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Title: Impact of the COVID-19 Pandemic on Cancer Diagnosis in Japan

Running Title: Impact of COVID-19 on Cancer Care in Japan

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Clinical Question Box

How did the COVID-19 pandemic impact cancer diagnosis in Japan, and what are the potential long-term effects on cancer outcomes?

The COVID-19 pandemic led to significant reductions in cancer screenings in Japan, especially in 2020 and 2021, due to healthcare system strain, government restrictions, and public fear of COVID-19 exposure. These disruptions are likely to result in delayed diagnoses, more aggressive treatments, and potentially worse long-term cancer outcomes.

The study highlights the need for better preparedness and strategies to ensure cancer care continuity during future pandemics.

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Abstract

Introduction: The COVID-19 pandemic severely disrupted healthcare systems worldwide, including cancer diagnosis. In Japan, cancer diagnosis significantly reduced during the pandemic. This study examines the changes in cancer diagnosis before and after the pandemic.

Methods: Data was collected from the National Cancer Center's hospital-based cancer registries, covering 875 facilities and over 70% of cancer cases in Japan from 2016 to 2022. The analysis focused on 10 cancer types: esophageal, gastric, colon, rectal, breast, prostate, pancreatic, NSCLC, bladder, and cervical cancers. A linear regression was used to estimate expected diagnoses, and deviations from these estimations during the 2020 fiscal year were analyzed.

Results: Diagnosed cases of prostate and gastric cancer decreased by 9.3% and 7.1%, respectively, with a total of 27,694 fewer diagnoses across nine cancer types. There was a significant decrease in cancer diagnoses during the pandemic years (2020-2021), followed by a resurgence post-pandemic.

Conclusion: The COVID-19 pandemic caused substantial disruptions in cancer care, leading to a decrease in cancer diagnoses. While there was a significant recovery in diagnoses post-pandemic, the delays during the pandemic are expected to have long-term

effects on cancer mortality. Future preparedness for pandemics should include strategies to minimize disruption in essential cancer care and maintain healthcare capacity.

Keywords: Cancer, Diagnosis, Surveillance study

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Introduction

The pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in 2020 quickly spread across the globe, profoundly impacting healthcare systems all over the world. Policymakers worldwide aimed to minimize the spread of the virus in healthcare institutions by implementing stringent mitigation strategies such as lockdowns and stay-at-home orders. Public healthcare systems were overwhelmed as the pandemic spread across the world and caused significant disruptions in services, including cancer diagnosis and treatment such as screenings, check-ups, and surgeries. According to Toes-Zoutendijk et. al, a decrease of up to 42% in monthly colorectal cancer screening during the first COVID-19 wave was seen in the Netherlands compared to what was expected.¹ As for Japan, it is estimated that the pandemic prevented 28817 resections for 10 cancers, including 8176 gastric cancers, 6032 colon cancers, and 3959 non-small cell lung cancers.² These declines can lead to increased cancer mortality rates and the need for more aggressive treatments, ultimately placing a greater burden on healthcare systems in the future.

Although the long-term effect of delayed diagnoses can take years to manifest, this issue requires urgent attention. Postponed cancer diagnoses may contribute to an increase in cancer-related mortality by allowing tumors to progress undetected.

Consequently, patients are more likely to be diagnosed at an advanced stage, when curative treatment is no longer an option and best supportive care is often the only approach. However, it is expected that preventive cancer screenings and diagnosis will increase back to normal now that the pandemic has come to an end. Our purpose in this study is to examine the changes in cancer diagnoses before and after the pandemic using the data.

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Methods

We collected data from the hospital-based cancer registries operated by the National Cancer Center.³ They accumulated newly diagnosed cancer cases from 875 facilities, covering more than 70% of cancer cases in Japan. We were provided data from 2016 to 2022, including two years of the COVID-19 pandemic (2020 to 2021). Each case was registered with the first treatment provided soon after the diagnosis, such as surgery alone, endoscopic therapy alone, radiation alone, medication alone, or a combination of them.

Fiscal year is defined as from April 1 to March 31 of the following year because it aligns with government budgeting and financial reporting cycles. Accordingly, we designated fiscal year 2020 (April 2020 to March 2021) as the primary “pandemic year” for the purpose of this analysis since national cancer screening programs resumed to near-normal levels starting in fiscal year 2021 in Japan. We used data from fiscal years 2016 to 2022 to build a linear regression model but excluded the pandemic year (2020).⁴ This allowed us to estimate what the number of diagnoses would have been in 2020 without the pandemic’s impact. The P-value was then calculated to assess the deviation between the observed and estimated number of events in 2020. The pre-pandemic period was defined as fiscal years 2016 to 2019, and the post-pandemic period as fiscal years 2021

to 2022.

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Results

Among the 24 cancer types recorded in the hospital-based cancer registry, ten major cancer types, esophageal, gastric, colon, rectal, breast, prostate, pancreatic, non-small cell lung cancer (NSCLC), bladder, and cervical, were analyzed and are illustrated in Figure 1. These cancers were selected due to their clinical significance and substantial caseloads. Compared to the expected estimations, prostate cancer experienced the most notable decrease in diagnoses, with 6,092 fewer cases than anticipated (-9.3% ; $P < 0.001$). Gastric cancer followed closely, showing a reduction of 6,044 cases (-7.1% ; $P = 0.003$) (Table 1). Breast cancer diagnoses also declined significantly by 4,513 cases (-5.4% ; $P < 0.001$).

Esophageal cancer showed a statistically significant reduction of 411 cases (95% CI: 154 to 668; $P = 0.01$), and rectal cancer declined by 601 cases (95% CI: 114 to 1,089; $P = 0.027$). Gastric cancer, notably, had a negative beta value ($\beta = -1,557$; 95% CI: $-2,786$ to -328 ; $P = 0.024$), indicating a significant reduction from the expected volume. In contrast, cancers such as pancreatic ($\beta = 1,002$; $P = 0.002$), NSCLC ($\beta = 1,603$; $P = 0.03$), and bladder ($\beta = 810$; $P = 0.004$) showed increases in diagnoses. Cervical and colon cancers did not show statistically significant changes ($P = 0.31$ and $P = 0.078$, respectively). Despite some variability, the cumulative shortfall across nine of the ten

cancers examined amounted to an estimated 27,694 missed diagnoses during the pandemic period, suggesting a considerable public health impact.

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Discussion

The global pandemic caused by COVID-19 affected all aspects of healthcare, including the foundation of cancer treatment. Our study revealed a significant reduction in cancer screenings and elective surgeries during 2020 and 2021 when the pandemic occurred in Japan.

One contributing factor is the drastic change in cancer care brought about by COVID-19. Two main factors likely contributed to the decrease. First, the pandemic of COVID-19 altered cancer care drastically. As governments imposed national lockdowns and outing restrictions, most national health systems suggested limiting non-urgent medical procedures to optimize the use of available beds for patients with COVID-19 and reduce the risk of infection in vulnerable patients and workers.⁵ For example, in Japan, the Ministry of Health, Labor, and Welfare instructed local governments to limit the number of screenings per unit time in 2021 to prevent overcrowding. This led to the introduction of stringent measures to halt cancer screenings, a decline in referrals from primary care to hospitals, and the postponement or cancellation of patient appointments.⁶ In addition, many people were reluctant to seek medical care or participate in recommended cancer screening programs because of the prevalent fear and anxiety of contracting COVID-19.⁷ These delays in screenings likely resulted in significant setbacks,

including delayed diagnoses and the initiation of treatments.

Second, patients diagnosed before the pandemic and who were undergoing treatment had to change the course of their treatments.⁸ For instance, surgical oncologists were forced to consider triage and rationing of cancer surgery cases due to the risk of exposing patients to COVID-19 infection during surgical procedures, especially as the transmission dynamics of the virus were not fully understood then.⁹ Moreover, this shift was largely due to a shortage of surgical staff, as many hospitals had to relocate their surgical workforce to maximize the capacity of the intensive care unit to manage the overwhelming influx of COVID-19 patients. We must also consider the fact that personnel who were trained or experienced in the use of ventilators were needed since many critically ill patients with COVID-19 were under respiratory support on ventilators. Although the impact of delays on cancer recurrence and survival rates may extend beyond the pandemic and take several years to fully emerge, these delays are expected to have a significant effect on cancer-related mortality rates.

However, the extent of this decline in Japan appeared to be less severe compared to countries that experienced widespread and prolonged outbreaks, since Japan successfully curbed the pandemic early on with early actions taken by the government. To understand the global impact of the pandemic on cancer care, we next compare the

situation in Japan with that of other countries with high COVID-19 burden. For example, Italy was one of the European countries most severely affected by the COVID-19 pandemic, with estimates of the excess mortality in Italy during the pandemic being more than 165,000 up to January 2022¹⁰. Healthcare systems were quickly overburdened due to the modest number of ICU beds and the lack of standardization of patient management¹¹. Moreover, Italy has the most elderly population in Europe and the second in the world after Japan, which represents one of the most significant risk factors for COVID-19–related mortality. According to Elisabetta Buscarini et. al, an 11.9% reduction in the total number of diagnoses of CRC, and a 15.9% reduction in stomach cancer diagnoses were found in 2020 compared to 2019 which is higher than those in Japan¹². This illustrates how differences in healthcare infrastructure and pandemic response strategies may have contributed to the variability in cancer care disruption globally.

We observed a significant resurgence of both diagnoses and surgical cases after the pandemic in our study. With the advancement of research, we have a better understanding of the transmission system of COVID-19 and effective prevention measures. Despite this progress, we must reassess cancer care in case another pandemic arises in the future, such as ensuring an ample supply of medical equipment and preventing neglect of cancer care treatment. Balancing both public health and cancer care

will be essential in minimizing long-term consequences on cancer outcomes.

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Conclusion

This study highlights the severe impact of the COVID-19 pandemic on cancer diagnosis and treatment in Japan. The significant decline in cancer screenings and surgeries during the pandemic years points to the long-term consequences on cancer care, including delayed diagnoses and treatment initiation. Despite the recovery in cancer care post-pandemic, the backlog of delayed cases poses an ongoing challenge to healthcare systems. These findings underscore the need for improved healthcare system preparedness for future pandemics, focusing on ensuring the continuity of essential cancer care. Balancing public health measures with uninterrupted cancer care will be critical in preventing long-term negative outcomes on cancer prognosis.

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Data availability: The datasets generated and/or analyzed during the current study are available in the Cancer Information Service, National Cancer Center repository (<https://jhcr-cs.ganjoho.jp/hbcrtables/>).

Ethical Statement: Not applicable.

Conflict of Interest: The authors report no conflicts of interest in this work.

References

1. Toes-Zoutendijk E, Vink G, Nagtegaal ID, et al. Impact of COVID-19 and suspension of colorectal cancer screening on incidence and stage distribution of colorectal cancers in the Netherlands. *Eur J Cancer*. Jan 2022;161:38-43. doi:10.1016/j.ejca.2021.11.008
2. Horita N. Impact of the COVID-19 pandemic on cancer diagnosis and resection in a COVID-19 low-burden country: Nationwide registration study in Japan. *Eur J Cancer*. Apr 2022;165:113-115. doi:10.1016/j.ejca.2022.01.027
3. Hospital-Based Cancer Registry National Aggregate Results Viewing System. Cancer Statistics. <https://jhcr-csganjohojp/hbcrtables/>. (Published 2024, Accessed March 1, 2025)
4. Xu T, Chen K, Li G. The more data, the better? Demystifying deletion-based methods in linear regression with missing data. *Stat Interface*. 2022;15(4):515-526. doi:10.4310/21-sii717
5. COVIDSurg Collaborative. Effect of COVID-19 pandemic lockdowns on planned cancer surgery for 15 tumour types in 61 countries: an international, prospective, cohort study. *Lancet Oncol*. Nov 2021;22(11):1507-1517. doi:10.1016/s1470-2045(21)00493-9
6. Addeo A, Friedlaender A. Cancer and COVID-19: Unmasking their ties. *Cancer Treat Rev*. Aug 2020;88:102041. doi:10.1016/j.ctrv.2020.102041
7. Kızıllırmak D, Yılmaz Z, Havlucu Y, Çelik P. Impact of the COVID-19 Pandemic on Diagnosis of Lung Cancer. *SN Compr Clin Med*. 2023;5(1):23. doi:10.1007/s42399-022-01366-z
8. Turtle L, Elliot S, Drake TM, et al. Changes in hospital mortality in patients with cancer during the COVID-19 pandemic (ISARIC-CCP-UK): a prospective, multicentre cohort study. *The Lancet Oncology*. 2024;25(5):636-648. doi:10.1016/S1470-2045(24)00107-4
9. Bartlett DL, Howe JR, Chang G, et al. Management of Cancer Surgery Cases During the COVID-19 Pandemic: Considerations. *Ann Surg Oncol*. Jun 2020;27(6):1717-1720. doi:10.1245/s10434-020-08461-2
10. Alicandro G, Remuzzi G, Centanni S, Gerli A, La Vecchia C. Excess total mortality during the Covid-19 pandemic in Italy: updated estimates indicate persistent excess in recent months. *Med Lav*. Apr 26 2022;113(2):e2022021. doi:10.23749/mdl.v113i2.13108
11. Boccia S, Ricciardi W, Ioannidis JPA. What Other Countries Can Learn From

Italy During the COVID-19 Pandemic. *JAMA Intern Med.* Jul 1 2020;180(7):927-928. doi:10.1001/jamainternmed.2020.1447

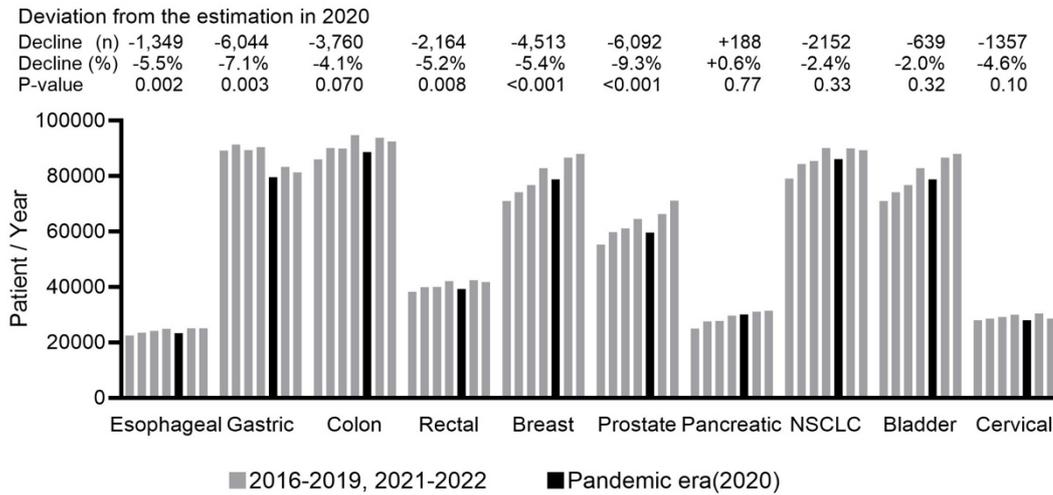
12. Buscarini E, Benedetti A, Monica F, et al. Changes in digestive cancer diagnosis during the SARS-CoV-2 pandemic in Italy: A nationwide survey. *Dig Liver Dis.* Jun 2021;53(6):682-688. doi:10.1016/j.dld.2021.02.021

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Table 1. Association Between Cancer Type and Outcome

Cancer type	β	95% CI	p value
Bladder	810	424 to 1196	0.004
Breast	2938	2147 to 3729	<0.001
Cervical	201	-287 to 690	0.31
Colon	1053	-188 to 2296	0.078
Esophageal	411	154 to - 668	0.01
Gastric	-1557	-2786 to -328	0.024
NSCLC	1603	265 to 2940	0.03
Pancreatic	1002	610 to 1394	0.002
Prostate	2337	1613 to 3060	<0.001
Rectal	601	114 to 1089	0.027

Figure 1: Decrease in Diagnosed Cases of Ten Major Cancer Types Compared to Estimations



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