JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Coronavirus Pandemic

A retrospective analysis of the effects of COVID-19 on cancer diagnosis and staging in Taiwan

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Abstract

Introduction: This study aimed to evaluate the psychological and behavioral impacts of the coronavirus disease-2019 (COVID-19) pandemic on cancer diagnosis and staging, with particular focus on patient delays and changes in healthcare-seeking behavior before and after the onset of COVID-19.

Methodology: Data pertaining to 8 cancer types, including breast cancer, hepatocellular carcinoma, oral cancer, prostate cancer, gastric cancer, esophageal cancer, colon cancer, and lung cancer, sourced from the cancer registry database of Taichung Veterans General Hospital, was analyzed. The focus was on the comparisons of data between the pre-pandemic period (2017–2019) and the pandemic year (2020).

Results: Breast cancer ($p < 0.001$), hepatocellular carcinoma ($p = 0.004$), prostate cancer ($p < 0.001$), gastric cancer ($p = 0.037$), and esophageal cancer ($p < 0.001$) exhibited a decrease in the rate of early stage patients and an increase in the rate of advanced stage patients after the COVID-19 outbreak. Furthermore, the number of newly diagnosed patients per year decreased for hepatocellular carcinoma, oral cancer, prostate cancer, gastric cancer, esophageal cancer, colon cancer, and lung cancer.

Conclusions: The COVID-19 pandemic disrupted cancer care, resulting in delayed diagnoses, stage migration, and a decline in newly diagnosed cases. These findings highlight the need for resilient healthcare systems to ensure continuity of cancer screening and treatment during global health crises.

Key words: COVID-19; cancer diagnosis; stage migration; Taiwan.

J Infect Dev Ctries 2026; 20(4):513-517. doi:10.3855/jidc.21890

(Received 27 May 2025 – Accepted 24 October 2025)

Introduction

Cancer remains one of the leading causes of mortality worldwide, imposing a significant burden on healthcare systems. The onset of the coronavirus disease-2019 (COVID-19) pandemic introduced unprecedented challenges, disrupting cancer care at multiple levels, including screening, diagnosis, and treatment. These disruptions stemmed from resource shortages, prioritization of COVID-19-related care, and altered healthcare-seeking behaviors among patients [1–3]. Consequently, concerns have emerged regarding the potential for delayed cancer diagnoses, stage migration, and worsened patient outcomes [4,5].

Despite Taiwan's relatively low incidence of COVID-19 cases in the early stages of the pandemic, significant psychological stress and behavioral changes among patients and healthcare providers may have indirectly influenced healthcare-seeking behaviors, potentially leading to delayed diagnoses and altered cancer staging. Proactive public health measures and strict pandemic controls successfully mitigated widespread viral transmission; however, these same measures significantly altered healthcare-seeking behaviors and reallocated medical resources. Elective procedures, including cancer screening programs, were deferred, and healthcare systems faced pressures to adapt to pandemic demands. These changes in medical practices and capacity could have far-reaching consequences on cancer diagnosis and treatment.

Previous studies have highlighted the detrimental effects of delayed cancer care during pandemics, with significant decreases in cancer diagnoses reported globally [3,6]. For example, suspended cancer screening programs and reduced healthcare access have led to stage migration, particularly for cancers typically detected through routine screenings, such as breast and colorectal cancer [6,7]. However, variations in the impact of the pandemic across cancer types and healthcare settings remain underexplored, especially in regions with differing healthcare infrastructure and pandemic responses.

This study aimed to evaluate the impact of the COVID-19 pandemic on cancer staging and diagnosis trends. Changes in the distribution of cancer stages and

the number of new diagnoses for 8 major cancer types were examined by comparing data from pre-pandemic years (2017–2019) with the pandemic year (2020). This analysis contributes to a deeper understanding of the effect of the COVID-19 pandemic on oncology and informs strategies to mitigate similar disruptions in the future.

Methodology

Data for 8 types of cancer, including breast cancer, hepatocellular carcinoma, oral cancer, prostate cancer, gastric cancer, esophageal cancer, colon cancer, and lung cancer, sourced from the cancer registry database of Taichung Veterans General Hospital were examined.

The study population was categorized into pre-pandemic and pandemic year groups. The data encompassing the pre-pandemic period spanned from 2017–2019, and the pandemic year data was from the calendar year 2020. A total of 19,198 patients were included across all cancer types, with per-cancer totals as follows: breast cancer (3,127), hepatocellular carcinoma (3,006), oral cancer (2,515), prostate cancer (2,298), gastric cancer (1,063), esophageal cancer (998), colon cancer (3,328), and lung cancer (4,861).

All eligible patients underwent a comprehensive pretreatment cancer staging workup, which included computed tomography and/or magnetic resonance imaging, chest X-ray, whole-body bone scan, and abdomen ultrasonography. Staging classification was determined according to the guidelines outlined in the American Joint Committee on Cancer (AJCC) tumor extent, regional lymph node involvement, and distant metastasis (TNM) classification system, 8th edition [8].

This retrospective study received approval from the Institutional Review Board of Taichung Veterans General Hospital (CE21457B).

Statistical analysis was performed using SPSS software, version 23, and differences in cancer staging were analyzed using the Chi-square test, with statistical significance defined as a p value less than 0.05.

Results

This study demonstrated alterations in cancer staging following the COVID-19 outbreak. Table 1 highlights the cancers that exhibited significant variations in cancer stages after the outbreak. Breast cancer had a decline in the proportion of stage I and II patients and an increase in the proportion of stage III and IV patients ($p < 0.001$). Similarly, hepatocellular carcinoma, prostate cancer, gastric cancer, and esophageal cancer demonstrated a decrease in the proportion of stage I and II patients and an increase in the proportion of stage III and IV patients. The p values of each cancer were 0.004, < 0.001, 0.037, and < 0.001,

Table 1. Cancers whose diagnosis stage changed after the COVID-19 outbreak.

	2017–2019	2020	*p* value
Breast cancer	**Total: 2270 (756/year)**	**Total: 597**	
CS I	780 (34.4%)	176 (29.5%)	
II	1056 (46.5%)	261 (43.7%)	< 0.001**
III	233 (10.3%)	82 (13.7%)	
IV	201 (8.8%)	78 (13.1%)	
Hepatocellular carcinoma	**Total: 2374 (791/year)**	**Total: 632**	
CS I	1003 (42.3%)	231 (36.6%)	
II	409 (17.2%)	94 (14.9%)	0.004**
III	546 (23.0%)	170 (26.9%)	
IV	416 (17.5%)	137 (21.6%)	
Oral cancer	**Total: 2007 (669/year)**	**Total: 508**	
CS I	448 (22.3%)	155 (30.5%)	
II	438 (21.8%)	113 (22.2%)	< 0.001**
III	246 (12.3%)	45 (8.9%)	
IV	875 (43.6%)	195 (38.4%)	
Prostate cancer	**Total: 1888 (629/year)**	**Total: 410**	
CS I	284 (15.0%)	46 (11.3%)	
II	864 (45.8%)	124 (30.2%)	< 0.001**
III	230 (12.2%)	116 (28.3%)	
IV	510 (27.0%)	124 (30.2%)	
Gastric cancer	**Total: 819 (273/year)**	**Total: 244**	
CS I	240 (29.3%)	60 (24.6%)	
II	167 (20.4%)	43 (17.6%)	0.037*
III	152 (18.6%)	39 (16.0%)	
IV	260 (31.7%)	102 (41.8%)	
Esophageal cancer	**Total: 817 (272/year)**	**Total: 181**	
CS I	70 (8.6%)	18 (9.9%)	
II	109 (13.3%)	22 (12.2%)	< 0.001**
III	456 (55.8%)	68 (37.6%)	
IV	182 (22.3%)	73 (40.3%)	

COVID-19: coronavirus disease 2019; CS: clinical stage. Chi-square test: *$p < 0.05$, **$p < 0.01$.

respectively.

In contrast, oral cancer experienced a decline in the proportion of stage III and IV patients and an increase in the proportion of stage I and II patients ($p < 0.001$).

Table 2 summarizes the cancers that did not show significant differences in cancer stages after the COVID-19 outbreak. In the case of lung cancer, there was an increase in the rate of stage I patients and a decrease in the rate of stage II, III, and IV patients, although this change was not statistically significant ($p = 0.288$). There was no difference in colon cancer stage before and after COVID-19 outbreak ($p = 0.954$).

Another significant finding of this study was a decrease in the number of new diagnosis cancer patients per year for each cancer after the COVID-19 outbreak. The number of newly diagnosed patients with hepatocellular carcinoma decreased to only 79.8% (632/791) of the pre-outbreak number. Similarly, the number of newly diagnosed patients with oral cancer decreased to only 75.9% (508/669) of the pre-outbreak number. The number of newly diagnosed patients with prostate cancer decreased to only 65.1% (410/629) of the pre-outbreak number, while the number of newly diagnosed patients with gastric cancer decreased to only 89.3% (244/273) of the pre-outbreak number. The number of newly diagnosed patients with esophageal cancer decreased to only 66.5% (181/272) of the pre-outbreak number, and the number of newly diagnosed patients with colon cancer decreased to only 76.3% (675/884) of the pre-outbreak number. Lung cancer also experienced a decrease in newly diagnosed patients, with only 64.2% (857/1334) of the pre-outbreak number. The only exception to this trend was breast cancer, which had an increase in newly diagnosed patients by 113.3% (857/756).

Discussion

The COVID-19 pandemic has profoundly disrupted cancer care globally, with wide-ranging effects on diagnosis, staging, and treatment. This study revealed significant stage migration for several cancer types, including breast cancer, hepatocellular carcinoma, prostate cancer, gastric cancer, and esophageal cancer. The proportion of early-stage diagnoses declined, while advanced-stage diagnoses increased. These findings align with previous studies that reported delays in cancer screening and diagnosis during the pandemic [3,5,6].

One of the primary drivers of stage migration is the suspension or reduction of cancer screening programs. For example, population-based screening for breast and colorectal cancer was delayed or halted in many regions, resulting in reduced early-stage detection rates [6,7,9]. In Taiwan, patients were also deterred from seeking timely medical care due to fears of COVID-19 exposure, contributing to diagnosis delays [2,10]. These disruptions underscore the vulnerability of healthcare systems during public health emergencies and highlight the need for more resilient cancer care pathways.

The findings also demonstrated a decline in the number of newly diagnosed cancer cases across most types. This pattern has been widely observed globally and is attributed to reduced healthcare access, altered patient behaviors, and resource reallocation toward pandemic management [3,11,12]. The implications of such delays are profound, as advanced-stage cancers often require more aggressive treatments and are associated with worse prognoses [13,14].

In this study, oral cancer showed an opposite trend, with an increase in early-stage diagnoses. This divergence could be explained by heightened awareness of oral and respiratory symptoms during the pandemic, prompting earlier consultations for head and neck conditions [15]. Similarly, in the case of lung cancer, while many studies reported a shift toward advanced stages during the pandemic [2,16], there was a slight increase in stage I diagnoses in this study. This may reflect increased vigilance regarding respiratory health, driven by public awareness of COVID-19 symptoms [2,13].

In contrast, colon cancer did not show a significant shift in stage distribution between 2017–2019 and the

Table 2. Cancers whose diagnosis stage did not change after the COVID-19 outbreak.

	2017–2019	2020	*p* value
Colon cancer	**Total: 2653 (884/year)**	**Total: 675**	
CS I	337 (12.7%)	90 (13.2%)	
II	799 (30.1%)	201 (29.8%)	0.954
III	806 (30.4%)	200 (29.7%)	
IV	711 (26.8%)	184 (27.3%)	
Lung cancer	**Total: 4004 (1334/year)**	**Total: 857**	
CS I	1243 (31.0%)	295 (34.4%)	
II	159 (4.0%)	33 (3.8%)	0.288
III	479 (12.0%)	99 (11.6%)	
IV	2123 (53.0%)	430 (50.2%)	

COVID-19: coronavirus disease 2019; CS: clinical stage.

pandemic year (p = 0.954). A possible explanation is that Taiwan's fecal immunochemical test (FIT)-based screening program, which was established prior to 2020, continued in a limited yet functional capacity during the pandemic year, thereby preserving early detection for a subset of patients. Additionally, symptomatic presentations (e.g., overt bleeding or obstruction) likely prompted urgent evaluation despite care disruptions, buffering the impact on stage migration.

The pandemic has highlighted the critical need to safeguard cancer care during global crises. Strategies such as integrating telemedicine into routine oncology care, developing alternative diagnostic pathways, and resuming cancer screenings as early as possible are essential [9,17]. Future research should also focus on the long-term impacts of these disruptions on patient outcomes, including survival rates and quality of life.

The fear of contracting COVID-19 significantly altered patient behaviors, which manifested as delayed consultations, reduced adherence to routine screenings, and heightened psychological distress. Anxiety, perceived infection risk, and information overload during the pandemic contributed to these altered behaviors, which may explain the observed shifts towards advanced stage cancer diagnoses observed in this study. Future interventions should thus include psychologic support and clear communication strategies to reassure patients about the safety and importance of timely cancer screening and diagnosis.

Study limitations

This study has several limitations. As a single-center retrospective analysis, the findings may not be generalizable to other settings. Additionally, data were limited to the pandemic year (2020), leaving the long-term effects unexplored. Further multi-center, longitudinal studies are needed to fully understand the pandemic's impact on cancer care and outcomes.

Conclusions

This study revealed the profound impact of the COVID-19 pandemic on cancer diagnosis and staging, characterized by a decrease in early-stage detections and an increase in advanced-stage presentations for several cancer types. These findings highlight the consequences of disrupted screening programs, delayed diagnoses, and altered healthcare-seeking behaviors during a global health crisis. The decline in newly diagnosed cases underscores the urgency of safeguarding cancer care continuity even during emergencies. Moving forward, healthcare strategies must also incorporate psychological interventions, such as anxiety reduction programs, patient education to mitigate fear of healthcare visits, and robust psychological support systems, to effectively manage behavioral and psychological barriers to timely cancer diagnosis and treatment during future crises. While this single-center study provides valuable insights, further multi-institutional research is needed to evaluate the long-term effects of the pandemic on cancer outcomes and inform future policy and practice.

Ethics approval

The study was approved by the Institutional Review Board of Taichung Veterans General Hospital.

Data availability

The data generated in this study may be requested from the corresponding author.

Authors' contributions

CCC: study design, manuscript draft and revision, supervision; WCY: study design; HSC and HLY: data analysis and interpretation; LLW, JC, YCL: statistical analysis. All authors approved the final version of the manuscript.

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Conflict of interest

No conflict of interest is declared.

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