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Are the Current Guidelines Sufficient to Establish Infection Control Strategies for COVID-19 Related Issues in Hospitals?

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ABSTRACT

As hospitals cater to elderly and vulnerable patients, a high mortality rate is expected if a coronavirus disease 2019 (COVID-19) outbreak occurs. Consequently, policies to prevent the spread of COVID-19 in hospital settings are essential. This study was conducted to investigate how effectively national and international guidelines provide recommendations for infection control issues in hospitals. After selecting important issues in infection control, we performed a systematic review and analysis of recommendations and guidelines for preventing COVID-19 transmission within medical institutions at national and international levels. We analyzed guidelines from the World Health Organization, Centers for Disease Control and Prevention, European Centre for Disease Prevention and Control, and Korea Disease Control and Prevention Agency. Recent guidelines do not provide specific solutions to infection control issues. Therefore, efforts need to be made to devise consistent advice and guidelines for COVID-19 control.

Keywords: Coronavirus Disease 2019; Hospital; Infection Control; Guidelines

Introduction

As hospitals are where elderly patients and those with underlying comorbidities are mainly cared for, a high mortality rate is expected if a coronavirus disease 2019 (COVID-19) outbreak occurs in hospitals. Therefore, strict measures to prevent the spread of COVID-19 in hospital settings are crucial.

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The authors have no potential conflicts of interest to disclose.

Author Contributions

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There are some guidelines to prevent the spread of COVID-19 in hospitals at the national and international levels.¹⁻¹⁷ This study aimed to review whether national and international guidelines provide detailed recommendations to tackle issues with infection control and prevent the spread of COVID-19 in hospitals.

Methods

We performed a systematic search for controversial issues regarding infection control during the management of patients with COVID-19 in the hospital. Controversial issues and key questions were selected based on discussions with four infectious diseases specialists (B.K., E.S.K., K.H.S., and H.B.K.). The selected issues and subordinate questions are listed in **Supplementary Table 1**. For the review of domestic and international guidelines, official websites of the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), European Centre for Disease Prevention and Control (ECDC), and Korea Disease Control and Prevention Agency (KDCA) were screened. Guidelines issued between January 1, 2020, and September 30, 2020, were investigated independently by two researchers (W.J. and B.K.), and contents relevant to the selected issues and subordinate questions were extracted (**Supplementary Fig. 1**). The reviewed guidelines and their official websites are presented in **Supplementary Table 2**. The contents were rephrased based on consensus among investigators (W.J. B.K., E.S.K., K.H.S., and H.B.K.).

Ethics statement

The study protocol was approved by the Institutional Review Board of the Seoul National University Bundang Hospital (B-2101/660-303). All methods were performed in accordance with these guidelines and regulations.

Results

Infection control measures for the management of COVID-19 patients

As for screening and selective treatment policies, most organizations recommended that patients with COVID-19 symptoms should be treated at a screening clinic. However, no organization provided recommendations for the type of screening that should be used to identify patients who need to visit a screening clinic, nor did any organization specify criteria for permission to enter the general outpatient clinic for patients with fever and/or respiratory symptoms. All organizations suggested educating patients and caregivers about wearing masks in the hospital.

WHO, CDC, and KDCA recommended a single isolated room for preemptive isolation; however, no organization provided recommendations for determining a specific ward for preemptive isolation. Each organization suggested different criteria for removing preemptive isolation; the disappearance of symptoms was recommended by WHO, a single negative polymerase chain reaction (PCR) result was recommended by CDC, and there was no recommendation by KDCA.

As for an isolation policy for patients with confirmed COVID-19, ECDC and KDCA recommended room requirements for isolation, while WHO and CDC had no recommendations. ECDC and KDCA recommended a single negative pressure room, but

they recommended organizing a cohort isolation ward for COVID-19 patients in the case of a shortage of negative pressure rooms. All organizations recommended implementing the symptom-based criteria for removing confirmed COVID-19 patients from isolation.

PCR tests, even for patients without symptoms of COVID-19, were recommended by CDC, while other organizations had no recommendations regarding diagnostic testing. In the case of emergency procedures or operations for patients with suspected COVID-19, CDC and KDCA recommended rapid PCR tests for determining the possibility of COVID-19.

On the strategy for hospital care for healthy individuals who come in close contact with an individual in self-quarantine, only CDC suggested providing a preemptive isolation room for such persons. No organization had recommendations for patients who are released from isolation based on the improvement of symptoms but have consistently positive results from the PCR test (Table 1).

Table 1. Infection control measures for the management of COVID-19 patients

Controversial issues and subordinate questions	WHO	CDC	ECDC	KDCA
Screening and selective treatment policy to prevent COVID-19 patients from entering the hospital				
1. System to prevent patients with COVID-19 symptoms from visiting places where other patients	Telemedicine screening	Telemedicine screening	Telemedicine screening	Screening symptoms using online-based survey
2. Criteria of patients treated at the screening clinic	COVID-19 symptoms	COVID-19 symptoms, epidemiologically relevant	-	COVID-19 symptoms, epidemiologically relevant, recent overseas travel
3. Screening measure for selecting of patients who need to visit the screening clinic	-	-	-	-
4. Criteria for permission of entrance to the general outpatient clinic for patients with fever and/or respiratory symptoms	-	-	-	-
5. Location of the screening clinic	-	Separated area from hospital building	Separated area from hospital building	Separated area from hospital building
6. Location of the sampling area	-	Separated area from hospital building	Separated area from hospital building, Areas for drive-through sampling	Separated area from hospital building, Areas for drive-through sampling
7. Isolation rooms in the emergency department for suspected or confirmed patients with COVID-19	-	-	Recommend	Recommend
8. Education concerning wearing of masks for patients and caregivers in the hospital	Recommend	Recommend	Recommend	Recommend
9. Regular monitoring of fever and respiratory symptoms of caregivers	-	Recommend	-	-
10. Other measures to prevent the influx of COVID-19 into the hospital through caregivers and family/acquaintances	Mandate to wear of masks	Restrict visiting and recommend video call	Keeping hand/respiratory hygiene, physical distancing, restrict visiting and recommend video call	Mandate to wear of masks
Preemptive isolation policy for patients with suspected COVID-19				
1. Patients recommended for preemptive isolation	COVID-19 symptoms	COVID-19 symptoms, epidemiologically relevant	-	COVID-19 symptoms, epidemiologically relevant
2. Room for preemptive isolation	Single isolated room	Single isolated room	-	Single isolated room
3. Ward for preemptive isolation	-	-	-	-
4. Preemptive isolation strategy if the number of suspected patients exceeds the hospital's capacity	Grouping patients by symptoms in the same place (with keeping physical distance each other)	Isolate in general ward (with keeping physical distance each other)	-	-
5. Criteria for removing preemptive isolation	Disappearance of symptoms (regardless of PCR results)	Single negative PCR result	-	-
6. Measures for close family members and caregivers of suspected patients during preemptive isolation	-	Restrict entering hospital	-	Restrict entering hospital

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Table 1. (Continued) Infection control measures for the management of COVID-19 patients

Controversial issues and subordinate questions	WHO	CDC	ECDC	KDCA
Isolation policy for patients with confirmed COVID-19				
1. Room for isolation of patients with COVID-19	-	-	Single room with negative pressure	Single room with negative pressure
2. Existence of separate isolation ward for patients with COVID-19	-	-	Organize cohort isolation ward if the number of patients exceeds the capacity	Organize cohort isolation ward if the number of patients exceeds the capacity
3. Type of isolation room in the case of shortage of negative pressure room due to the increase of patients with COVID-19	-	-	Single room without negative pressure	Single room without negative pressure
4. Designated routes that minimize contact with suspected or confirmed COVID-19 patients	-	Recommend	-	Recommend
5. Criteria for removing the isolation for confirmed COVID-19 patients	Symptom-based criteria ^a	Symptom-based criteria ^a	Symptom-based criteria ^a	Symptom-based criteria ^a
PCR test for patients without symptoms of COVID-19				
1. Range of performing PCR test for patients without symptoms and/or epidemiologically relevance of COVID-19	-	Prior to admission or surgical procedure in closed facility	-	-
Strategy for procedures or operations for patients with suspected or confirmed COVID-19				
1. Policy for detecting cases of COVID-19 infection before emergent procedures or operations	-	Recommend rapid PCR test	-	Recommend rapid PCR test
2. Decision-making process for operations or procedures in patients suspected of COVID-19 in an emergent situation	-	-	-	-
3. Infection control policy in the operating room during the treatment of confirmed or suspected COVID-19 patients	Perform procedures in an adequately ventilated room	Avoid AGP	Environmental disinfection using sodium hypochlorite after procedures	Perform procedures in an adequately ventilated room, environmental disinfection using sodium hypochlorite after procedures
Strategy for hospital care for close contacts during self-quarantine period				
1. Allocation of rooms in case of hospitalization	-	Preemptive isolation room	-	-
2. Elective procedures or operations policy	Perform procedure after the self-quarantine period, but perform it wearing proper PPE in emergent situation	Perform procedure after the self-quarantine period, but perform it wearing proper PPE in emergent situation	Perform procedure after the self-quarantine period, but perform it wearing proper PPE in emergent situation	Perform procedure after the self-quarantine period, but perform it wearing proper PPE in emergent situation
Strategy for hospital care for patients whose symptoms have improved and released from isolation but COVID-19 PCR results are still positive				
1. Allocation of rooms in case of hospitalization	-	-	-	-
2. Elective procedures or operations policy	-	-	-	-

COVID-19 = coronavirus disease 2019, WHO = World Health Organization, CDC = Centers for Disease Control and Prevention, ECDC = European Centre for Disease Prevention and Control, KDCA = Korea Disease Control and Prevention Agency, PPE = personal protective equipment, PCR = polymerase chain reaction, AGP = aerosol-generating procedure.

^aSymptom-based criteria for discontinuing transmission-based precautions; - Patients with mild to moderate illness who are not severely immunocompromised: (1) At least 10 days have passed since symptoms first appeared, (2) At least 24 hours have passed since last fever without the use of fever-reducing medications, and (3) Symptoms (e.g., cough, shortness of breath) have improved. - Patients with severe to critical illness or who are severely immunocompromised: (1) At least 10 days and up to 20 days have passed since symptoms first appeared, (2) At least 24 hours have passed since last fever without the use of fever-reducing medications, (3) Symptoms (e.g., cough, shortness of breath) have improved, and (4) Consider consultation with infection control experts. - Patients who were asymptomatic throughout their infection and are not severely immunocompromised: (1) At least 10 days have passed since the date of their first positive viral diagnostic test.

Infection control measures for healthcare workers in hospitals

All four organizations recommended an equivalent level of personal protective equipment (PPE) to treat patients suspected or confirmed with COVID-19: N95/high-level respirator, gown, gloves, and eye protector. Only WHO and ECDC recommended using PPE for the disposal of items from patients with confirmed COVID-19. All guidelines did not consistently recommend disinfection or sterilization of N95/KF94 for reuse. CDC and KDCA provided guidance for disinfection or sterilization of powered air-purifying respirator hoods for reuse.

No organization provided guidance for separating healthcare workers who participate in the care of patients with COVID-19 from those who care for general patients. There were also no recommendations for regular monitoring with PCR tests or chest X-rays or a limit on working hours to prevent excessive workloads for healthcare workers who treat patients with COVID-19. Daily screening using the COVID-19 checklist was recommended in all guidelines.

As for work restriction policies, only CDC provided recommendations for work restriction or PCR tests for healthcare workers who have been in contact with COVID-19 patients or had a fever or respiratory symptoms. The criterion for returning to work for healthcare workers with fever or respiratory symptoms was a single negative PCR test in the CDC guideline.

As for the recommendation for activities outside the hospital for healthcare workers, CDC and ECDC provided some guidance, while WHO and KDCA had no guidance (Table 2).

Table 2. Infection control measures for the healthcare workers in the hospital

Controversial issues and subordinate questions	WHO	CDC	ECDC	KDCA
PPE for healthcare workers providing care for COVID-19 patients				
1. PPE for the treatment of patients confirmed with COVID-19	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector
2. PPE for the treatment of patients suspected or confirmed with COVID-19: aerosol-producing procedures	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector
3. PPE for the treatment and collection of samples from patients suspected of COVID-19	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector	N95/high-level respirator, gown, gloves, eye protector
4. PPE for the treatment of patients requiring hospitalization during self-quarantine period	N95/high-level respirator, gown, gloves, eye protection	N95/high-level respirator, gown, gloves, eye protection	N95/high-level respirator, gown, gloves, eye protection	N95/high-level respirator, gown, gloves, eye protection
5. PPE for the treatment of patients whose symptoms have improved and released from isolation but COVID-19 PCR results are still positive	Not recommend	Not recommend	Not recommend	Not recommend
6. PPE for disposal of items from COVID-19 confirmed patients	Medical mask, gown, heavy duty gloves, eye protector	-	N95/high-level respirator, gown, gloves, eye protector	-
7. Education concerning wearing and removing PPE in the hospital	Recommend	Recommend	Recommend	Recommend
Measures to prevent a shortage of PPE				
1. Disinfection or sterilization of N95/KF94 for reuse	Not recommend	Not recommend	Reuse as a last resort	Not recommend
2. Disinfection or sterilization of PAPR hoods for reuse	-	Disinfect according to the manufacturer's reuse guidelines	-	Disinfect according to the manufacturer's reuse guidelines
3. Replaceable PPE strategy in the case of shortage of PPE for medical staff	Use respirators for an extended time	Use medical masks instead of respirators	Use medical masks instead of respirators	-
4. Other preventive measures for excessive use of PPE	Recommend telemedicine for mild symptom-patients, use physical barriers to prevent direct contact with patients, minimize number of HCW for treating isolated patients	-	Minimize the use of PPE in cohort isolation wards if the number of patients exceeds the capacity, perform the procedures at once and minimize contact	-
Measures for healthcare workers participating in the care of COVID-19 patients				
1. Separate them from the care of general patients	-	-	-	-
2. Regular monitoring with PCR tests or CXR	-	-	-	-
3. Limit working hours to prevent excessive workloads	-	-	-	-
4. Screen with the COVID-19 checklist	Recommend	Recommend	Recommend	Recommend

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Table 2. (Continued) Infection control measures for the healthcare workers in the hospital

Controversial issues and subordinate questions	WHO	CDC	ECDC	KDCA
Work restriction Policy for healthcare workers				
1. Work restriction and/or performing PCR tests on healthcare workers who have visited high-risk areas of COVID-19 but have no clear epidemiological relations	-	-	-	-
2. Work restriction and/or performing PCR tests on healthcare workers who have been in contact with COVID-19 patients prior to confirmation	-	Recommend both if they did not use proper PPE	-	-
3. Existence of plans for the lack of healthcare workers due to the quarantine within the hospital	-	Recommend for establishment of plans	-	-
4. Work restriction and/or performing PCR tests on healthcare workers who have fever or respiratory symptoms	-	Recommend both	-	-
- When to perform PCR test	-	As soon as symptoms are recognized	-	-
- The conditions for returning to work	(Confirmed COVID-19) 10 days after isolation or 3 days after being asymptomatic	Single negative PCR result	-	-
- Active surveillance policy after returning to work	-	Self-monitoring after returning to work, wearing mask	-	-
Recommendation for activities outside the hospital for healthcare workers				
1. Existence of restrictions on certain activities outside the hospital	-	Keep social distancing, avoid visiting high-risk areas	Keep social distancing, use own car to commute, use separate room at home if they perform high-risk group care	-

COVID-19 = coronavirus disease 2019, WHO = World Health Organization, CDC = Centers for Disease Control and Prevention, ECDC = European Centre for Disease Prevention and Control, KDCA = Korea Disease Control and Prevention Agency, PPE = personal protective equipment, HCW = health care worker, PAPR = powered air-purifying respirator, PCR = polymerase chain reaction, CXR = chest X-ray.

Discussion

As for the screening and selective treatment policy, there were no guidelines on the criteria for permission to enter a general outpatient clinic. Since the COVID-19 pandemic began, many hospitals have been operating outdoor screening clinics for managing patients with suspected COVID-19 symptoms, such as fever and respiratory symptoms.¹⁸ However, screening clinics are equipped with minimal facilities and a workforce that can only provide a minimal examination. Therefore, many hospitals often care for patients with fever and respiratory symptoms who are unlikely to have COVID-19 in the general outpatient clinic because screening clinics have difficulty providing careful evaluation and management. There might be differences among hospitals regarding criteria for permission to enter general outpatient clinics due to the lack of clear guidance on this issue.

A single-center study conducted in South Korea found that 350 suspected COVID-19 cases, defined by symptom and epidemiological associations, were preemptively isolated, and none of them were confirmed with COVID-19.¹⁹ Based on the result of this study, both WHO and CDC guidelines, which suggested that isolation can be discontinued if there are no symptoms or if the PCR test is negative, seem appropriate. After all, both WHO and CDC guidelines might be used only in the low possibility of confirmation, such as no close contact with COVID-19 patients.

CDC recommended PCR tests for screening of COVID-19 even for hospitalized patients without COVID-19-related symptoms. The proportion of asymptomatic patients among COVID-19 cases was about 20–30%, and viral shedding also occurred in such patients; there have been concerns about spreading COVID-19 by asymptomatic patients.²⁰⁻²² According to the Infectious Diseases Society of America, the prevalence of COVID-19 among asymptomatic individuals is < 1 to 10%, and considering results of missing a diagnosis of COVID-19 and the sensitivity of the PCR tests, screening for asymptomatic patients is expected to be effective in regions with more than 2% prevalence.²³ A study conducted in long-term care facilities in the United States showed that the prevalence of COVID-19 in facilities that performed broad preemptive PCR tests on inpatients was 0.5%, which was significantly lower than 28.0% in facilities that did not perform them.²⁴ This result supports the effectiveness of PCR screening on asymptomatic inpatients.

There were no guidelines for patients who were released from isolation despite a positive PCR test. Although the probability of the existence of infectious severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) is very low after 10 days from the onset of COVID-19 symptoms in most cases, patients who are severely ill or immunocompromised could transmit infectious virus particles even after 10 days.²⁵⁻²⁹ Therefore, there have been concerns about the possibility of spreading COVID-19 from hospitalized patients who were released from isolation despite a positive PCR test, especially those who need aerosol-generating procedures.^{28,30-32} Given that the cut-off values for quantitative RT-PCR and quantitative immunoassays tend to be correlated with infectivity of COVID-19, some researchers have suggested that certain cut-off values could be used as a surrogate marker for the decision to release hospitalized patients from isolation.^{28,33,34} Further research is needed to determine clear test-based criteria that can guarantee the lack of infectivity of the virus.

Regarding strategies for healthcare workers, there were many recommendations on PPE, but few guidelines for the management of healthcare workers. More specific recommendations are required for patients and healthcare workers because outbreaks in medical institutions could also be spread by medical personnel.³⁵ In addition, there are various reports that healthcare workers in charge of managing patients with COVID-19 are complaining of psychological distress and being exposed to the risk of infection; thus, recommendations to prevent burnout are also needed.^{36,37}

There were some potential limitations to this study. Recommendations on key topics might have been updated since then. First, guidelines from only four organizations were reviewed due to linguistic limitations. Second, we reviewed WHO, CDC, ECDC, and KDCA guidelines in September 2020. Even though there have been no critical changes of recommendations on key topics, some significant newly introduced recommendations have been found in revised guidelines until November 2021 (**Supplementary Table 3**). Given that the average incubation period of COVID-19 is 4 to 5 days after exposure to SARS-CoV-2, CDC currently recommends performing a second PCR test to remove preemptive isolation and return to work for the persons with a higher level of suspicion for COVID-19.³⁸ Moreover, since mRNA vaccines against COVID-19 showed significant efficacy, CDC currently suggests preemptive isolation and PCR tests only for unvaccinated patients if they have no symptoms.³⁹ However, as it has been confirmed that the effectiveness of the vaccine decreases over time, further consideration of the validity period of the vaccine is needed.⁴⁰

In conclusion, the current guidelines are not yet concrete and uniform enough to be applied to hospital settings, and there is a lack of clear guidelines on controversial vital topics

that need to be considered in real medical situations. Therefore, it is necessary to develop recommendations that can be applied to hospital settings after an analysis based on clinical experiences and discussion with experts.

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SUPPLEMENTARY MATERIALS

Supplementary Table 1

Controversial issues for infection control during the management of COVID-19 patients within hospitals

[Click here to view](#)

Supplementary Table 2

Reviewed infection prevention and control guidelines for hospital settings and their official websites

[Click here to view](#)

Supplementary Table 3

Updated infection control measures against COVID-19 in the hospital

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Supplementary Fig. 1

Flowchart of the study procedure.

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