

DR. SUNG-SOO PARK (Orcid ID : 0000-0002-8826-4136)

PROF. DONG-WOOK KIM (Orcid ID : 0000-0003-3967-4267)

Article type : Letters

Successful prevention and screening strategies for COVID-19: focused on patients with hematologic diseases

Sung-Yeon Cho^{1,2,3*}, Sung-Soo Park^{1,4*}, Ji-Young Lee², Hee-Je Kim^{1,4}, Yoo-Jin Kim^{1,4},
Chang-Ki Min^{1,4}, Bin Cho^{1,5}, Dong-Gun Lee^{1,2,3#}, Dong-Wook Kim^{1,4#}

¹Catholic Hematology Hospital, College of Medicine, The Catholic University of Korea, Seoul, South Korea

²Infection control office, Seoul St. Mary's Hospital, Seoul, South Korea

³Division of Infectious Diseases, Department of Internal Medicine, College of Medicine, The Catholic University of Korea, Seoul, South Korea

⁴Division of Hematology, Department of Internal Medicine, College of Medicine, The Catholic University of Korea, Seoul, South Korea

⁵Department of Pediatrics, College of Medicine, The Catholic University of Korea, Seoul, South Korea

This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1111/bjh.16818](https://doi.org/10.1111/bjh.16818)

This article is protected by copyright. All rights reserved

*The first author: Two authors contributed equally to this work as first authors

#Corresponding author: Two authors contributed equally to this work as corresponding authors

Short title: Coping with COVID-19 in a hematology hospital (45 characters and spaces)

#Corresponding authors:

#Dong-Gun Lee, MD, PhD

Address: Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea

222 Banpo-daero, Seocho-Gu, Seoul 06591, South Korea

Tel: +82-2-2258-6003, Fax: +82-2-535-2494, E-mail: symonlee@catholic.ac.kr

#Dong-Wook Kim, MD, PhD

Address: Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea

222 Banpo-daero, Seocho-Gu, Seoul, 06591 South Korea

Tel: +82-2-2258-7030, Fax: +82-2-593-2522, E-mail: dwkim@catholic.ac.kr

Text word count: 999 words

Number of figures and tables: 2 figures

Number of supplemental table and illustrations: 1 supplementary document (questionnaire) and 1 supplementary figure

Number of references: 10 references

Main body of text

Hematologic patients are immunocompromised, particularly susceptible to life-threatening viral infections (Cho, *et al* 2018). Regarding the world-wide outbreak of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2), the first case was diagnosed in Korea on January 20, 2020 (Kim, *et al* 2020, Wang, *et al* 2020). With spreading of COVID-19, the number of new COVID-19 cases had increased exponentially with peak of 909 new infections on February 29 in Korea (Korean Society of Infectious Diseases, *et al* 2020). The World Health Organization declared COVID-19 pandemic on March 11, and as of May 6, 2020, more than 3.5 million cases have been confirmed around the world

In-hospital outbreaks of SARS-CoV-2 infection can have a major negative impact on providing essential medical services, and temporary hospital closures may be necessary to prevent further transmission (Cho, *et al* 2016, Lee, *et al* 2020). The European Society for Blood and Marrow Transplantation recommends that, in this pandemic situation, non-urgent hematopoietic stem cell transplantation (HSCT) should be deferred if possible (European Society for Blood and Marrow Transplantation 2020). However, if the medical use of HSCT in severely-ill patients is restricted, there may be a worsening of their underlying diseases. Thus, appropriate screening strategies are needed for triaging patients to block the influx and nosocomial spread of COVID-19 while continuing to provide essential medical services for hematologic patients (European Centre for Disease Prevention and Control 2020, Huh, *et al* 2020).

Seoul St. Mary's hospital, serves as a national referral hospital, has a 1,365-bed. Our hematology hospital, which is a part of Seoul St. Mary's Hospital, is the largest medical institute for hematologic patients in Korea. We used four buildings: the main hospital, and an annex, college, and research institute (Fig 1). The main hospital contains all the facilities,

including outpatient clinics, imaging departments, a clinical laboratory, a stem cell processing facility, and about 250 beds, for hematologic patients.

We classified hospital users based on their symptoms, potential epidemiological risk factors, and the purpose of their hospital visit, and applied stringent moving route control within the hospital according to their classification. All outpatients, inpatients, and medical staff were grouped according to the purpose of their hospital visit using a questionnaire (Fig 1). The questionnaire (Supplementary material) was created and updated based on the national and global epidemic information (Central Disaster Management Headquarters and Korean Central disease Control Headquarters 2020).

1) Gates

We changed patient flow and hospital services as follows: Gates II and III of the main hospital were closed. All visitors should enter through Gate I, except for patients needing emergency care, who entered through Gate-IV. All individuals were required to state whether they had COVID-19-related symptoms and/or epidemiological risk factors by answering the questionnaire. At Gate I, security personnel measured visitors' body temperature with a non-contact thermometer. Thermal imaging cameras were also installed in the main connecting passages and monitored by security staff.

2) Moving route, new clinics, and the 'COVID-19-floor'

We set up three screening clinics (SCREENs) in separate areas: (i) for asymptomatic but at risk patients (SCREEN-ASx) in the annex; (ii) for symptomatic patients (SCREEN-Sx) in the research institute; and (iii) for critical patients in the emergency department (SCREEN-ED). Each SCREEN had separated space to collect respiratory specimens. To avoid unnecessary visits to the main hospital, these clinics provided oral prescriptions as well as laboratory/imaging tests. We also provided other forms of alternative clinical services such as

tele-clinics and clinic visits by the guardian without the patient. SCREEN-ASx also had beds to provide simple procedures including transfusion, administration of granulocyte colony-stimulating factor, and indwelling-catheter care to hematologic patients. The patient flow according to group is shown in Fig 1.

We remodeled the entire floor of the hospital (hereafter the ‘COVID-19 floor’, Supplementary Fig) dividing it into three spaces: (i) intensive care unit for critically-ill COVID-19 (West Wing) patients; (ii) buffer rooms for asymptomatic patients with epidemiological risk factors (East Wing–Zone A); and (iii) buffer rooms for patients with pneumonia who required further monitoring of signs related to COVID-19 (East Wing–Zone B). The heating/ventilation/air conditioning system of the COVID-19 floor was separated from that of the other floors. All patients’ rooms were set to negative pressure. For neutropenic patients, anteroom kept negative pressure, and a room where patient stays is set for positive pressure. Healthcare workers (HCWs) routinely reported their body temperature and any symptoms by a web-based system. HCWs used a separate route (F) to access main hospital (Fig 1).

Until April 24, 2020, seven critically-ill COVID-19 patients confirmed from outside were hospitalized in the West Wing of the COVID-19 floor, and there were four newly diagnosed COVID-19 patients in SCREEN-Sx and SCREEN-ED. There have been no cases of nosocomial-onset or spread of COVID-19 in our hospital to date. The proportion of hematologic patients using alternative clinics increased from 1.3% in February to 9.6% in March 2020. In March 2020, we provided alternative consultations by tele-clinics (n=194) and the guardian without the patient (n=68) as well as SCREENs (n=487). We performed 260 SARS-CoV-2 PCR tests for hematologic patients in February and March 2020. Among the hematologic patients, 1.3% were admitted to the East Wing of COVID-19-floor. Despite decreasing the number of new hematologic patients during COVID-19 epidemic, the number

of outpatient visit, mean number of inpatients each month, and the number of HSCT per month were comparable compared to those in corresponding months on 2019 preceding the COVID-19 epidemic (Fig 2).

Several factors may have contributed to the successful prevention of in-hospital COVID-19 transmission without interruption of all treatments for hematologic patients: First, a screening questionnaire and measuring of body temperature was introduced at the hospital entrance and in each clinic. Second, patient groups and their moving routes were rigorously controlled. Third, SCREENs were housed in different buildings so that patients at risk were screened without entering the main hospital. Fourth, symptomatic patients were screened at SCREEN-Sx before entering to outpatient clinic area or hospitalization, and asymptomatic patients with epidemiological risk were also screened at SCREEN-ASx for hospitalization. However, the current mass-screening strategy is labor-intensive and requires dedicated cooperation from employees as well as visitors.

We have maintained our medical service for hematologic patients using aforementioned systematic approaches. These could be valuable to avoid unnecessary scare about continuing treatments for immunocompromised patients. We hope that our experience could contribute to rapid ending of COVID-19 pandemic.

Acknowledgements

We acknowledge the administrative support of Seoul St. Mary's Hospital and the efforts of all the hospital employees. We also appreciate all the members of Catholic Hematology Hospital

for excellent care of the patients. We sincerely appreciate all the families of the infection control team of Seoul St. Mary's Hospital.

Authorship Contributions

S-Y. C. and S-S. P. contributed the conception and design the study, and participated in the data interpretation and drafting the article. D-G. L and D-W. K. conceived the idea and planned the project, analyzed data, and revised the manuscript critically. J-Y. L., Y-J. K., H-J. K., C-K. M., and B. C. reviewed and revised the paper.

S-Y. C. and S-S. P. contributed equally to this work.

D-G. L and D-W. K. contributed equally to this work.

Disclosure of Conflicts of Interest

For all authors, there are no conflicts of interest to report related to this work.

Ethical statement

The Institutional Review Board of Seoul St. Mary's Hospital approved the research protocol and waived the need for informed consent due to the anonymous and retrospective design of the study (KC20RISI0273).

Figure legends

Fig 1. Classification of hospital users and moving routes

(A) Group A: If there are no risk factors identified by filling out the questionnaire and submitting it to the security personnel in the ‘questionnaire preparation area’ (Groups A-1, A-2), the visitor enters the main hospital through Gate I and their body temperature is measured. Patients who reported symptoms at Gate I are directed to the symptomatic screening clinic (SCREEN-Sx, dotted line).

(B) Group B: If the patient resides (or has visited within the past 14 days) in a region classified as domestic COVID-19 ‘special management zones’ by the Korean government (*i.e.* Daegu City, and surrounding North Gyeongsang Province), has attended a gathering where a COVID-19 outbreak had been reported, or has visited a “COVID-19 epidemic area” within the past 2 weeks, they are referred to the asymptomatic screening clinic (SCREEN-ASx) to rule out asymptomatic SARS-CoV-2 infection. The definition of ‘COVID-19 epidemic area’ was initially limited to China, but was expanded sequentially to all other countries. Group B-2 patients, are hospitalized after being confirmed to have negative results for SARS-CoV-2 using real-time polymerase chain reaction (RT-PCR) testing of nasopharyngeal and throat swab samples. They are admitted to a buffer ward (East Wing, Zone A) on the COVID-19 floor with a separate heating/ventilation/air conditioning system, and observed to determine whether symptoms occurred during the incubation period. Group B-3 –even if they report that they are asymptomatic– are directed to SCREEN-ASx for X-ray screening and a check of their medical condition by hematologists, and then proceed to main hospital with approval.

(C) Group C: All symptomatic patients are guided to the SCREEN-Sx. Group C-1, Patients who were aware of their symptom and/or signs; group C-2, symptomatic patients needing hospitalization; and group C-3, patients who visited to be evaluated for COVID-19. Symptomatic patients (Group C) are managed in space separated from the asymptomatic

patient groups (Groups A and B).

(D) Group D: Confirmed cases of COVID-19 transferred from other medical facilities are moved via a dedicated elevator entering the elevator in the first basement, and connecting to the isolation ward (West Wing) of the COVID-19 floor.

(E) Group E: If the patient visits the emergency department with signs or symptoms suggestive of COVID-19, SARS-CoV-2 PCR and/or chest X-ray is performed in a negative pressure room. Patients with pneumonia needing hospitalization are admitted to the COVID-19 floor after they have tested negative for SARS-CoV-2 on PCR.

(F) Group F: The route of healthcare workers (HCWs) to the main hospital is separated from the route taken by patients.

(G) Group G: The person delivering unrelated-donor hematopoietic stem cells from other institute is not allowed to enter the main hospital, and stem cell delivery to main hospital building is done outside the hospital building.

*Others: The accompanying guardians are only permitted to enter the main hospital, if necessary and are asked to fill out a questionnaire for symptoms and epidemiological risk as the patients.

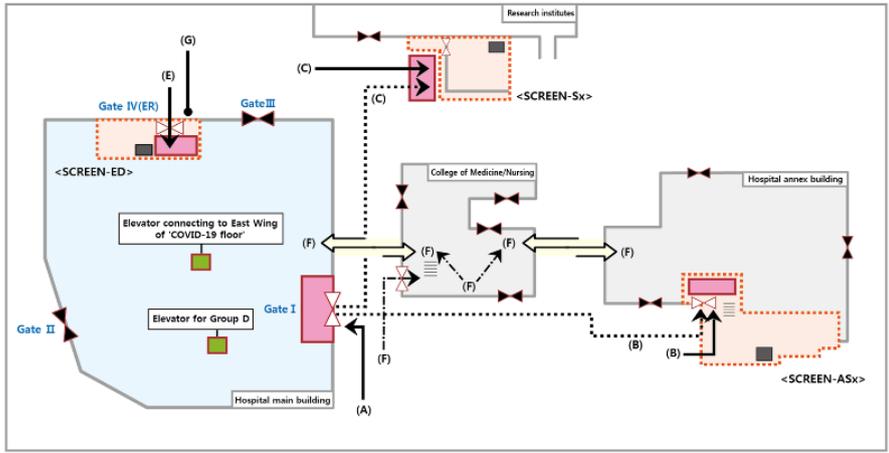
Fig 2. The performance of medical services since the beginning of the COVID-19 pandemic and during the corresponding period in 2019

(A) Monthly total numbers of outpatient care and total number of new patients

(B) Mean number of inpatients per month, and monthly total numbers of hematopoietic stem cell transplantation procedures

References

- Central Disaster Management Headquarters and Korean Central disease Control Headquarters (2020) Latest updates.
- Cho, S.Y., Kang, J.M., Ha, Y.E., Park, G.E., Lee, J.Y., Ko, J.H., Lee, J.Y., Kim, J.M., Kang, C.I., Jo, I.J., Ryu, J.G., Choi, J.R., Kim, S., Huh, H.J., Ki, C.S., Kang, E.S., Peck, K.R., Dhong, H.J., Song, J.H., Chung, D.R. & Kim, Y.J. (2016) MERS-CoV outbreak following a single patient exposure in an emergency room in South Korea: an epidemiological outbreak study. *Lancet*, **388**, 994-1001.
- Cho, S.Y., Lee, H.J. & Lee, D.G. (2018) Infectious complications after hematopoietic stem cell transplantation: current status and future perspectives in Korea. *Korean J Intern Med*, **33**, 256-276.
- European Centre for Disease Prevention and Control (2020) Infection prevention and control and preparedness for COVID-19 in healthcare settings -second update.
- European Society for Blood and Marrow Transplantation (2020) Coronavirus diseases COVID-19: EBMT recommendations update April 7, 2020. European Society for Blood and Marrow Transplantation.
- Huh, K., Shin, H.S. & Peck, K.R. (2020) Emergent Strategies for the Next Phase of COVID-19. *Infect Chemother*, **52**, 105-109.
- Kim, J.Y., Choe, P.G., Oh, Y., Oh, K.J., Kim, J., Park, S.J., Park, J.H., Na, H.K. & Oh, M.D. (2020) The First Case of 2019 Novel Coronavirus Pneumonia Imported into Korea from Wuhan, China: Implication for Infection Prevention and Control Measures. *J Korean Med Sci*, **35**, e61.
- Korean Society of Infectious Diseases, Korean Society of Pediatric Infectious Diseases, Korean Society of Epidemiology, Korean Society for Antimicrobial Therapy & Korean Society for Healthcare-associated Infection Control and Prevention and Korea Centers for Disease Control and Prevention (2020) Report on the Epidemiological Features of Coronavirus Disease 2019 (COVID-19) Outbreak in the Republic of Korea from January 19 to March 2, 2020. *J Korean Med Sci*, **35**.
- Lee, H., Heo, J.W., Kim, S.W., Lee, J. & Choi, J.H. (2020) A Lesson from Temporary Closing of a Single University-affiliated Hospital owing to In-Hospital Transmission of Coronavirus Disease 2019. *J Korean Med Sci*, **35**, e145.
- Wang, C., Horby, P.W., Hayden, F.G. & Gao, G.F. (2020) A novel coronavirus outbreak of global health concern. *Lancet*, **395**, 470-473.



Classification of hospital user	Descriptions	Symbols or Markings	Descriptions
A-1	Asymptomatic, outpatients, without epidemiological basis		Opened gates
A-2	Asymptomatic, patients for admission, without epidemiological basis		Closed gates
B-1	Asymptomatic, outpatients, with epidemiological basis		Screening clinics
B-2	Asymptomatic, patient for admission, with epidemiological basis		Isolated room for aerosol generating procedures (i.e. nasopharyngeal/oropharyngeal swab or sputum collection for COVID-19 PCR)
B-3	Asymptomatic, new outpatients with hematologic disease		Questionnaire preparation area
C-1	Symptomatic, outpatients, with or without epidemiological basis		Dedicated elevator connecting to COVID-19 floor
C-2	Symptomatic, patients for admission, with or without epidemiological basis		Bridge connecting building on 2nd floor for Group F
C-3	Symptomatic, visit for testing COVID-19		Moving routes according to classification of users
D	COVID-19 confirmed cases		Arranged moving routes for patients after visiting Gate I
E	Emergency patients		Moving routes for healthcare workers
F	Healthcare workers		
G	Hematopoietic stem cell transporter from other institutes		

