

Original Research

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Factors Preventing Nosocomial Outbreak Following a Single case of COVID-19 Diagnosed During Hospitalization: A Retrospective Review

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Abstract

Objective: Our hospital experienced a hospital shutdown and 2 week quarantine after a case of COVID-19 was diagnosed during hospitalization. We analyzed the reopening process following hospital closure and possible factors that prevented hospital spread.

Methods: We retrospectively reviewed the confirmed patient's medical records and results of epidemiological survey available from the infection control team of our hospital.

Results: A total of 117 hospital staff members were tested, 26 of whom were self-isolated. Of the 54 inpatients tested, 28 on the same floor, and 2 close contacts in the endoscopic room were quarantined in a single room. Finally, all quarantined hospital staff, inpatients and outpatients were tested for COVID-19 on the 14th day of close contact. The results were all negative, and the hospital work resumed completely.

Conclusion: Although closing and isolating the hospital appeared to have played a useful role in preventing the spread of COVID-19 inside the hospital and to the local community, it is still debated whether or not the duration of hospital closure or quarantine was appropriate. The lessons from the 2-week hospital closure suggest that wearing a mask, hand hygiene and the ward environment are important factors in preventing nosocomial outbreaks of COVID-19.

In order to prevent the in-hospital spread of COVID-19 in South Korea, the private health sector has established a prevention strategy based on guidelines provided by the Center for Disease Control and Prevention (KCDC).¹ Our hospital also used a checklist based on clinical and epidemiological criteria to evaluate the risk of SARS-CoV-2 infection, and only allowed people to enter the main hospital if the risk was low. Since the entry of the first coronavirus disease 2019 (COVID-19) patient into Korea from China, medical institutions have assessed the epidemiological risk mainly by asking questions about overseas travel within the last 2 weeks when entering the hospital.² However, after the mass outbreak in Daegu, Korea, residents or recent visitors to the Daegu-Gyeongbuk region were also included in the COVID-19 epidemiological risk checklist.^{3,4} Nonetheless, a patient with epidemiological risk was admitted to the hospital and was diagnosed with a definitive SARS-CoV-2 infection on day 6 of hospitalization. The Seoul city government then announced the closure of the hospital on the same day to prevent a health care associated outbreak. Although the confirmed case of COVID-19 was a symptomatic patient who was hospitalized in a 4-person room, this case did not spread as a nosocomial outbreak. We analyzed the steps followed during the 2-week hospital closure until reopening and the possible factors that prevented nosocomial outbreak.

Methods

We retrospectively reviewed the confirmed patient's medical records and the results of epidemiological survey obtained from the infection control team of our hospital. Contact tracing and management for isolation and quarantine were analyzed by dividing hospital staff, inpatients, and outpatients. We also summarized the management of the hospital from closure to reopening. This study was approved by the Institutional Review Board of Seoul Paik hospital (PAIK 2020-11-009).

Results

In-Hospital Case Diagnosis and Initial Management

A female patient in her late 70s was hospitalized in a 4-bed room on the sixth floor for 3 weeks due to nausea, vomiting, loss of appetite, and generalized weakness. The 4-bed rooms on the sixth floor have a minimum distance (measured from side-to-side) > 1 m between beds, which are separated by curtains for privacy (Figures 1 and 2). On the second day of hospitalization, the patient underwent gastric endoscopy. In the CXR obtained on the first day of hospitalization, no

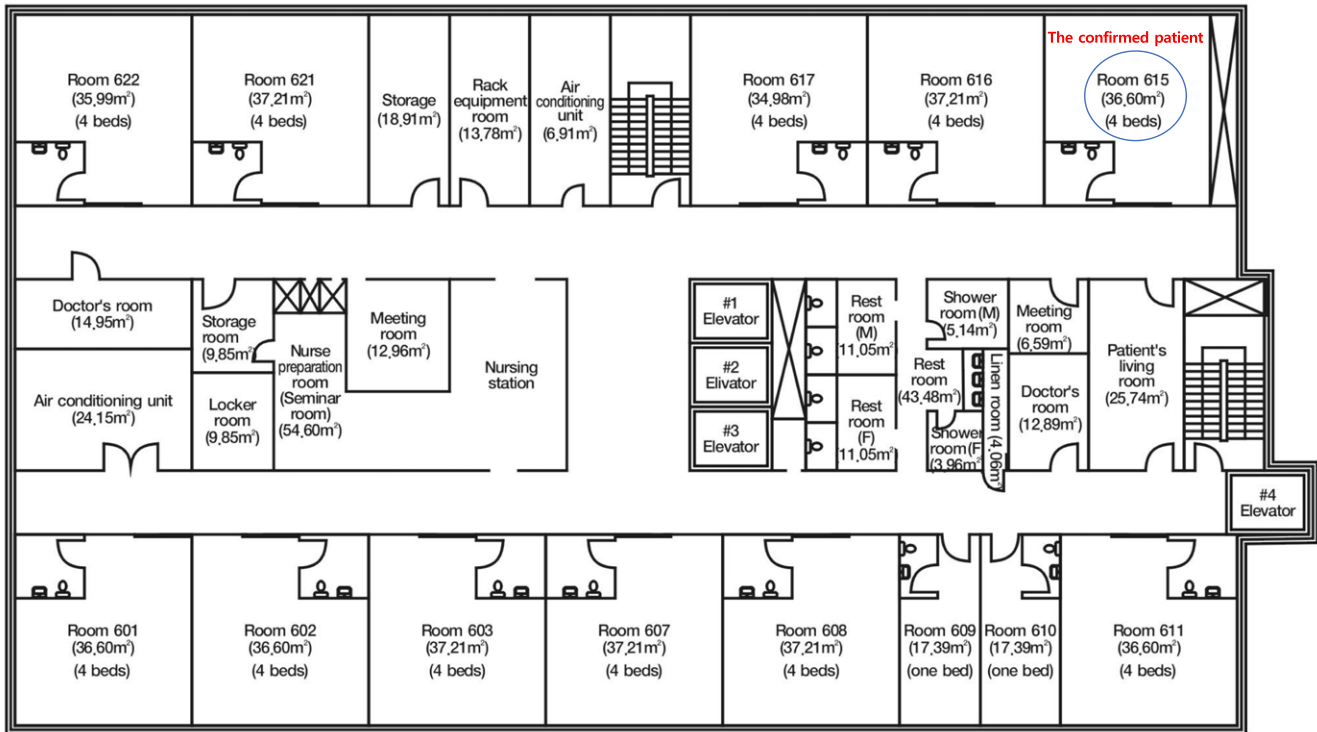


Figure 1. Schematic diagram representing the general ward located on the sixth floor and location of confirmed COVID-19 patient.

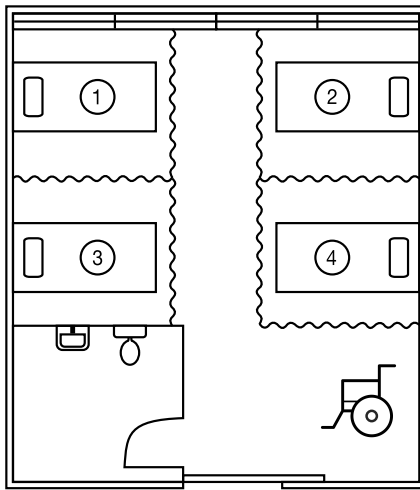


Figure 2. Schematic diagram of the hospitalization room for confirmed COVID-19 patient.

lesions were apparent except for suspicious subtle infiltration. However, on the 4th day of hospitalization, although the patient reported chronic cough caused by postnasal drip, other patients in the same room were concerned about her persistent cough, and therefore a chest CT was performed in the evening. The CT findings showed multifocal patchy ground glass opacity and consolidation of subpleural and peribronchial distribution in both lungs. On the morning of the fifth day of hospitalization, after isolation into a single room, nasopharyngeal, and oropharyngeal swabs and sputum test for SARS-CoV-2 real-time reverse transcriptase polymerase chain reaction (rRT-PCR) were performed. The patient was confirmed with SARS-CoV-2 infection on the

sixth day of hospitalization (March 8, 2020). The cycle threshold (Ct) values of rRT-PCR were: RdRp (Ct value of 24.35), E (Ct value of 22.69) and N (Ct value of 25.22) genes, detected from the upper respiratory sample (cut-off value: 40) and: RdRp (Ct value of 29.37) and E (Ct value of 29.30) genes detected from the lower respiratory sample (cut-off value: 35).

After reporting to the regional public health center, a meeting of the hospital infection control team was convened immediately. In order to prevent the occurrence of a cluster infection in the hospital, hospital staff in close contact with the COVID-19 patient were immediately asked to self-isolate after a COVID-19 test. The same afternoon, after a meeting at the hospital countermeasures headquarters along with Seoul Metropolitan City, and regional public health center officials and epidemiological investigators at Seoul Metropolitan Government, the hospital was temporarily closed and quarantined for prevention and contact management according to the patient's in-hospital movements. The COVID-19 patient, who was judged to be in the high-risk group, was transferred to a preselected hospital where infectious disease units were ready for isolation of confirmed cases. In addition, the patient's family self-quarantined after the COVID-19 test.

Contact Tracing and Management of Hospital Staff

Medical staff in close contact with the patient, endoscopy staff, CT room personnel, and staff members associated with the sixth floor ward were tested for COVID-19 (Figure 3). All the results were negative. A total of 26 individuals who were in close contact were quarantined for 2 weeks under the direction of the Seoul Metropolitan epidemiological investigator, including 11 nurses (42.3%), 7 doctors (26.9%), 7 radiology technicians (26.9%), and 1 environment service worker. In addition to active surveillance of all the other hospital staff, entrance into the hospital was

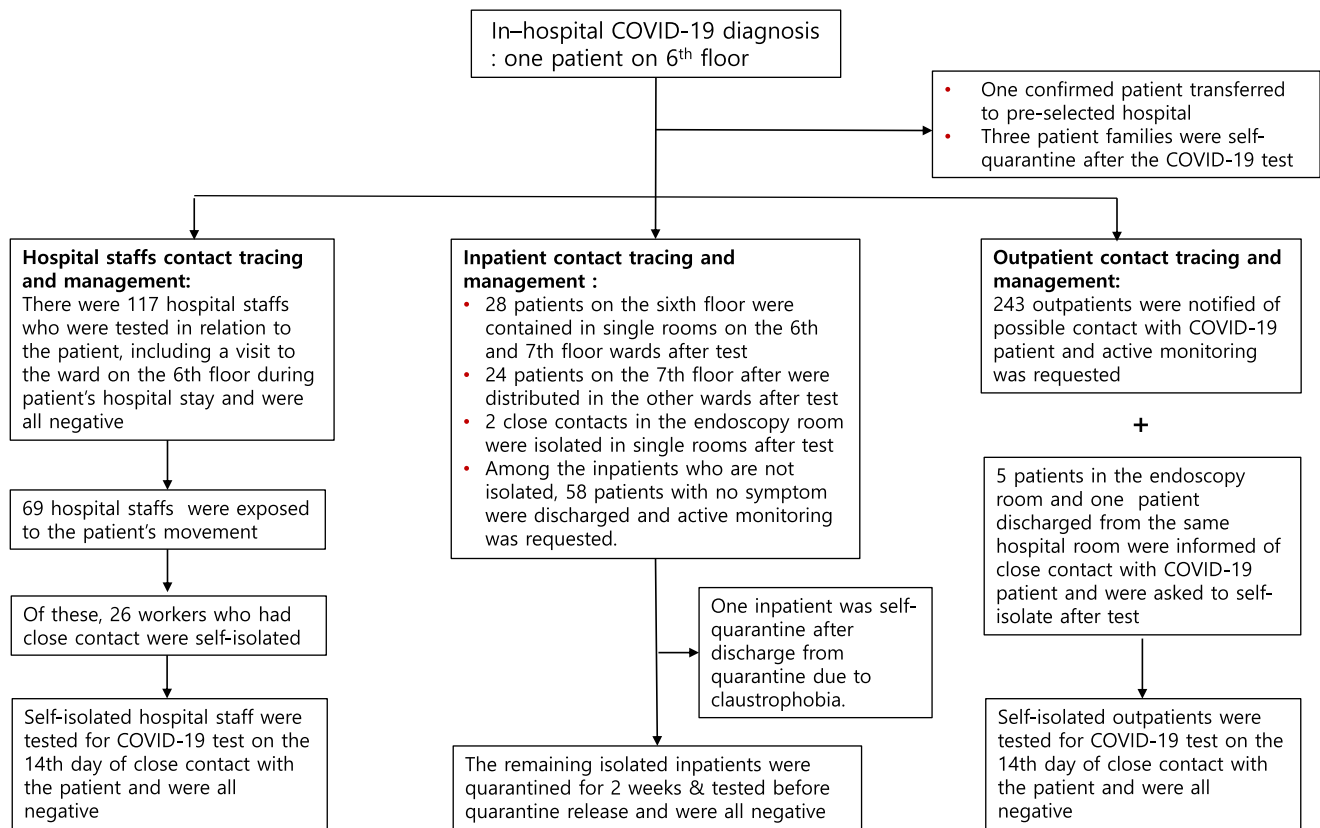


Figure 3. Flow diagram of the isolation and quarantine process followed at Seoul Paik hospital after a case of in-hospital COVID-19 diagnosis.

prohibited if fever or related symptoms were suspected and tested. All employees in service were recommended to regularly check-up for fever and respiratory symptoms, at least twice a day. Self-isolated hospital staff repeated the COVID-19 test on the fourteenth day after their last exposure to the patient. All of them were confirmed negative and returned to the hospital.

Inpatient Contact Tracing and Management

All inpatients on the seventh floor who were using the same air conditioner as the sixth floor where the COVID-19 patient had been hospitalized were tested on the day COVID-19 was confirmed (Figure 3). The next day, after confirming all negatives, patients on the seventh floor were distributed to the other wards, and patients on the sixth floor began single room isolation on the sixth and seventh floors after environmental cleaning and disinfection. Access to 2 quarantine wards (sixth and seventh floors) was granted only to specific hospital staff, and the quarantine wards were managed by a separate group of health care workers. After the test, 2 inpatients that were present in the endoscopy room at the same time as the COVID-19 patient were isolated in a single room. Since caregivers were not allowed to stay in containment wards, the medical staff provided care for the inpatients 24 hours a day in shifts. All the hospital staff used personal protective equipment such as gowns, gloves, medical masks and eye protection when providing care to isolated patients.

Since discharge or hospitalization was prohibited, none of the inpatients or isolated patients could be discharged for 3 days. After an external advisory committee meeting, it was decided to allow discharge if desired or possible, excluding quarantine wards.

Active monitoring was requested for 2 weeks after discharge. All guardian visits other than residential caregivers were completely prohibited. We continuously monitored the remaining inpatients for new symptoms and immediately performed COVID-19 testing after isolation into a single room if new symptoms developed.

Out-of-Hospital Contact Tracing and Management

Outpatients with potential contact during outpatient care were notified of the possible contact with the COVID-19 patient and active monitoring was requested (Figure 3). Also, 5 patients with potential contact in the endoscopy room and 1 patient discharged from the same hospital room were informed of close contact with the COVID-19 patient. They were asked to self-isolate after the COVID-19 test and their initial and follow-up results were negative. Potential contact was suspected by the presence in the same outpatient clinic or examination room, 1 hour before, and after the COVID-19 confirmed patient.

Guardians had limited access to wards on the sixth and seventh floors. At the time, guardian visits were prohibited unless it was an emergency. The hospital condition was notified to those who visited the sixth floor during the hospitalization of the COVID-19 patient and active monitoring was requested.

Management After Temporary Hospital Closure

The patient was diagnosed with COVID-19 on a Sunday. All hospital access was prohibited after notifying inpatients and guardians of the situation. Scheduled hospitalization and discharges were canceled, and the emergency center was also closed. All 24 surgeries scheduled for the first week were canceled. All face-to-face

outpatient care was discontinued starting the following day. Following telephone calls to all reserved patients, a fax was sent to the pharmacy after a telephone interview if continuous medication was needed. However, to address the needs of outpatients with chronic kidney disease in need of dialysis, an in-hospital dialysis room was set up and maintained during the duration of hospital closure. Also, the screening clinic for COVID-19 tests was maintained. After 2 weeks from the date of definitive diagnosis, the ward quarantine was released after all patients who were quarantined on the sixth and seventh floors tested negative during the follow-up, and hospital work resumed completely.

Discussion

Our hospital experienced a shutdown and quarantine for 2 weeks because of a single case of COVID-19 diagnosis during hospitalization. At that time, a few other hospitals were also entirely closed due to the occurrence of a cluster infection in hospital.⁵⁻⁷ In our hospital, there were no in-hospital clusters or community infections that occurred from contact with the COVID-19 patient. Although SARS-CoV-2 infection is spread person-to-person via close contact, it is not clear why nosocomial outbreak of SARS-CoV-2 infection occurred in some hospital wards and not in others.

A previous study investigating the risk factors associated with nosocomial outbreaks of SARS reported that environmental and administrative factors were important in causing and preventing nosocomial outbreaks of SARS.⁸ The most important factor contributing to the prevention of additional infections in our hospital involved a stringent adherence to basic principles by both inpatients and hospital staff, such as wearing masks and washing hands. In addition, the hospitalization of the patient in a ward that cannot be accessed by caregivers may have helped prevent further infection. Next, the ward environment in which the distance between beds exceeded 1 m and each bed was separated by a curtain may have helped prevent the spread of infection. Finally, the fact that the patient experienced cough symptoms without the need for oxygen therapy or ventilatory support may also have contributed to lowering the risk.

The biggest challenge associated with COVID-19 control is the uncertainty of the new virus. Effective contact tracing and isolation contribute to reducing the overall size of an outbreak.⁹ Also, closing and isolating the hospital appear to have played a useful role in preventing the in-hospital spread of COVID-19 and dissemination to the local community. However, the appropriate duration of hospital closure or quarantine period is still debated.¹⁰ It may appear excessively harsh to implement single-room quarantine in a closed ward for 2 weeks because of a 'stay in the same hospital ward/floor' following exposure to a confirmed case based on risk assessments and recommendations for Middle East Respiratory Syndrome issued in 2015.¹¹ The socio-economic and psychological damage experienced by quarantined patients who are forced to remain in a closed ward for 2 weeks should not be overlooked.¹²⁻¹⁴ In fact, 1 of the patients in quarantine reported an exacerbation of claustrophobia despite psychiatric care. It is important to prevent in-hospital infection, but it is also important that existing patients and non-COVID-19 patients receive timely treatment without long-term hospital closure or quarantine.

In conclusion, wearing face masks regardless of symptoms is crucial for preventing the spread of COVID-19 in hospitals. Prevention of nosocomial outbreaks of other respiratory infections in the future requires effective management of hospital wards

ensuring that environmental factors associated with nosocomial infections are kept to the minimum.

Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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