Case Report

Implications for Online Management: Two Cases with COVID-19

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Abstract

Satisfactory outcome was observed in one mild case and one severe case of COVID-19 pneumonia after the use of the online/offline multidisciplinary quarantine observation form, online monitoring, and classified diagnosis and treatment, as well as strict compliance with quarantine measures. Conditions of both patients were improved, and cross-infection and disease onset clustering were not observed. The multidisciplinary self-quarantine model provides early judgment, identification, and treatment of disease, improves compliance with early rehabilitation, increases confidence in recovery, and enhances self-management capabilities. This model is applicable to the current novel coronavirus pneumonia epidemic and can actively promote the management of suspected or confirmed mild cases, monitoring of critical cases, and self-management of discharged patients. The application of this new management model is worthy of being promoted in our specialized treatment facilities and in countries with severe epidemics.

Keywords: *novel coronavirus pneumonia, quarantine, multidisciplinary collaboration, self-management, online management, telemedicine, e-Health*

Introduction

Pneumonia of unknown cause, detected in Wuhan City since December 2019, is now confirmed to be an acute respiratory infection caused by the novel coronavirus (COVID-19), which is currently known as the novel coronavirus pneumonia (NCP). NCP is highly infectious and is primarily transmitted through droplets and contact.[1] Early on March 10, 2020, there were 80,924 confirmed cases, 3,140 deaths, and 59,982, cured cases in China. A total of 7,478, 7,161, and 9,172 confirmed cases, and 53, 237, and 463 deaths have also been identified in South Korea, Iran, and Italy, respectively. The rapid spread of disease and increase in confirmed cases have posed a great challenge to the health care system of China and other countries. The shortage of treatment facilities and medical staff is a prominent problem in the face of a major epidemic.

Wuhan is the hardest-hit city due to the rapid increase in cases and limited medical resources during the early phase of the NCP epidemic. As a result, we developed a multidisciplinary self-managed home quarantine method that was not only effective in the control of the source of infection, but was also helpful in alleviating the shortage of medical resources in the later phase of the epidemic, along with the opening of specialized treatment facilities and support from medical experts nationwide.

In this study, we review the successful recovery of one mild case and one severe case to provide a practical management model for quarantine and epidemic prevention and control.

Clinical Data

GENERAL INFORMATION AND TREATMENT OUTCOME

Case 1 was a 32-year-old male physician in the emergency department of a class A tertiary hospital. The patient had been healthy without any underlying disease but had contact with NCP patients. The patient presented with cough and rhinorrhea on January 15 and developed dyspnea, soreness, lack of strength, and fever (38.5°C) on January 19. He received oral oseltamivir, arbidol, and avelox as per the physician's instructions and was rested and quarantined at home. From January 19 to 20, the patient had persistent fever with chest tightness, dyspnea, soreness, lack of strength, and diarrhea, and his SpO_2 was 95–97%. His symptoms gradually improved after the use of the multidisciplinary self-quarantine method and his computed tomography (CT) results indicated significant absorption of lesions in the lung (*Fig. 1*). The patient's throat swab samples tested negative for COVID-19 nucleic acid on February 20 and 21.

Case 2 was a 31-year-old male physician in the emergency department of a class A tertiary hospital. The patient had been healthy without any underlying disease but had contact with an NCP patient. The patient developed persistent fever (maximum 39.5°C) of unknown cause on January 5 and his CT results revealed blurry patchy shadows in the lower right lobe of the lung. The patient subsequently developed chest

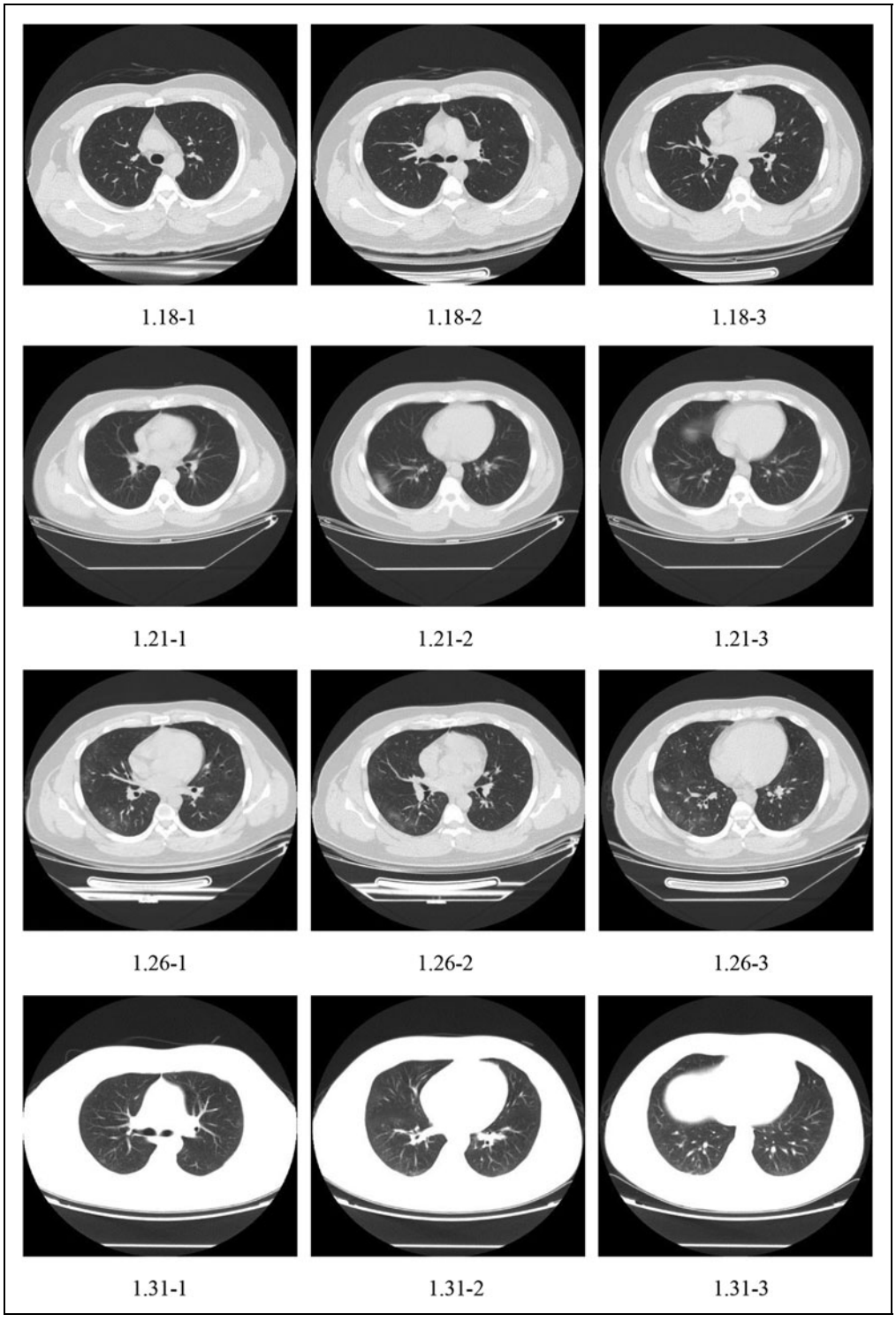

Fig. 1. Changes in CT results of case 1. CT, computed tomography.

tightness and dyspnea on January 7 and was quarantined in the emergency department for observation. The patient was admitted into the respiratory department on January 10 and his CT results on January 14 indicated significant pathological changes. He was given alternating noninvasive mechanical ventilation and high-flow oxygen therapy, and his SpO_2 was 89–97%. The patient tested positive for COVID-19 nucleic acid on January 16 and was thereby transferred to the ICU of a hospital dedicated for the treatment of NCP on January 17. The patient's conditions began to improve on day 25 after onset, and his CT results indicated significant absorption of lesions in the lung (*Fig. 2*). The patient's throat swab samples were consecutively tested negative for COVID-19 nucleic acid and fever was not detected for 17 days. The patient was eventually transferred to the general quarantine ward.

Detailed medical histories of case 1 and case 2 are given in Supplementary Data S1.

Multidisciplinary Self-Quarantine Model

CONTROL OF SOURCE OF INFECTION BY DISINFECTION AND QUARANTINE

Strict implementation of quarantine measures is a key to successful recovery. Both cases in this report were medical staff with a great knowledge of quarantine and good compliance. While case 1 was living by himself, case 2 was living with his family and had to undergo single-room quarantine. Both cases strictly implemented the instructions of the nursing staff, including (1) ventilating the

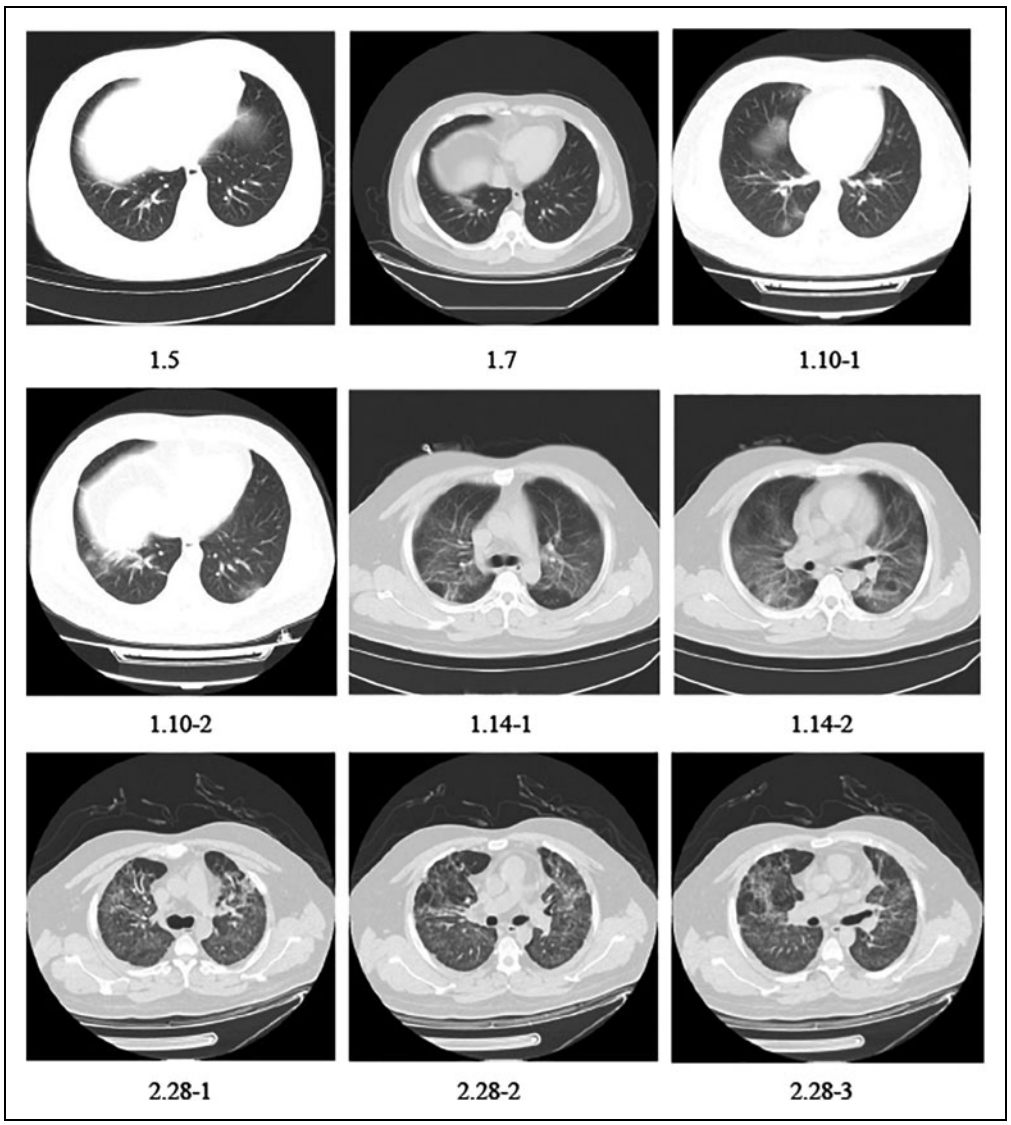

Fig. 2. Changes in CT results of case 2.

room at least twice a day and having few simple items and a garbage bin with a cover in the room, (2) cleaning surfaces with 1,000 g/L chlorinated disinfectant or 75% alcohol at least once daily and washing hands frequently, (3) using a separate set of utensils for eating and washing and sterilizing (56°C for 30 min or longer) the utensils separately, and (4) sterilizing clothes at high temperature (60–90°C) then washing them separately with general laundry detergent, followed by complete drying.[2]

CLOSE ONLINE/OFFLINE MONITORING BY A MULTIDISCIPLINARY TEAM AND CLASSIFIED QUARANTINE

Establishment of a multidisciplinary team and development of a quarantine observation form. We formed a quarantine team comprising experts in medicine, rehabilitation, psychology, and nursing, and created a WeChat group for ease of communication. Based on the clinical symptoms of NCP, we developed an online quarantine observation form (*Table 1*), in which each symptom can be evaluated using options in the pull-down menu. The two patients were asked to truthfully record their current symptoms and severity on this form through their phones, and the frequency of observation was determined based on their actual conditions by the multidisciplinary team. This form primarily contains general information of the two cases and progression of their clinical manifestations, such as fever, cough, and lack of strength.

Online guidance for self-monitoring. The two home quarantine cases were asked to record their conditions at least once daily by our multidisciplinary team. Changes in conditions must be truthfully recorded and an emergency contact must be set up on each individual's phone. Case 1 had a thermometer and a portable oximeter for measuring changes in body temperature and blood oxygen saturation, respectively. Changes in the conditions of case 1 from January 19 to February 1, 2020 are given in *Table 1*, and disease progression is shown in *Figures 3* and *4*. Case 2 developed persistent fever with chest tightness and dyspnea during the first 3 days of home quarantine. He was advised to stay in the emergency quarantine ward for symptomatic treatment during his follow-up visit and was subsequently hospitalized for treatment after 3 days due to worsening symptoms.

Online guidance for treatment regimen during quarantine. Treatment regimen was adjusted by the multidisciplinary team based on the efficacy reported in the online observation form. Case 1 had been taking oral oseltamivir, arbidol, and avelox for 8 days since January 19, and at 6:00 pm on January 28,

Table 1. Online Quarantine Record Form for Suspected/Confirmed COVID-19 Patients with Mild Symptoms

NAME	Ke	AGE	32 years old	OCCUPATION	Physician
INITIAL SYMPTOMS	Fever and chest tightness	DATE OF ONSET	January 18, 2020	BODY TEMPERATURE	38.5°C
CHEST CT	Features of viral pneumonia			C-REACTIVE PROTEIN	–
PCT	–	THROAT SWAB TEST	Positive	BLOOD TEST	Increased monocytes

QUARANTINE FOLLOW-UP RECORD DATE, TIME, BODY TEMPERATURE, AND MENTAL STATE (1 TO 10, 1 = EXTREMELY POOR, 10 = EXTREMELY GOOD), OPTIONS FOR OTHER PARAMETERS ARE IN THE PULL-DOWN MENU

DATE	TIME	BODY TEMPERATURE (°C)	MENTAL STATE	MUSCLE SORENESS	COUGHING	CHEST TIGHTNESS	DYSPNEA	LACK OF STRENGTH	DIARRHEA	BLOOD OXYGEN SATURATION (%)
January 19, 2020	18:00	38	3	Severe	No change	Orthopnea	No change	Severe	Watery stool, five times a day	–
January 19, 2020	22:00	37.8	3	Severe	No change	Orthopnea	No change	Severe	Watery stool, six times a day	–
January 20, 2020	7:00	37.8	4	Severe	No change	Lacked endurance	No change	Severe	Watery stool, four times a day	96
January 20, 2020	13:00	37	4	Exacerbated	No change	Lacked endurance	No change	Severe	Absent	95
January 20, 2020	18:00	37	5	Exacerbated	No change	Lacked endurance	No change	Severe	Absent	96
January 20, 2020	22:00	37.3	5	Severe	No change	Lacked endurance	No change	Severe	Absent	96
January 21, 2020	8:00	36.8	5	Improved	No change	Lacked endurance	Exacerbated	Improved	Absent	97
January 21, 2020	15:50	36.3	6	Improved	No change	Lacked endurance	Exacerbated	Improved	Absent	96
January 21, 2020	21:30	36	7	Improved	No change	Lacked endurance	Exacerbated	Improved	Absent	95
January 22, 2020	9:00	36.5	7	Improved	No change	Lacked endurance	Exacerbated	Improved	Absent	95
January 22, 2020	15:50	36.4	7	Improved	No change	Lacked endurance	Improved	Improved	Absent	96
January 22, 2020	21:00	36.4	7	Improved	Severe	Lacked endurance	Improved	Improved	Absent	94
January 23, 2020	10:30	36.7	8	Absent	Severe	Improved	Improved	Improved	Absent	95
January 23, 2020	21:00	35.8	7	Absent	Severe	Improved	Improved	Improved	Absent	96
January 24, 2020	10:00	36.7	8	Absent	Severe	Lacked endurance	Exacerbated	Improved	Absent	95
January 24, 2020	21:00	36.5	7	Absent	Severe	Lacked endurance	Exacerbated	Improved	Absent	94

continued →

Table 1. *continued*

DATE	TIME	BODY TEMPERATURE (°C)	MENTAL STATE	MUSCLE SORENESS	COUGHING	CHEST TIGHTNESS	DYSPNEA	LACK OF STRENGTH	DIARRHEA	BLOOD OXYGEN SATURATION (%)
January 25, 2020	8:00	36.4	8	Absent	Improved	Improved	Exacerbated	Improved	Watery stool, three times a day	96
January 25, 2020	21:00	36.4	7	Absent	Improved	Improved	Improved	Absent	Absent	97
January 26, 2020	7:00	36.4	8	Absent	Improved	Improved	Improved	Absent	Absent	96
January 26, 2020	20:00	36.7	7	Absent	Improved	Improved	Improved	Absent	Absent	98
January 27, 2020	8:00	36.1	7	Absent	Improved	Improved	Improved	Absent	Absent	96
January 27, 2020	19:00	36.7	7	Absent	Improved	Improved	No change	Absent	Absent	97
January 28, 2020	9:00	36.4	8	Absent	Improved	Improved	No change	Absent	Absent	96
January 28, 2020	20:00	36.5	7	Absent	Improved	Improved	No change	Absent	Absent	97
January 29, 2020	8:00	36.4	8	Absent	Improved	Improved	Improved	Absent	Absent	97
January 29, 2020	20:00	36.7	8	Absent	Improved	Improved	Improved	Absent	Absent	96
January 30, 2020	8:00	36.4	8	Absent	Improved	Absent	Improved	Absent	Absent	98
January 30, 2020	20:00	36.4	8	Absent	Improved	Absent	Improved	Absent	Absent	99
January 31, 2020	8:00	36.5	8	Absent	Improved	Absent	Improved	Absent	Absent	98
January 31, 2020	20:00	36.1	9	Absent	Improved	Absent	Improved	Absent	Absent	100
February 1, 2020	8:00	36.6	10	Absent	Improved	Absent	Improved	Absent	Absent	99

CT, computed tomography; PCT.

Note: Mental state is evaluated based on a 1–10 point scale, where 1 represents extremely poor and 10 represents extremely good. Muscle soreness, coughing, chest tightness, dyspnea, and lack of strength are evaluated by absent, severe, exacerbated, no change, or improved in the pull-down menu. If diarrhea is observed, fill in the frequency and type of diarrhea.

he began to develop itchy rose spots on both hands with no sign of fever. After online consultation with a dermatologist, case 1 was recommended to take oral antiallergic medication (cetirizine) and apply calamine lotion, which gradually improved his skin rash. Given that the patient had elevated alanine aminotransferase level but improved clinical symptoms, treatment discontinuation and close monitoring were subsequently recommended. The patient's conditions became stable in the next few days and his mental state gradually improved. Changes in symptoms of case 1 are shown in *Figure 2*.

REDUCTION OF SUSCEPTIBILITY/RISK AND EARLY PULMONARY REHABILITATION

A reduction in lymphocyte count may impact the immune function of NCP patients. Since there is currently no cure for NCP, the immune system is the key "weapon" for recovery.

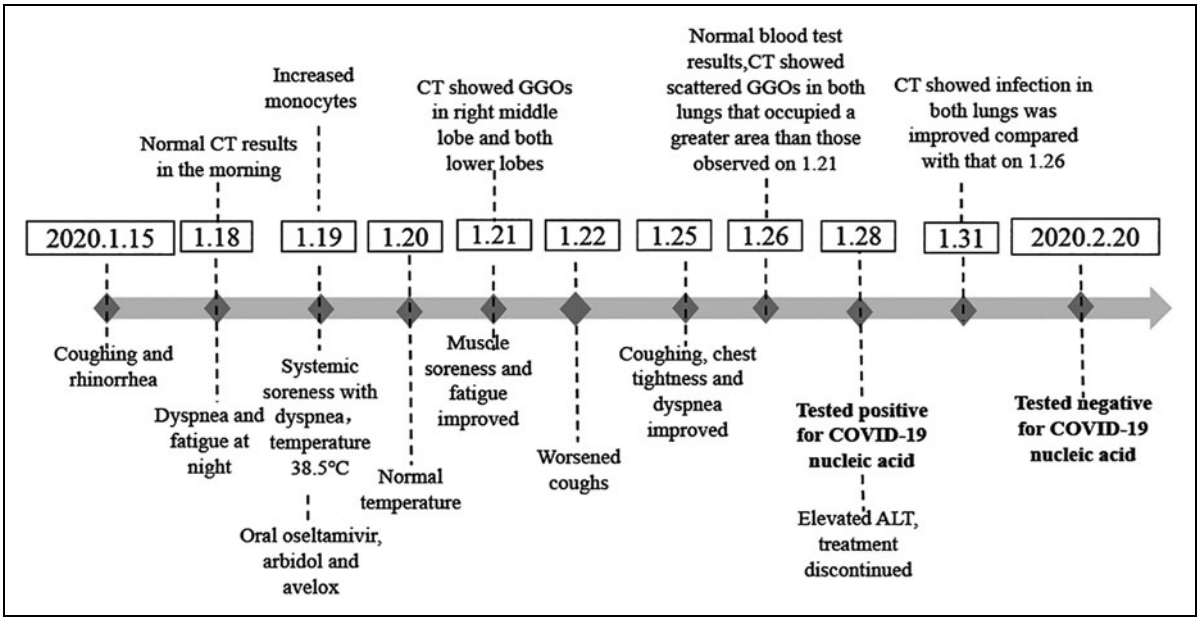

Fig. 3. Disease progression of case 1.

Enhanced care, positive mentality, and improved resistance. Care for NCP patients should be enhanced during quarantine. Patients with diarrhea should consume low-sodium diets and avoid oily foods. Patients with fever should mainly consume rice soup, noodle, and vegetables to avoid exacerbation of diarrhea. Mentality is an important factor for overcoming a disease. Previous studies[3,4] have shown that negative emotions, such as anxiety and depression, can adversely affect the cellular immunity of cancer patients and, in turn, affect treatment efficacy. When a person is quarantined alone at home, it is inevitable that he/she may feel physically uncomfortable, scared, lonely, and depressed. Although case 1 lived by himself, he was able to release his negative emotions by regularly talking with his family through phone or video calls and thereby maintain an optimistic attitude.

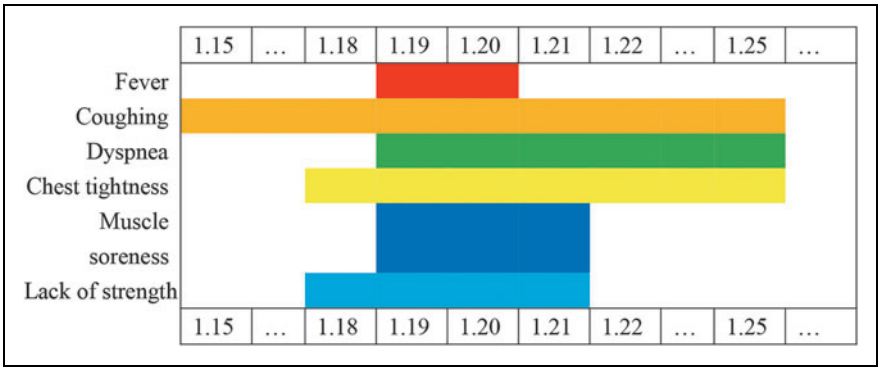

Fig. 4. Time of appearance and disappearance of clinical symptoms in case 1.

Early pulmonary rehabilitation and exercise. Patients were recommended to rest, avoid excessive work, and do pulmonary rehabilitation exercises when they feel physically fit. Baduanjin (eight section brocade)[5] is a traditional Chinese exercise that regulates *qi* and blood in organs, restores metabolic functions, strengthens the body, activates physical vitality, and improves the immune system. Changes in patient's blood oxygen saturation and heart rate were monitored in real-time during the exercise. When blood oxygen saturation dropped <95% or heart rate increased >120 beats/min, patients were recommended to stop exercising and to rest and adjust breathing.

IMPLICATIONS

Lesion absorption was slower than clinical symptom improvement, and symptom recurrence should not be neglected during observation and care.

The early imaging features of NCP are multiple small patchy shadows and interstitial changes in the outer zone of the lungs. These features can subsequently progress into multiple ground-glass opacities (GGOs) and infiltration shadows as well as pulmonary consolidation in severe cases. However, pleural effusion was rarely observed. As shown in *Figure 1*, the CT results of case 1 were normal on day 3 of symptoms, and GGOs were only observed on day 7 in his CT re-examination. Although the patient's

clinical symptoms improved and disappeared by day 11 of onset, his CT results showed significant expansion of GGOs, which suggests that the severity of symptoms in mild cases does not correspond to the severity of NCP detected by CT, and CT changes may emerge later than clinical manifestations during the early stage of the disease. As a result, infected individuals without CT changes are easily neglected, especially individuals without symptoms or with mild symptoms who are not quarantined, and the lack of attention to these individuals can lead to disease dissemination. Therefore, individuals with persistent symptoms such as fever, coughing, chest tightness, and diarrhea that are suggestive of NCP are recommended to seek medical attention immediately.[2] Chest CT results should be used as an important basis for early screening, and quarantined individuals should return regularly for CT re-examination to allow physicians to monitor the progression of infection and to guide clinical treatment and care.

The multidisciplinary self-management model is worthy of wide application. The patients in this report were enrolled in the multidisciplinary self-management system since the early stage of the disease. The patients have filled out the online quarantine observation form based on the changes in their conditions, and experts in the multidisciplinary team were able to learn about the patient's conditions timely, monitor the dynamic changes in their conditions, and provide further medical guidance. Nursing experts in the medical observation team provided guidance on quarantine and disinfection, oversaw the patients' diet and sleeping schedule, and reminded the patients to record their conditions and drug-related reactions online at least twice per day. Rehabilitation experts developed a practical and feasible rehabilitation plan for the patients, and psychotherapists encouraged the patients to keep an optimistic attitude. All of these measures are very helpful for improving the patient's immune response. It is also important to note that a quarantined individual is not alone as the medical observation team is always present to keep a close eye on the individual's conditions and provide appropriate guidance. If continuous deterioration in conditions, <90% blood oxygen saturation, persistent fever and diarrhea, or reduction in mental state score, is observed, the quarantined individual is urged to seek medical attention to prevent delayed treatment. Our model enabled medical experts to closely monitor disease progression in both cases (one mild case and one severe case), which allowed the classified quarantine and treatment of the patients that ultimately resulted in satisfactory recovery. Given that the number of NCP patients is currently increasing, home quarantine may serve as an effective measure for controlling the source of infection as it reduces patient mobility.[7] Active participation in self-monitoring by patients with mild symptoms not only improves the patient's initiative but also helps compensate the overloaded medical system. It is worth noting that individuals must strictly adhere to the principles of quarantine when they are quarantined at home to avoid familial clustering of infection. As more shelters continue to open, our model may prove to be useful for the observation of sheltered and discharged patients as well as for the improvement of patients' self-management capabilities.

In addition, the rapid spread of NCP has led to increased number of confirmed cases in other countries including South Korea, Japan, and Italy, posing a major threat to public health worldwide. Our online/offline multidisciplinary epidemic management model has demonstrated some success in the management of mild cases and screening of severe cases. Furthermore, clustered infection was not observed in cases 1 and 2 during the quarantine period. Our management model was not only helpful for the screening of confirmed or suspected cases during the early stage when there was a lack of knowledge about the infectious disease, but it was also useful for the management of mild and severe cases during the epidemic as well as for the follow-up of discharged patients. We believe that our model has great potentials in providing effective control of NCP in other countries and serves as a feasible response to a widespread infectious disease.

In summary, confirmed or suspected NCP patients with mild symptoms should ensure sufficient rest, have a balanced diet, and keep an optimistic attitude during the quarantine period. These patients should also monitor their conditions closely, improve self-management of the disease, fill out the quarantine observation form in time, report their conditions, and return for chest CT re-examination regularly under the guidance of the medical observation team. Our online/offline multidisciplinary management model has potential application in our specific quarantine sites and treatment facilities as well as in other countries with severe epidemic.

Acknowledgments

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ETHICAL APPROVAL

Ethical approval was obtained for this study from Ethical Committee of Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology (No. TJ-C20200136). The two patients gave written consent for their

personal or clinical details along with any identifying images to be published in this study.

Disclosure Statement

No competing financial interests exist.

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Supplementary Material

Supplementary Data S1

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