and the "First Few X cases (FFX)" protocols.

Question 30. Compare between the HTI and FFX regarding their purposes, uses, and limitations.

It was seen that the cases were exported to 28 countries except to central Asia, Middle East (except one country) and African continent.

Question 31. What will be the main reasons for not reporting imported cases in those parts of the world?

The World Health Organization on Feb. 11 convened 400 scientists at a global research and innovation forum to draw up an R&D blueprint for COVID-19. Now, companies and institutions are developing technologies to develop rapid and flexible diagnostics, including Point of Care (POC) diagnostics, vaccines, and therapeutics against novel coronavirus and the efforts are still ongoing.

Question 32. How long it will take to develop vaccines, diagnostics and therapeutics for unknown viral infections?

Since its announcement, many countries and peoples around the global started to be concerned by the outbreak and some panicked. MOH has assigned you as the focal person for risk communication during this event.

Question 33. Design a risk communication plan to manage the situation during the current outbreak at the national level?

Part 5: Conclusion:

Coronavirus infection is considered highly contagious, and the countries of the EMR are at high risk. The countries need to collaborate and work in a coordinated fashion to support each other's capacity. Now, you have been assigned by EMPHNET as the focal person to coordinate the preparedness and response activities with the countries and other partners.

Question 34. Suggest a coordination plan to facilitate coordinating the EMR countries to effectively and efficiently manage the current the threat.

Question 35. What is the role of FETP in the country to support the national efforts in preparing for and responding to such an outbreak?

FETPs in the region have been updating their countries' daily COVID-19 cases and deaths.
Question 36. Referring to the table in the annex, draw the epidemic curve for each country as well as the regional curve. What is the CFR in each country?

Annexes

Annex 1: "Household Transmission Investigation"

Annex 2: "First Few X cases (FFX)" protocol

Annex 3: International health regulations (2005)

Annex 4: Daily cases and deaths of COVID-19 in the EMR

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