



Editorial

How to optimize the Radiology protocol during the global COVID-19 epidemic: Keypoints from Sichuan Provincial People's Hospital



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ABSTRACT

Currently, the COVID-19 pneumonia epidemic is spreading worldwide. Pulmonary imaging plays an important role. The pulmonary imaging (chest computed tomography and Digital radiography) are indispensable for definitive diagnosis and reexamination. It should be noted that nosocomial infection is not uncommon. Many cases including health workers are infected. This is the experience of our radiology department's protocols during the outbreak, we used this protocol to cope with the COVID-19 in Sichuan Province, besides, there is zero infection for health workers during the whole epidemic. So, we would like to share our experience to other radiologists to avoid the nosocomial infection as low as possible. We have six key points for updating the protocol in the epidemic period of COVID-19: 1. Triage system: three-level triage, 2. Maximum Protection Principle, 3. Technical operation principle: careful, fast and stable, 4. Radiologist's Responsibility and Notice, 5. Disinfection measures of machine room, 6. Hospital information construction, network office, accelerate the sharing of imaging, and carry out MDT consultation.

Currently, the COVID-19 pneumonia epidemic is spreading worldwide. Up to Mar 20, 2020, there were 164,191 confirmed cases and 6783 deaths outside China [1]. The COVID-19 pneumonia may cause Acute Respiratory Distress Syndrome and lead to the use of mechanical ventilation or even need extracorporeal membrane oxygenation in critical patients. The mortality rate is even higher than 10% in some epidemic areas [2]. With the rapid increase of COVID-19 around the world, timely diagnosis of patients is of great importance. According to the previous reports and the guidelines of the World Health Organization Center for COVID-19 Control and prevention [3], pulmonary imaging was widely involved. The clinical and imaging manifestations in the early stage of COVID-19 are definitely important. Hence, the pulmonary imaging (chest computed tomography and Digital radiography) play a crucial role in clinical works during the prevalence of COVID-19 [4]. Department of Radiology is a very important auxiliary examination department in the hospital, especially during the epidemic. It is necessary to adjust the routine protocol during the outbreaks for maximum exam efficiency and reduce cross infection.

In the research centers included in this study, no medical staff have been infected so far. According to reports from other centers, there were 30 cases of medical staff infection in a hospital in Wuhan from January 10 to 30, 2020, because there was no protection or improper protection [5]. It was because of that in the early days when medical staffs were not well aware of the highly contagious disease, and the protective measures were imperfect without effective protocol which might cause the medical staff infected. But in our centers, we soon launched effective measures specifically for the COVID-19 and established a multi-disciplinary collaboration team, which effectively prevented the infection of medical staff [6]. In the current report, we aim to share the experience of our radiology department's protocols during the COVID-19 outbreak (Fig. 1).

1. Triage system: three-level triage

According to the three-level triage system, patients were divided into three categories: 1. All outpatients with fever clinic (temperature $> 37.2^{\circ}\text{C}$ in 2 weeks or with epidemiological history). 2. Emergency patients with or without general respiratory symptoms. 3. Scheduled patients without any respiratory symptoms. According to the different risk levels, the patients were divided into low-risk level (ordinary outpatients and inpatients), medium-risk level (emergency non-respiratory patients), high-risk level (fever outpatients). 1) High-risk patients: special examination channel and room should be arranged for fever outpatients, fix the separate devices (DR, CT) and medical staff responsible for examination. 2) Medium-risk patients: special emergency room (emergency non-respiratory patients) should be set up with special emergency signs to guide patients to the examination room as soon as possible.

3) Low-risk patients: make an appointment by different time periods for ordinary outpatient patients and inpatients: a) inpatients and ordinary outpatients should make appointment separately according to the time periods of morning and afternoon, b) the number of appointments should not exceed 20 in each time period (per hour).

There were 14,751 scheduled patients, 10,955 emergency patients and 1739 fever clinic patients underwent CT examination during the outbreak (From January 23 to March 23) in our hospital. We recommend that four separate CT scanner devices should be prepared for scanning. One CT machine was arranged in a fixed room only for fever clinic patients. One for emergency patients with or without general respiratory symptoms and two for routine CT (scheduled patients without any respiratory symptoms).

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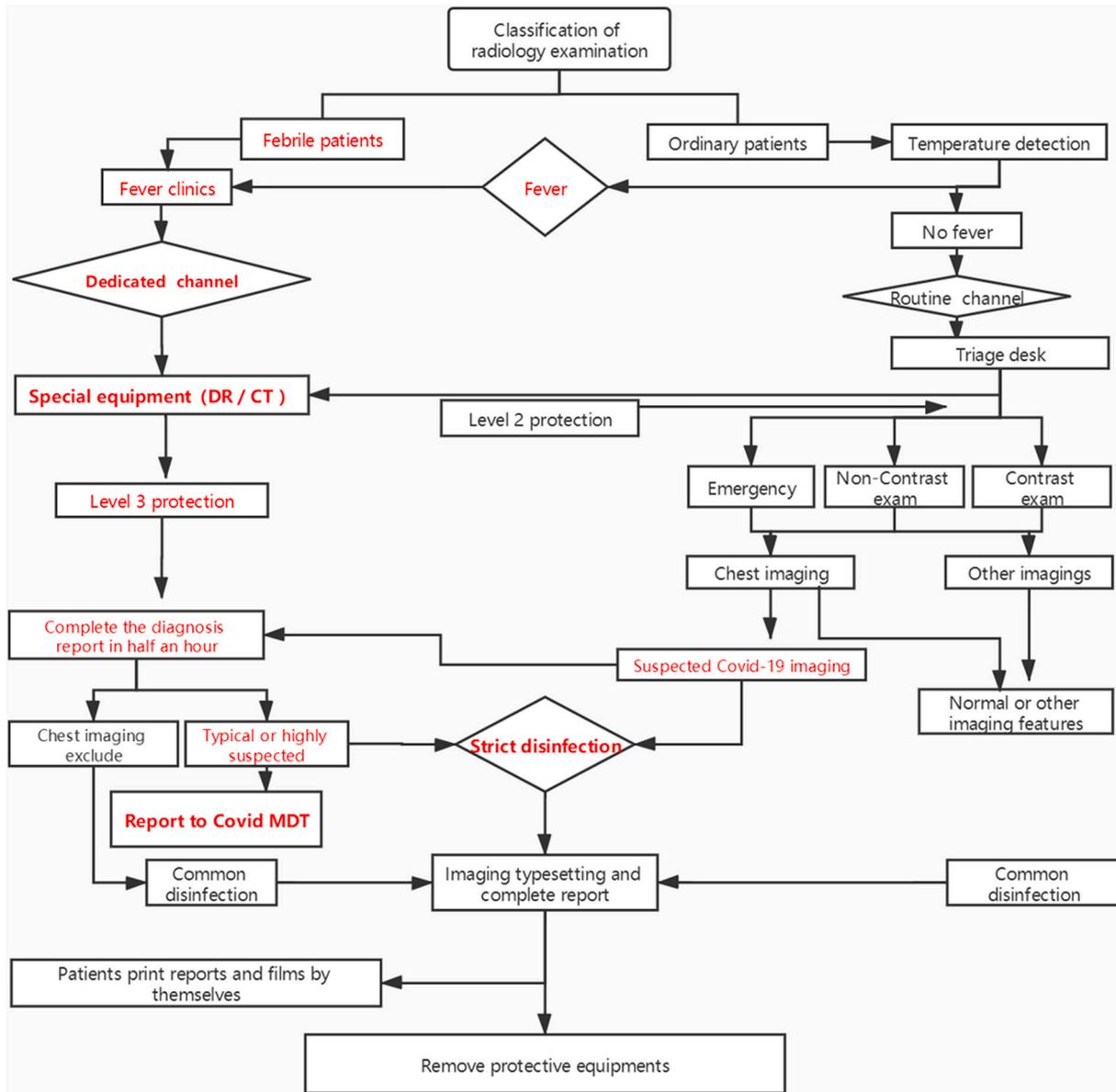


Fig. 1. Examination process of patients with or without suspected 2019-nCoV pneumonia.

2. Maximum protection principle

All patients must wear masks and use alcohol for hand hygiene. Separated area for wearing and taking off protective equipment was organized. In addition, we also set three waiting rooms in each area according to the triage system (Fig. 2).

- 1) The radiology department is divided into pollution area (inspection room and waiting area), semi-pollution area (staff passage, reception room, dressing room and toilet) and cleaning area (diagnosis office, meeting room, rest room and warehouse).
- 2) Doctors and patients enter and leave through different channels, and body temperature detection station was set up at each entrance.
- 3) Note: **a.** Personal protective equipment should be worn at the semi-polluted area (concentrated in medical staff access in the morning). **b.** Take off the protective equipment at registration station, preparation room or CT/DR examination room. **c.** Discard the disposable protective equipment in the special medical garbage. **d.** Do not enter the semi-polluted area once wearing protective clothing and do not enter the clean area once wearing work clothes.

Medical staff protection and Working schedule:

- 1) Classification of medical protective equipment: **a.** Level 3 protection , work clothes, surgical caps, medical protective masks, disposable medical protective clothing, goggles, latex gloves. **b.** Level 2 protection , disposable medical protective clothing, face mask, surgical mask, gloves and surgical caps. **c.** Level 1 protection , surgical caps, surgical masks.
- 2) Working schedule , set up special radiologic technologists and radiologist (24 h on duty) for the high-risk patients. The rest of the staff have a flexible timetable according to the number of reserved patients.
- 3) Inspection and supervision: pay attention to the epidemiological history of the patient and the family. We set up a large waiting room for patients in fever CT, each patient's seat was 50 cm apart with each other, and we also have prepared priority channel waiting room for patients with Stroke and Acute chest pain in emergency CT scanner department (Fig. 2).

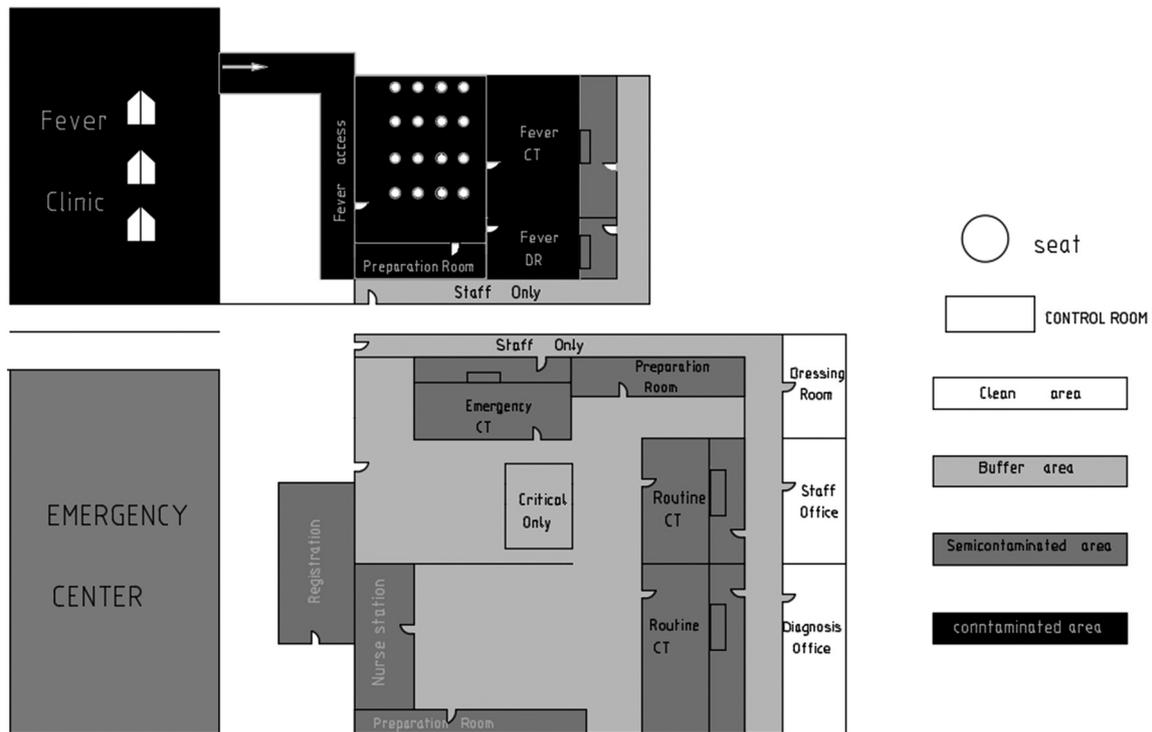


Fig. 2. Layout of CT/DR examination room in radiology department.

3. Technical operation principle: careful, fast and stable

The hospital closed unnecessary entrances. Only staff access and patient access are reserved. All fever patients were screened by fever clinic. The fever clinic will ask the patient's epidemiology history, fever and other symptoms related to the COVID-19 pneumonia in detail. If the patient was highly suspected, a special entrance will be offered to enter the special examination room of the radiology department for radiological examination.

- 1) CT scan is the first choice , sometimes DR is alternative. Low dose CT scanning parameters: large pitch, low dose (100 kV, automatic mAs).
- 2) DR examination: emphasize the importance of holding breath training before examination. DR scanning parameters: 102 kV, 4.1 mAs; photography distance: 180 cm. Mobile X-ray machine: 55–80 kV, tube current 3–6 mA, photography distance between 80 and 120 cm.
- 3) Radiologic technologists must make an initial diagnosis immediately for each patient after chest imaging examination, and immediately inform radiologist of the diagnosis if the patient was highly suspected through special phone lines. After being rechecked by radiologist and identified as suspicious patients, we should disinfect the examination room immediately. Two radiologic technologists operated each Routine CT exam together from 8 AM to 6 PM, Three radiologic technologists on duty in turn for Emergency CT scan in 24 h. Two radiological technologists on duty in turn for fever clinic CT in 24 h.

4. Radiologist's responsibility and notice

- 1) The special doctor (radiologist in charge of fever clinic) should complete the diagnosis report (CT, DR) within half an hour. Once the suspected patient was established, radiologist should inform the radiologic technologists to transfer the patient to the isolation room by fixed transfer team. Make a record as soon as possible and report

to COVID-19 MDT for consultation and transfer to a special isolation ward.

- 2) Non-specialist radiologist: Start the management of COVID-19 process once finding suspicious patients.

5. Disinfection measures of machine room

- 1) Disinfection of imaging equipment and operation platform: wipe with 75% alcohol and disinfect at any time in case of pollution.
- 2) Ground disinfection: 2000 mg/L chlorine disinfectant, three times per day.
- 3) Air disinfection: the circulating air disinfectant works continuously for 24 h. Ultraviolet radiation (60 min each time) was conducted when the room is empty.
- 4) Management of medical waste: all medical protective equipment should be directly discarded in the medical waste bucket, and should be double-layer sealed, clearly marked and sealed for transportation.

6. Hospital information construction, network office, accelerate the sharing of imaging, and carry out Multi-Disciplinary Team (MDT, which include experts from department of respiratory, radiology, Infectious disease) consultation

- 1) Cancel clustered meetings, but deeply learned imaging findings of new coronavirus pneumonia by network (radiologic technologists and radiologist). Focused on record of confirmed patients and heighten our vigilance when they were back for reexamination.
- 2) In case of clinical suspected patients, launch the MDT consultation, do not miss any suspected patient.
- 3) Avoid the gathering meeting. Discuss the complicated cases through the WeChat group. Cancel paper reports and manual delivery, use fixed electronic system to send reports directly to the department terminals.
- 4) We also managed some patients outside our hospital by tele-radiology in the form of MDT.

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