Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Research

Innovative countermeasures can maintain cancer care continuity during the coronavirus disease-2019 pandemic in Korea

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Abstract ***Background:*** Even though Korea was known to have the highest number of coronavirus disease-2019 (COVID-19) infection in the early phase of the pandemic, Korea was able to successfully flatten the curve in a short period of time without extreme measures. We compared the status of cancer management before and after COVID-19 and analysed how cancer care continuity was maintained in Korea.
Patients and methods: We investigated the medical records on the number of cancer diagnosis, cancer surgery, radiation therapy and scheduled chemotherapy conducted in Korea University Anam Hospital from January 1 to April 30, 2019 and from the same period in 2020. We also collected the data of metastatic cancer patients who were hospitalised due to respiratory disease.
Results: Of all diagnoses, 1694 cancer diagnoses were made in the study period of 2019, and 1445 diagnoses in 2020 (decreased by 14.7%); the cancer surgery performed 830 and 800 cases; the set-up for radiation therapy decreased from 185 to 140 cases; the number of systemic chemotherapies for metastatic cancer patients treated in department of medical oncology increased from 2555 to 2878 cases. Among hospitalised patients, emergency centre visit, intensive care unit admission, discharge after recovery and death reveal no drastic changes.
Conclusions: Routine cancer care for patients with metastatic cancer has been maintained without significant difference before and after the COVID-19 pandemic. The Korean

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government's innovative countermeasures in the early phase of outbreak made it possible for cancer care practitioners to provide cancer patients with regular care under the standard infection control protocol.

1. Introduction

Although the coronavirus disease-2019 (COVID-19) continues to spread, there is a growing concern over the influence of COVID-19 on patients with cancer. Patients affected by cancer are generally more vulnerable to infections due to coexisting chronic disease, overall poor health status, and systemic immunosuppressive states caused by both cancer and anti-cancer treatments. As a consequence, cancer patients infected with COVID-19 are likely to face more difficult outcomes than other populations [1–3]. The case fatality rate reached to 7.2% among cancer patients compared with 2.3% in the general population [4,5].

As the same time, there is uncertainty concerning the daily practice of cancer care during the COVID-19 pandemic for patients with cancer. In terms of cancer diagnosis, active treatment such as surgery, radiation therapy, scheduled chemotherapy and longitudinal follow-up, oncology specialists face additional challenges, for they need to consider how to balance a delay in cancer diagnosis or treatment against the risk for a potential COVID-19 exposure, mitigate the risks for significant care disruptions associated with social distancing behaviours, and manage the appropriate allocation of limited healthcare resources in this unprecedented time of healthcare crisis [5].

Korea is no exception in this global pandemic. As of 30 May 2020, a total of 11,441 confirmed cases with COVID-19 have been reported in South Korea, including 269 deaths, 10,398 recovered individuals released from isolation, and 774 patients staying in hospital or non-hospital facility for isolation. A total of 902,901 tests were performed, of which 886,603 were concluded; the positive rate (confirmed cases) was 1.3% and the case fatality was 2.35% [6]. Because the very first COVID-19 case was identified in Korea on January 20, 2020, patients with COVID-19 increased exponentially peaking at 909 cases a day on February 29. However, the number dropped significantly in the next two weeks to fall below 100 on March 15. Korea was able to flatten the COVID-10 curve in only 20 days without enforcing extreme measures of restricting freedom and movement of the people.

In the early stage of the COVID-19 outbreak, the Korean Centres for Disease Control and Prevention (KCDC) actively and speedily performed contact tracing, quarantined the contacted persons, and aggressively diagnosed and isolated the COVID-19 infected patients. Responding promptly to the situation and acting in accordance with the government's COVID-19 policies, many private hospitals accommodated and treated COVID-19 infected patients from regions where the medical facilities were overwhelmed. In the meantime, hospitals managed to keep up with daily practices, and most of the cancer centres across the country were able to maintain cancer care continuity under the organised planning and strategic resource allocation in accordance with the KCDC guidance [7].

We investigated the cancer management status before and after the COVID-19 pandemic in the institutional level and analysed how cancer care continuity was maintained during the COVID-19 pandemic crisis.

2. Methods

2.1. Study design

We investigated the status of daily practice for patients with cancer such as cancer diagnosis, cancer surgery, radiation therapy and scheduled chemotherapy from January 1 to April 30, 2020 in Korea University Anam Hospital.

In particular, we compared the hospitalised events of patients with metastatic cancer who suffered from respiratory disease and their clinical outcomes from January 1 to April 30, 2019 and the same period in 2020. Respiratory signs and symptoms, when combined with lung cancer diagnosis or lung metastasis, are included in this analysis, whereas the same signs and symptoms were excluded when caused only by cancer itself with no infection.

Clinical retrospective data were retrieved from the medical records including demographic and clinical features, laboratory findings and radiologic images. Two physicians reviewed the data independently. Severe clinical events defined by unscheduled visits during regular therapy, visits emergency centre, requiring admission to an intensive care unit (ICU), or death. We compared the number of virus testing assay for influenza B and other respiratory viruses for patients with metastatic cancer, and counted the number of COVID-19 testing assay for patients with metastatic cancer since January 2020 at which time the COVID-19 diagnostic testing became available.

This study was approved by the Ethics Committee of the Korea University Anam Hospital (No. K2020-1119-001). The requirement for informed consent was waived by the Ethics Committee, for this study is a retrospective data analysis which does not access the patient's personal information.

3. Results

We collected the medical records of the patients with cancer diagnosis, receiving cancer surgery, setting up radiation therapy or receiving scheduled chemotherapy (both outpatient and inpatient), as well as foreign patients coming from abroad for cancer treatment via international health centre during the study period (Table 1).

The numbers of initial cancer diagnosis were 1694 from January to April 2019, and 1445 in the same period in 2020 (decreased by 14.7%), and cancer surgery was performed for 830 and 800 cases, respectively (decreased by 3.6%). The number of set-up for radiation therapy decreased from 185 in 2019 to 140 cases in 2020 (by 24.3%), with most of the decreased portion concentrated in March and April 2020.

On the other hand, the patients with metastatic cancer who received treatment in department of medical oncology increased from 2555 to 2878 cases (increase by 12.6%) during the study period (Fig. 1), and the number continued to increase despite hospital's implementation of multiple procedures for COVID-19 surveillance after March 2020. Patients coming from other countries for cancer treatment dramatically decreased due to special immigration procedures at the border and government-mandated self-isolation obligations since March 2020.

The clinical contexts and outcomes of metastatic cancer patients hospitalised due to respiratory complication from January and April 2020 were compared with the data from the same period of 2019 in Table 2. The admission rate due to respiratory complication was 1.66% in 2019 and 1.59% in 2020, indicating no significant change.

In 2019, 20 patients (54.1%) visited the emergency centre due to their symptoms and 4 (10.8%) out of hospitalised patients were admitted ICU for critical care. In 2020, 22 patients (66.6%) visited the emergency centre and 3 patients (9.1%) were admitted to ICU in 2020. In terms of clinical outcomes, 19 patients (51.4%) and 16 patients (48.5%) were discharged after recovery from their respiratory complications; 15 patients (40.5%

Table 1
Comparison the status of routine cancer care between 2019 and 2020 (January to April).

		2019					2020				
		Total	January	February	March	April	Total	January	February	March	April
Cancer diagnosis		1694	503	365	418	408	1445 (85.3%)	425 (84.5%)	381 (104%)	325 (77.8%)	314 (77.0%)
Cancer surgery		830	240	177	190	223	800 (96.4%)	202 (84.2%)	199 (112%)	233 (122%)	166 (74.4%)
Radiation therapy		185	46	49	36	54	140 (75.7%)	31 (67.4%)	37 (75.5%)	43 (119%)	29 (53.7%)
Chemotherapy	Outpatient	657	182	158	157	160	1136 (173%)	283 (155%)	259 (164%)	286 (182%)	308 (193%)
	Inpatient	1896	506	416	467	507	1742 (91.9%)	425 (102%)	361 (86.8%)	466 (99.7%)	490 (99.6%)
	Total	2555	688	574	624	667	2878 (113%)	708 (103%)	620 (108%)	752 (121%)	798 (120%)
Foreign patients		64	15	10	19	20	49 (76.6%)	12 (80%)	20 (200%)	12 (63.2%)	5 (25%)

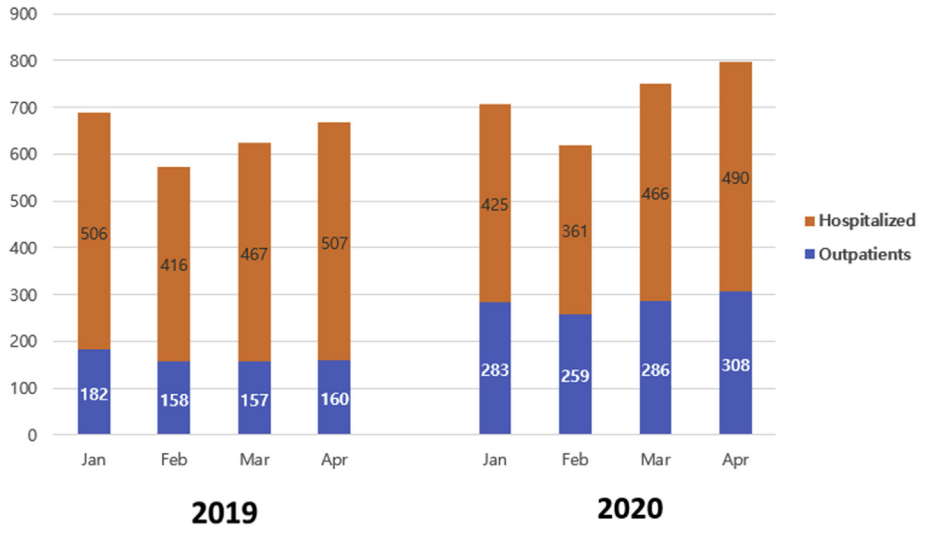

Fig. 1. The number of scheduled chemotherapies between 2019 and 2020.

Table 2
Comparison the number of hospitalised patients due to respiratory symptom between 2019 and 2020 (January to April).

	2019					2020				
	Total	January	February	March	April	Total	January	February	March	April
Total admission events	2232	599	485	596	552	2079	523	483	544	529
Hospitalization	37	9	4	13	11	33	12	4	8	9
Admission rate	1.66%	1.50%	0.82%	2.18%	1.99%	1.59%	2.29%	0.83%	1.47%	1.70%
emergency centre visit	20	5	2	7	6	22	11	3	3	5
ICU admit	4	0	1	2	1	3	1	0	0	2
Outcome										
Discharge	19	7	2	6	4	16	3	3	5	5
Death	15	2	1	7	5	15	7	1	3	4
Transfer to hospice	3	0	1	0	2	2	2	0	0	0

ICU, intensive care unit.

in 2019) and 15 patients (45.5% in 2020) were died during the hospital stay.

Among total admission of patients with metastatic cancer, 70 events were collected which were hospitalised for treatment of respiratory complications. Their demographics and clinical features are summarised in Table 3. The median ages were 69 in 2019 and 72 in 2020. 62.9% of them were men. The most frequent type of cancer was gastrointestinal cancer in 2019 and lung cancer in 2020. Fourteen cases (37.8%) in 2019 and 23 cases (69.7%) in 2020 had received the scheduled chemotherapy before they were admitted (Table 3).

Influenza virus testing was conducted in 115 cases in 2019 and the numbers fell to 72 cases in 2020, and the positive rate went down from 4.3% in 2019 to 1.4% in 2020. Respiratory virus testing was conducted in 28 cases in 2019 and 33 cases in 2020 and the positive rate were 17.9% and 21.2%, respectively, the numeric difference here indicating no significant difference. Interestingly, since March 2020, few cases occurred which necessitated both influenza and respiratory virus testing. This coincides with the onset of the government's campaign for strict social distancing and heightened personal hygiene, which must have alerted the patients with cancer regarding their daily activities and self-care routines. Here we see a reason why the number of necessary testing sharply dropped in March and thereafter (Fig. 2).

The COVID-19 test was conducted 79 times for patients with metastatic cancer. Fever was the most common cause that called for COVID-19 testing, and the second most common cause was the respiratory infection signs and symptoms. In preventive quarantine efforts, testing for COVID-19 was recommended to patients who lived in or visited the areas where community infection was prevalent (13%), as well as to patients who were scheduled to have surgery, or planning to transfer to nursing homes or other medical facilities (Fig. 3). But none of the patients and medical staff tested positive during the COVID-19 outbreak even though patients with COVID-19 from other regions were admitted and treated in the isolation ward within our institution.

Table 3
The characteristics of hospitalised patients with metastatic cancer due to respiratory infection

	2019	2020
Age, median, y	69	72
Sex		
Female	15	11
Male	22	22
Cancer type		
Lung	8	8
Breast	4	5
GI	16	7
Others	9	13
Patient status		
Ongoing scheduled chemotherapy	14	23
Newly diagnosis of cancer	1	3
Disease progression	22	7
Symptom		
Fever	9	8
Dyspnoea	15	22
Others*	13	3

*pulmonary tuberculosis activation, haemoptysis, cough and sputum and so on.

4. Discussion

Because World Health Organisation declared COVID-19 a global pandemic, global oncology societies have been struggling with challenges in delivering cancer care and striving to profoundly reorganise oncological care so that hospital visits, admissions, therapy-induced or immune-related complications could be reduced as much as possible without compromising cancer outcomes [8,9]. Consequently, primary physicians would sometimes defer cancer screening tests, running a risk of missing diagnosis, and delay referring patients with suspected cancer to specialised care [10]. At the same time, downscaling of cancer care in specialist units has been reported in many countries. Concerns over treatment-induced complications might lead to withholding of systemic treatments, whereas curative

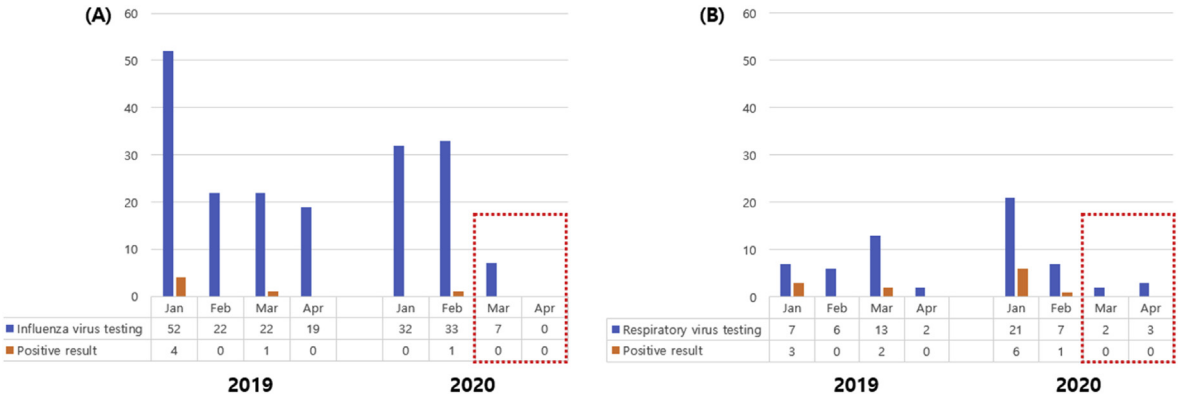

Fig. 2. The number of virus testing (A) Influenza virus (B) Respiratory virus.

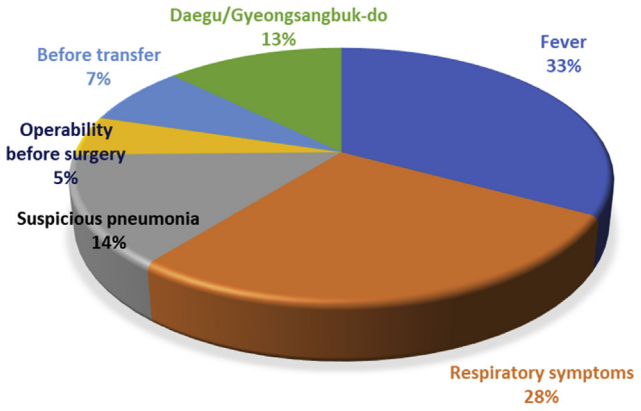

Fig. 3. Reason for COVID-19 testing for metastatic cancer patients. COVID-19, coronavirus disease-2019.

surgeries would face delays due to shortage of medical resources in a time of crisis [11].

Our study shows that cancer diagnosis, cancer surgery, and radiation therapy only slightly decreased after the COVID-19 pandemic. It might have much to do with the shared belief among various academic societies in Korea that sufficient clinical resources and intensive care capacity could be reserved for critical care [12]. On the other hand, the number of systemic chemotherapies for patients with metastatic cancer who have treated in the department of medical oncology increased by 12.6% even when the new hospital quarantine regulations required patients to go through more procedures for COVID-19 surveillance. Management of acute complications such as respiratory infection did not suffer despite COVID-19 outbreak, even when compared with last year before. The influenza testing numbers show that influenza-like illness seems to have rather decreased in this period. During the 2019–2020 season, the influenza epidemic period was exceptionally short, and epidemic peak was lower than that of previous seasons in Korea. The COVID-19 pandemic might have affected individuals' health seeking behaviours to varying extents, and various hygiene and physical distancing measures might have played a role in interrupting influenza virus transmission [13].

Country-specific choice of strategies for COVID-19 control are critical for individual cancer centres, as they determine in which ways and to what degree oncological care should and could be reorganised during the pandemic. From the beginning of the pandemic in Korea, KCDC has been spearheading the responses to COVID-19 as the nation's primary control tower for disease control and most of the hospitals and academic societies in Korea cooperated closely with the government [14–16]. Most of the private hospitals have been able to maintain their cancer care continuity because the following four strategies have been successfully implemented; early recognition of the threat and rapid activation of national response protocols initiated by national leadership [17]; rapid establishment of widespread diagnostic capacity [18,19]; upscaling of preventive measures against community transmission, including contact tracing, quarantine, and isolation [6,20]; and redesigning triage and treatment systems and mobilising necessary resources for case management [7].

Korea University Anam Hospital, one of the tertiary hospitals in Korea, has quickly implemented systems to protect patients and medical staff, including outdoor triage clinics for patients with fever or respiratory symptoms; pre-emptive isolation wards for patients with pneumonia; entrance surveillance using fever checks and questionnaires about respiratory symptoms and travel history; protective programs for high-risk units such as the ICU and heightened COVID-19 surveillance for hospital employees (Fig. 4). Cancer centre staff especially nursing specialists made a point of calling the patients individually the day before their scheduled appointment to screen any possible symptoms and check recent travel and contact history; they also informed patients that non-urgent hospital visits were not beneficial for patient's well-being or infection control or optimising hospital capacity during the pandemic. With regard to outpatients for chemotherapy infusion units and patients to be hospitalised, COVID-

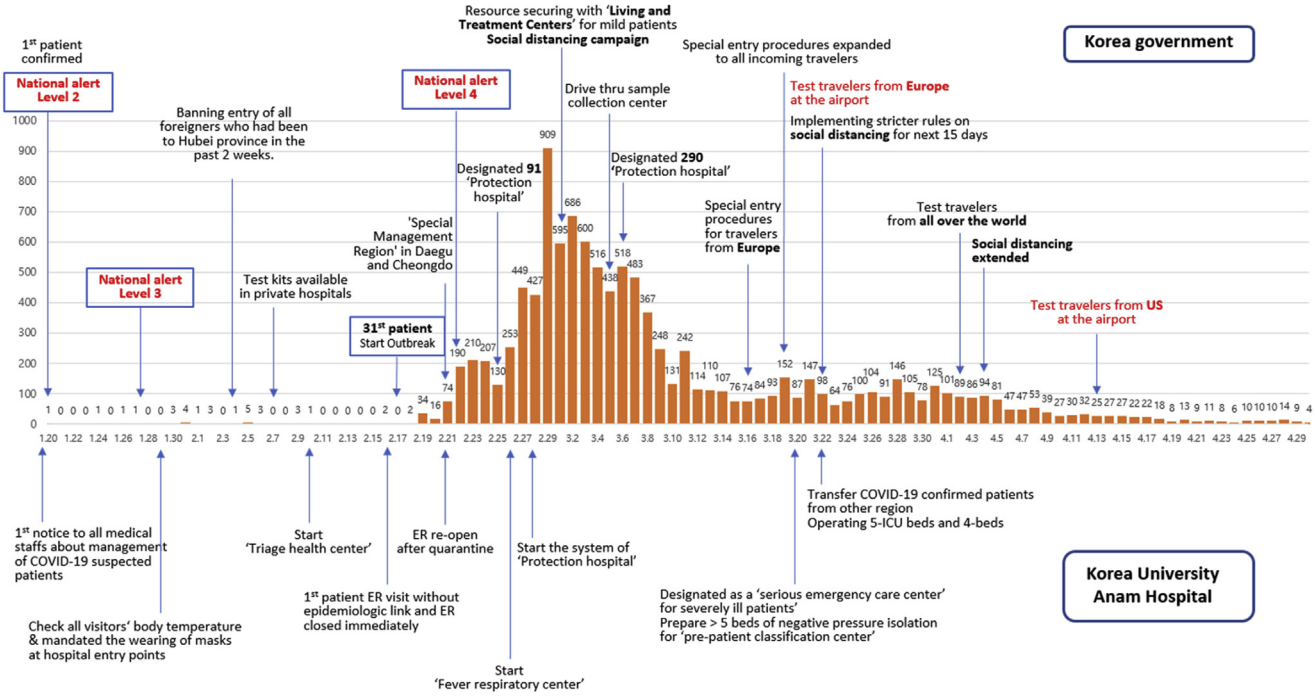

Fig. 4. New COVID-19 cases and speedy response of Korea government and an individual institution. COVID-19, coronavirus disease-2019

19 test was performed at hospital entering point, if they were 'suspicious cases' or 'patients under investigation'. After a patient underwent COVID-19 testing at a screening clinic, he or she was sent back home to begin self-isolation until the test results were available, which were usually notified to the patient through their cell phone within 12 h. All patients who resided in highly infectious areas, such as Daegu and Gyeongsangbuk-do, or who have arrived from overseas or contacted the confirmed patient, could receive outpatient clinic management after 2-week self-isolation and visit to the screening clinic. Once tested negative, patients are then allowed to enter the hospital. Because our institution was designated by the government as a 'COVID-19 Protection Hospital', one of the cancer wards was turned into a quarantine ward, which necessarily put a limit on the hospitalisation capacity for patients with cancer. Some patients from Daegu, however, could not be discharged because the risk of infection and difficulties in accessing local hospital in their hometown forced them to remain in the hospital. After the designation of 'COVID-19 Protection Hospital', a large portion of our doctors, nurses, and hospital personnel worked beyond their regular duties to serve in turn at the 'fever respiratory center'. With our institution's efforts to operate successfully as an official 'COVID-19 Protection Hospital', almost all patients with cancer with scheduled anti-cancer therapy could seek and receive necessary medical care and services in a timely and stable manner, without being much affected by the pandemic.

As a result of all these tremendous endeavours, we could maintain high standards of care for patients with cancer without overwhelming current healthcare system capacity, and almost all patients with cancer with scheduled anti-cancer therapy were able to receive medical services on track. However, without vaccine and therapeutic medicine, we still need to be cautious in continuing our approach to mitigate the crisis with limited knowledge of COVID-19. We believe the information and insights provided in this study will help improve our understanding of the importance of early intervention and cooperation between public and private sector for public health in a time of the pandemic.

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Nothing to declare.

Conflict of interest statement

The authors have declared no conflicts of interest.

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