The Early Impact of the COVID-19 Pandemic on Lung, Colorectal, and Breast Cancer Screening and Treatment at a Tertiary Cancer Center

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Objectives: During the coronavirus-19 pandemic, experts recommended delaying routine cancer screening and modifying treatment strategies. We sought to understand the sequalae of these recommendations.

Materials and Methods: We performed a retrospective single-center analysis of screening, diagnosis, and treatment of lung, colorectal, and breast cancer. Data was collected from our institutional cancer registry. Prepandemic (2016-2019) was compared with pandemic (2020) data.

Results: Three thousand three sixty one screening chest computed tomography scans (CTs), 35,917 colonoscopies, and 48,093 screening mammograms were performed. There was no difference in CTs [81.0 (SEM10.0) vs. 65.6 (SEM3.29), $P=0.067$] or mammograms [1017.0 (SEM171.8) vs. 809.4 (SEM56.41), $P=0.177$] in 2020 versus prepandemic. There were fewer colonoscopies in 2020 [651.4 (SEM103.5) vs. 758.91 (SEM11.79), $P=0.043$]. There was a decrease in cancer diagnoses per month in 2020 of lung [22.70 (SEM1.469) vs. 28.75 (SEM0.8216), $P=0.003$] and breast [38.56 (SEM6.133) vs. 51.82 (SEM1.257), $P=0.001$], but not colorectal [13.11 (SEM1.467) vs. 15.88 (SEM0.585), $P=0.074$] cancer. There was no change in stage at presentation for lung ($P=0.717$), breast ($P=0.115$), or colorectal cancer ($P=0.180$). Lung had a shorter time-to-treatment in 2020 [38.92 days (SEM 2.48) vs. 66 (SEM1.46), $P=0.002$].

Conclusions: In 2020, there was no difference in screening studies for lung and breast cancer but there was a decrease in new diagnoses. Although there were fewer colonoscopies performed in 2020, there was no change in new colorectal cancer diagnoses. Despite changes in guidelines during the pandemic, the time-to-treatment for lung cancer was shorter and was unchanged for colorectal and breast cancer. These findings highlight the importance of continuing care for a vulnerable patient population despite a pandemic.

Key Words: COVID-19, pandemic, lung cancer, colorectal cancer, breast cancer, cancer screening, cancer treatment

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In December 2019, a novel coronavirus (COVID-19) was detected and became a global pandemic by March 2020.[1] Multiple national agencies and academic societies provided recommendations to divert care toward COVID-19 patients at the expense of elective testing and routine health maintenance. The American College of Surgeons (ACS) released recommendations in late March 2020 recommending that hospitals discontinue elective procedures and triage cancer operations.[2] Shortly thereafter, ACS developed acuity-based cancer-specific guidelines, which recommended delaying screening and elective surgeries to avoid exposures, conserve resources, and decrease hospital capacity during the height of the pandemic.[3]

Cancer patients are particularly vulnerable to COVID-19, with a higher incidence of severe events, longer ICU admissions, and higher mortality in infected cancer patients.[4] Cancers with established screening recommendations include lung, colorectal, and breast cancer.[5] Several consensus groups for these malignancies aimed to provide guidance in addition to the ACS recommendations.[3,6] The American College of Chest Physicians expert guidelines recommended delaying routine and annual screening and surveillance of low-risk nodules.[7] The Thoracic Surgery Outcomes Research consensus statement recommended surgery for patients whose survivorship would be compromised if delayed for 3 months, such as those with larger lung nodules or node-positive disease, with strong consideration for utilizing neoadjuvant therapy.[8] For colorectal surgery, ACS guidelines supported continuing surgery for asymptomatic colon cancer and early-stage rectal cancer and modifying regimens to include chemoradiation for rectal cancers when possible.[3] The COVID-19 Pandemic Breast Cancer Consortium recommended deferral of all screening exams and imaging, delaying surgery by 6 to 12 weeks if it would not impact overall survival, and considering systemic therapy for high-risk lesions.[9] In addition, patients with hormone-positive breast cancer were recommended to receive neoadjuvant endocrine therapy as a bridge to definitive surgical management.

With a delay in routine cancer screening and modification of established oncologic treatment algorithms, clinicians were concerned with how these changes would impact the incidence, staging, and management of these cancers. Preliminary studies found an increase in lung nodules suspicious for malignancy and breast cancer staging after the resumption of screening.[10,11] Models from European groups predicted an increase in 5-year mortality, ranging from 4.8 to 16.6%, depending on the type of cancer.[12,13] The goal of our study was to review a single-center experience at an academic cancer program to understand the short-term effects on cancer care during COVID-19.

MATERIALS AND METHODS

Data Collection

We performed a single-center retrospective analysis of patients with new lung, colorectal, and breast cancer who presented to MD Anderson Cancer Center at Cooper University Hospital from 2016 to 2020 and associated screening imaging from 2017 to 2020, as imaging data was not consistently available before 2017 for all 3 modalities. This study was approved by our Institutional Review Board. Screening chest computed tomography (CTs) scans were identified with procedure codes IMG7885 and IMG101071, screening colonoscopies were identified with procedure codes 45278, G0105, and G0121, and screening mammograms were identified with procedure codes IMG105339, IMG105340, IMG105341, IMG105358, IMG105357, IMG605, IMG5002, IMG608, IMG609, IMG105264, IMG105265, IMG105266, and IMG210605.

Using our institutional cancer registry and electronic medical record system, patients' demographics, diagnostic, oncologic, and treatment data were collected. Patients younger than 18 years old and patients with lobular carcinoma in situ were excluded. Median household income of zip codes was obtained from U.S. Census data.[14] Quarters were defined by the fiscal calendar: quarter 1 (Q1) was defined as January-March, quarter 2 (Q2) April-June, quarter 3 (Q3) July-September, and quarter 4 (Q4) October-December. Prepandemic years were defined as 2016-2019, and the pandemic year as 2020. The date of initial diagnosis was determined by our tumor registry in accordance with the ACS Standard for Oncology Registry Entry.[15] We utilized electronic medical record case logs to identify the surgical volume. Time-to-treatment was defined as the time from the date of initial diagnosis to first treatment regardless of modality.

Statistical Analysis

Patient demographics and disease characteristics were summarized using counts and percentages for categorical variables or means and standard error of means for continuous variables. The analysis of differences between groups was performed using χ^2 test, ANOVA, and independent t tests. *P*-values less than 0.05 were considered statistically significant. Statistical analyses and graphical representation were conducted using SPSS (V.28) and GraphPad Prism.

RESULTS

Demographic Characteristics

Comparing the pandemic year to prepandemic years, there was no significant difference in sex, race, smoking history, or average median household income (Table 1A–C). For breast cancer, 99.4% of the patients were women; sex was equally distributed for lung and colorectal cancer. In colorectal cancer patients during the pandemic, there was a higher proportion who resided in counties bordering Camden, NJ compared with prepandemic years (85.7% vs. 77.1%; $P=0.015$; Table 1B). This difference was also seen in breast cancer patients (88.8% vs. 85.1%; $P=0.034$; Table 1C). There was a greater proportion of lung (36.7% vs. 30.4%; $P=0.035$; Table 1A) and breast cancer (25.4% vs. 20.5%; $P=0.017$; Table 1C) patients during the pandemic compared with prepandemic who lived in area codes with average median incomes below the national average. In breast cancer patients in the pandemic year compared with prepandemic, there was a greater proportion covered by Medicaid (23.8% vs. 15.2%; $P<0.001$) and a smaller proportion covered by Medicare (25.5% vs. 32.3%; $P<0.001$; Table 1C).

Volume of Screening Tests

There were 3361 screening chest CT scans (2017 to 2020). There was no difference in the number of CTs per month between the pandemic year versus the prepandemic years [81.0 (SEM10.0) vs. 65.6 (SEM3.29), $P=0.067$; Fig. 1A]. Comparing pandemic to prepandemic, there was no difference in the number of CTs in Q1 [93.7 (SEM23.9) vs. 60.6 (SEM5.01), $P=0.055$] or Q2 [49.3 (SEM16.3) vs. 64.1 (SEM4.43), $P=0.229$]. However, during the pandemic, there was a significant increase in the mean number of CTs in Q3 [95.0 (SEM4.58) vs. 59.0 (SEM4.95), $P=0.003$] and Q4 [110.0 (SEM2.31) vs. 67.0 (SEM7.25), $P=0.011$] compared with prepandemic (Fig. 1B).

There were 35,917 screening colonoscopies from 2017 to 2020, with a reduction in the average number of screening colonoscopies during the pandemic year [651.4 (SEM103.5) vs. 758.91 (SEM11.79), $P=0.043$; Fig. 1C]. In Q1, there was no difference in the mean number of colonoscopies during the pandemic compared with prepandemic [786.2 (SEM17.75) vs. 730.0 (SEM110.8), $P=0.410$]. During Q2, there was a significant decrease in 2020 compared with the average in Q2 of 2017-2019 [323.3 (SEM19.21) vs. 824.6 (SEM209.8), $P=0.001$]. There was no difference in Q3 [785.7 (SEM21.00) vs. 715.8 (SEM15.41), $P=0.054$], but there was an increase in the monthly mean in Q4 of 2020 [845.33 (SEM49.093) vs. 739.50 (SEM18.735), $P=0.032$; Fig. 1D].

There were 48,093 screening mammograms from 2017 to 2020, with no significant change in the mean number of screening mammograms performed during the pandemic year compared with prepandemic [1017.0 (SEM171.8) vs. 809.4 (SEM56.41), $P=0.177$; Fig. 1E]. In Q1, there was no difference in 2020 [932.0 (SEM183.5) vs. 894.6 (SEM28.76), $P=0.736$]. There was a decrease in Q2 of 2020 [465.0 (SEM344.5) vs. 982.7 (SEM16.95), $P=0.017$] followed by an increase in Q3 compared with the prepandemic years [1243.0 (SEM11.27) vs. 1019.7 (SEM39.07), $P=0.010$]. There was no difference in the number of mammograms during the pandemic in Q4 [1343.0 (SEM65.26) vs. 1081.2 (SEM59.60), $P=0.052$; Fig. 1F].

New Lung, Colorectal and Breast Cancer Diagnoses

From 2016 to 2020, 5851 patients were diagnosed with cancer: 1663 lung, 928 colorectal, and 3260 breast. The number of lung cancer diagnoses per month decreased in 2020 compared with 2016-2019 [22.70 (SEM1.469) vs. 28.75 (SEM0.8216), $P=0.003$; Fig. 2A]. This reduction was not present in Q1 [25.667 (SEM2.906) vs. 28.42 (SEM1.448), $P=0.411$] or Q3 [27.67 (SEM2.666) vs. 25.83 (SEM1.766), $P=0.639$]. In Q2, there was a decrease in the number of new diagnoses per month in the pandemic year [21.00 (SEM1.000) vs. 29.75 (SEM1.750), $P=0.031$]. There also was a significant drop in Q4 of 2020 [20.00 (SEM2.517) vs. 31.00 (SEM1.387), $P=0.003$; Fig. 2B].

There was no change in the monthly average of new colorectal cancer diagnoses in 2020 versus 2016-2019 [13.11 (SEM1.467) vs. 15.88 (SEM0.585), $P=0.074$; Fig. 2C]. There was also no significant difference seen in Q1 [14.33 (SEM2.028) vs. 16.17(SEM1.079), $P=0.457$], Q3 [16.00 (SEM2.000) vs. 14.08 (SEM1.131), $P=0.455$], or Q4 [13.67 (SEM0.8819) vs. 17.17 (SEM1.302), $P=0.218$]. There were fewer new colorectal cancer diagnoses than in Q2 of 2020 versus 2016-2019 [9.667 (SEM3.283) vs. 16.50 (SEM1.317), $P=0.044$; Fig. 2D].

TABLE 1. Patient Demographics for Patients Diagnosed With Lung (A), Colorectal (B), and Breast (C) Cancer Comparing the Peak Prepandemic in 2016-2019 and Acute Pandemic Period in 2020

Lung	Prepandemic N (%)	Pandemic N (%)	*P*
A.			
Sex	—	—	0.688
Male	691 (50.1)	138 (48.8)	—
Female	689 (49.9)	145 (51.2)	—
Race	—	—	0.230
White	1088 (79.2)	233 (82.3)	—
Non-white	286 (20.8)	50 (17.7)	—
From neighboring county	—	—	0.154
No	322 (23.3)	55 (19.4)	—
Yes	1058 (76.7)	228 (80.6)	—
Average median household income of patient zip code	$73,583	$73,848	0.867
Number of patients below median household income	419 (30.4)	104 (36.7)	0.035*
Insurance status	—	—	0.193
Medicaid	158 (11.8)	45 (16.3)	—
Medicare	844 (62.8)	167 (60.5)	—
Private/self-pay	295 (21.9)	53 (19.2)	—
Military/VA	19 (1.41)	7 (2.54)	—
Insured – unknown type	12 (0.89)	1 (0.36)	—
Uninsured	16 (1.19)	3 (1.09)	—
Smoking Hx	—	—	0.225
Never	104 (7.61)	18 (6.40)	—
Former	724 (53.0)	137 (48.8)	—
Current	538 (39.4)	126 (44.8)	—
Mean age SEM (range)	67.5 SEM 10.7 (31-95)	67.5 SEM 9.4 (41-95)	0.956
B.			
Colorectal			
Sex	—	—	0.866
Male	401 (52.3)	83 (51.6)	—
Female	366 (47.7)	78 (48.4)	—
Race	—	—	0.448
White	580 (76.1)	118 (73.3)	—
Non-white	182 (23.9)	43 (26.7)	—
From neighboring county	—	—	0.015*
No	176 (22.9)	23 (14.3)	—
Yes	591 (77.1)	138 (85.7)	—
Average median household income of patient zip code	$73,815	$73,252	0.811
Number of patients below median household income	239 (31.2)	61 (37.9)	0.099
Insurance status	—	—	0.067
Medicaid	120 (15.9)	24 (14.9)	—
Medicare	344 (45.6)	71 (44.1)	—
Private/self-pay	270 (35.8)	55 (34.2)	—
Military/VA	10 (1.32)	7 (4.35)	—
Insured – unknown type	4 (0.53)	0 (0.0)	—
Uninsured	7 (0.93)	4 (2.48)	—
Smoking Hx	—	—	0.057
Never	308 (43.4)	86 (53.8)	—
Former	288 (40.6)	52 (32.5)	—
Current	114 (16.1)	22 (13.8)	—
Mean age SEM (range)	63.3 SEM 12.7 (27-96)	64.2 SEM 13.4 (26-94)	0.460
C.			
Breast			
Sex	—	—	0.836
Male	14 (0.56)	3 (0.63)	—
Female	2503 (99.4)	470 (99.4)	—
Race	—	—	0.395
White	1992 (79.6)	367 (77.9)	—
Non-white	509 (20.4)	104 (22.1)	—
From neighboring county	—	—	0.034*
No	376 (14.9)	53 (11.2)	—
Yes	2141 (85.1)	420 (88.8)	—
Average median household income of patient zip code	$83,405	$83,388	0.853
Number of patients below median household income	517 (20.5)	120 (25.4)	0.017
Insurance status	—	—	< 0.001*
Medicaid	376 (15.2)	112 (23.8)	—
Medicare	798 (32.3)	120 (25.5)	—
Private/self-pay	1200 (48.5)	229 (48.7)	—

TABLE 1. (*continued*)

Lung	Prepandemic N (%)	Pandemic N (%)	*P*
Military/VA	30 (1.21)	2 (0.43)	—
Insured – unknown type	44 (1.78)	0 (0.0)	—
Uninsured	23 (0.93)	7 (1.50)	—
Smoking Hx	—	—	0.155
Never	1339 (55.7)	276 (60.1)	—
Former	758 (31.5)	136 (29.6)	—
Current	306 (12.7)	47 (10.2)	—
Mean age SEM (range)	60.8 SEM 12.5 (23-98)	61.4 SEM 12.9 (22-94)	0.377

*Indicates significant at $P < 0.05$.

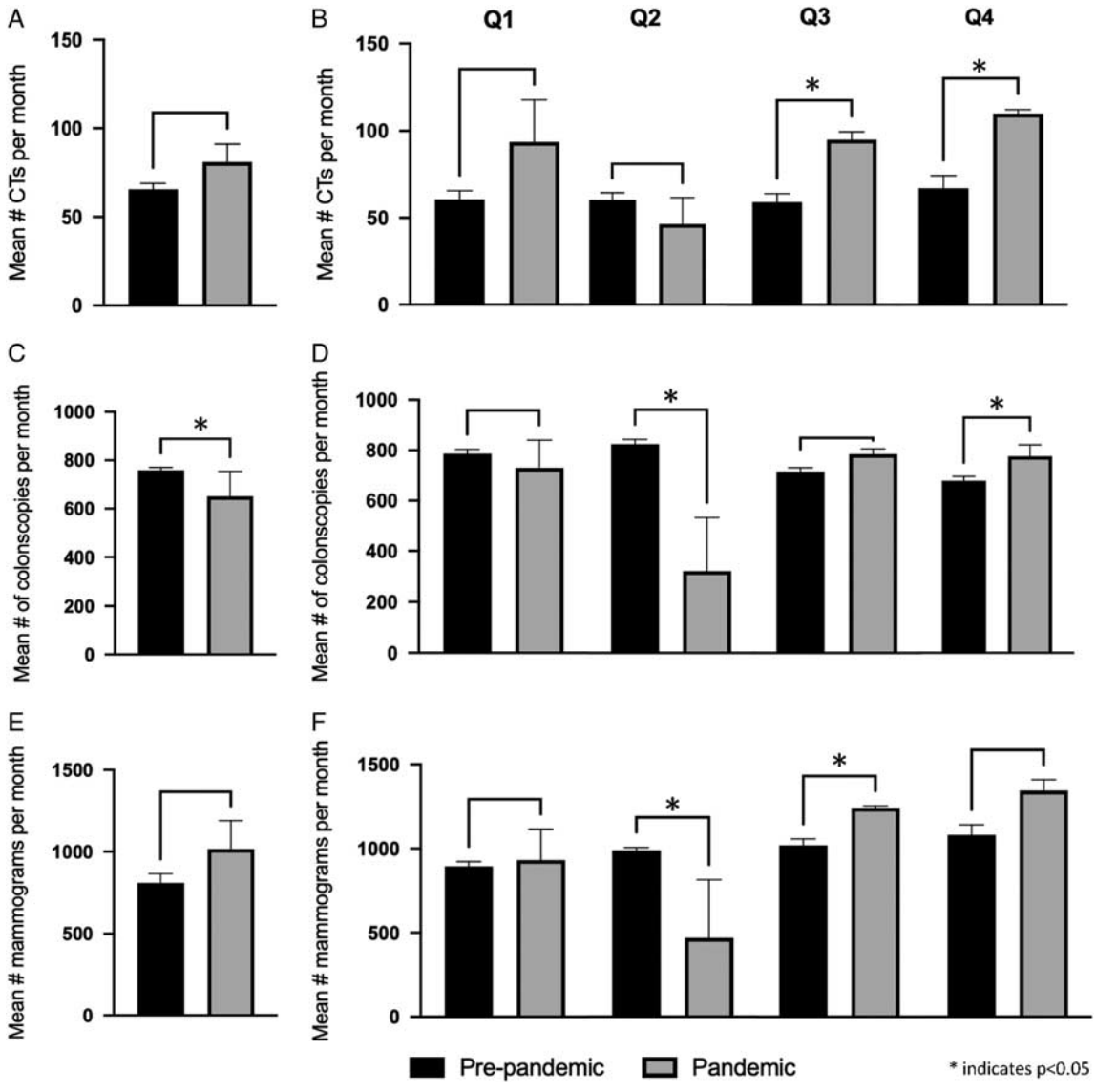

FIGURE 1. The mean number of screening chest computed tomography scans (1A, B), coloscopies (1C, D), and mammograms (1E, F) per month in the prepandemic period compared with the pandemic period stratified by year (1A, C, E) and quarter (1B, D, F). Error bars represent SEM.

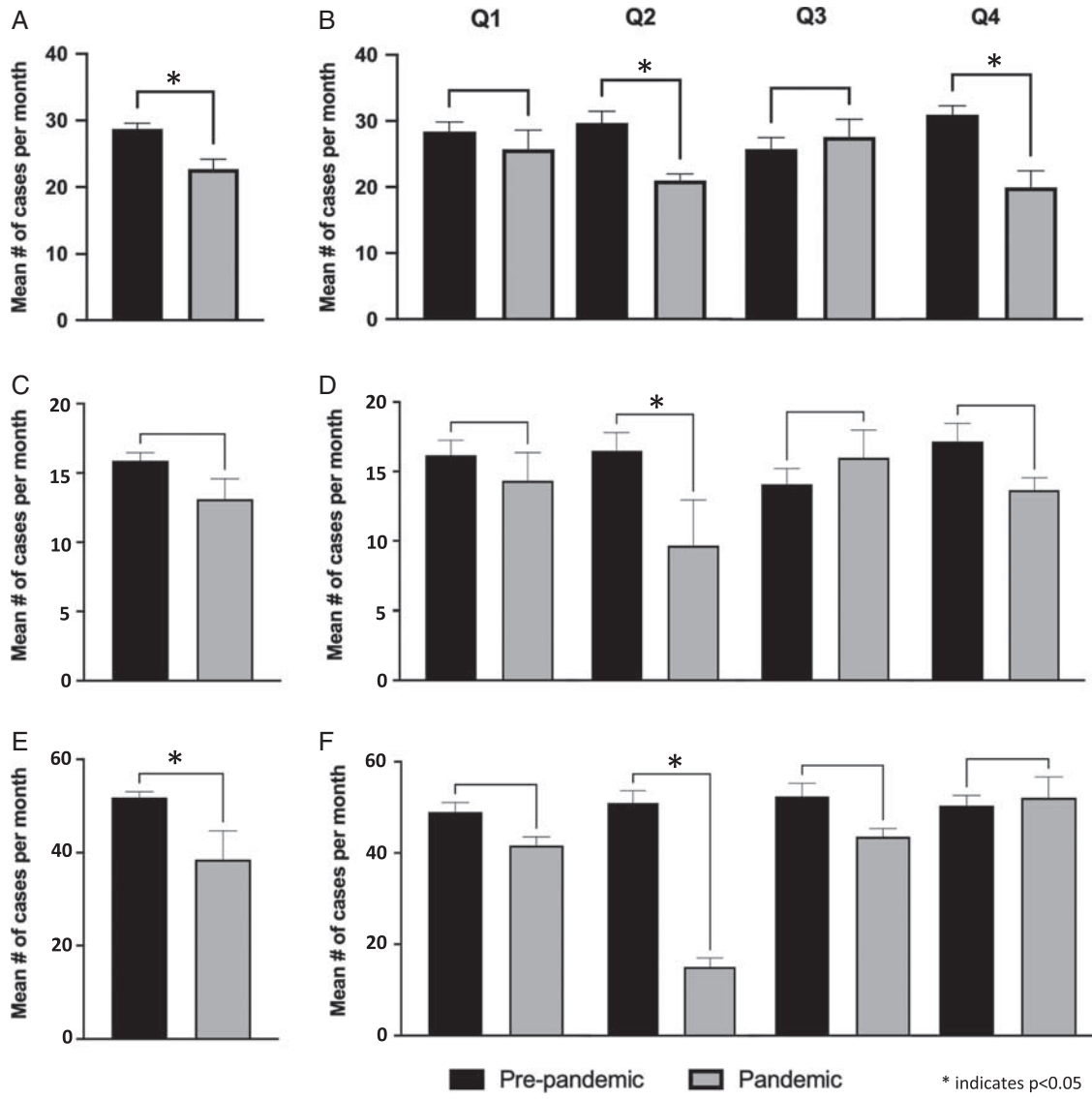

FIGURE 2. The number of new lung (2A, B), colorectal (2C, D), and breast (2E, F) cancer diagnoses per month in the prepandemic period of 2016-2019 and pandemic year of 2020, stratified by year (2A, C, E) and quarter (2B, D, F). Error bars represent SEM.

In 2020, there was a decrease in the monthly average of new breast cancer diagnoses [38.56 (SEM6.133) vs. 51.82 (SEM1.257), $P = 0.001$; Fig. 2E]. This decrease during the pandemic year was also noted in Q2 [16.00 (SEM2.082) vs. 54.17 (SEM2.828), $P < 0.001$]. There was no significant decrease in new diagnoses in Q1 [41.67 (SEM1.856) vs. 49.00 (SEM2.063), $P = 0.114$], Q3 [43.67 (SEM1.764) vs. 52.50 (SEM2.862), $P = 0.161$], or Q4 [56.00 (SEM4.933) vs. 54.17 (SEM2.412), $P = 0.740$; Fig. 2F].

Disease Characteristics and Staging

Comparing the pandemic year to prepandemic years, there was no change in the distribution of clinical stage for lung cancer (stage 1: 33.5% vs. 30.1%, stage 2: 8.06% vs. 7.72%, stage 3: 16.5% vs. 17.7%, stage 4: 41.5% vs. 44.3%, $P = 0.757$; Fig. 3A).

For colorectal cancer, there was no difference in the site of presentation, histology, or pathologic stage distribution during the pandemic year (stage 0: 6.56% vs. 3.40%, stage 1: 24.6% vs. 21.3%, stage 2: 17.2% vs. 27.1%, stage 3: 28.7% vs. 26.0%, stage 4: 22.9% vs. 21.7%, $P = 0.180$; Supplemental Table 1, Supplemental Digital Content 1, http://links.lww.com/AJCO/A426; Fig. 3B).

For breast cancer, there was a greater proportion of DCIS in 2020 compared with prepandemic (12.7% vs. 9.73%) and a smaller percent of invasive ductal or lobular carcinoma in 2020 (77.8% vs. 84.3%, $P < 0.001$; Supplemental Table 1, Supplemental Digital Content 1, http://links.lww.com/AJCO/A426). There was no change in clinical stage distribution (stage 0: 17.1% vs. 18.9%, stage 1: 54.7% vs. 48.1%, stage 2: 15.9% vs. 10.1%, stage 3: 7.28% vs. 7.61%, stage 4: 4.93% vs. 5.01%, $P = 0.115$; Fig. 3C).

Treatment Characteristics

In 2020, there was a decrease in the overall surgical volume at our institution in April and May, with a return to baseline by June (Fig. 4). There was a similar decrease in

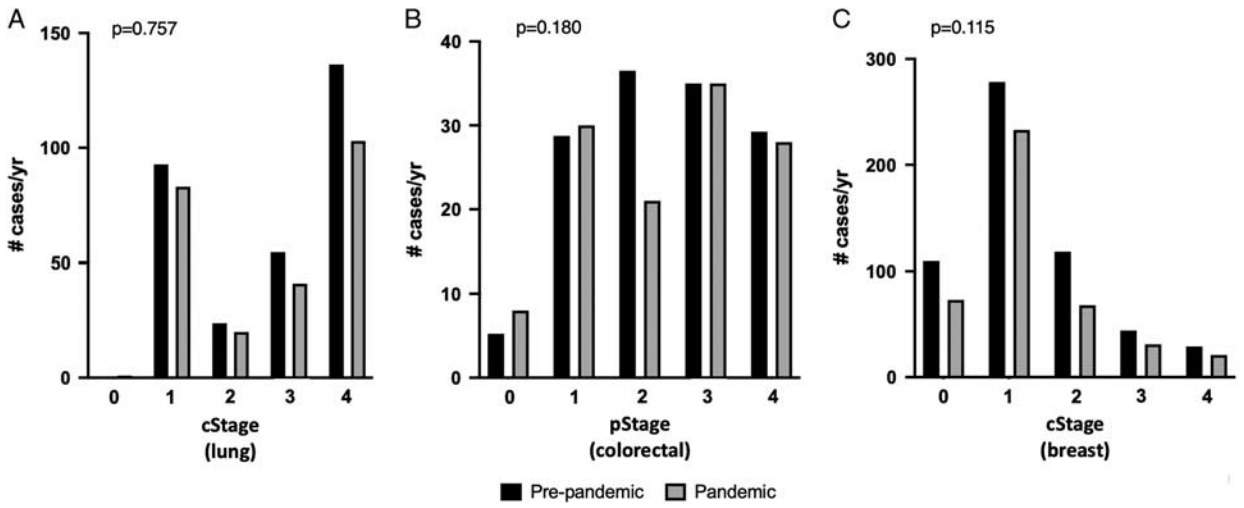

FIGURE 3. Clinical stage of lung (A), pathologic stage of colorectal (B), and clinical stage of breast (C) cancer during the prepandemic and pandemic years.

surgeries for lung, colorectal, and breast cancer. Breast surgeries were also decreased in June and did not rebound until July. For lung cancer (Table 2A), a greater proportion of patients underwent surgical resection in the pandemic year compared with prepandemic (37.1% vs. 30.6%, $P=0.032$). In Q3, there were more patients who received surgery in 2020 than in the previous years (38.9% vs. 25.6%, $P=0.019$). There was no difference for the other quarters. There was no change during the pandemic compared with prior years in the proportion of patients receiving radiation (41.0% vs. 44.2%, $P=0.321$) or chemotherapy (47.0% vs. 46.6%, $P=0.902$). In 2020, more patients were treated with immunotherapy compared with prepandemic period (25.4% vs. 16.3%, $P<0.001$).

For colorectal cancer, there was no change in 2020 in the proportion of patients who underwent surgery (85.1% vs. 84.9%, $P=0.944$), chemotherapy (47.8% vs. 50.6%, $P=0.524$), or radiation therapy (13.7% vs. 17.6%, $P=0.223$; Table 2B).

For breast cancer, a smaller proportion of patients underwent surgery (87.9% vs. 91.4%, $P=0.016$), radiation (46.5% vs. 52.8%, $P=0.012$) or endocrine therapy (ET) (61.9% vs. 68.5%, $P=0.005$) compared with prepandemic years. There was no difference in patients treated with chemotherapy (36.6% vs. 36.3%, $P=0.913$) or immunotherapy (11.2% vs. 10.1%, $P=0.464$). There was no difference in types of definitive breast surgery [lumpectomy 47.3% vs. 48.6%, mastectomy 45.1% vs. 44.8%, other 7.61% vs. f6.57%, $P=0.726$; Table 2C].

TABLE 2. Utilization of Different Treatment Modalities for Patients With Lung (A), Colorectal (B), and Breast (C) Cancer Before and During the Pandemic

Lung	Prepandemic N (%)	Pandemic N (%)	*P*
A.			
Surgery	422 (30.6)	105 (37.1)	0.032*
Chemo	643 (46.6)	133 (47.0)	0.902
Radiation	610 (44.2)	116 (41.0)	0.321
Immunotherapy	225 (16.3)	72 (25.4)	<0.001*
B.			
Colorectal			
Surgery	651 (84.9)	137 (85.1)	0.944
Chemo	388 (50.6)	77 (47.8)	0.524
Radiation	135 (17.6)	22 (13.7)	0.226
Immunotherapy	31(4.04)	10 (6.21)	0.223
C.			
Breast			
Surgery	2301 (91.4)	416 (87.9)	0.016*
Chemo	914 (36.3)	173 (36.6)	0.913
Radiation	1329 (52.8)	220 (46.5)	0.012*
Endocrine Therapy	1725 (68.5)	293 (61.9)	0.005*
Immunotherapy	254 (10.1)	53 (11.2)	0.464

*Indicates significant at $P<0.05$.

Treatment Timing

During the pandemic, the average time-to-treatment for lung cancer was shorter than prepandemic [38.92 d (SEM 2.48) vs. 66 (SEM1.46), $P=0.002$; Fig. 5A]. The time-to-chemotherapy was also shorter in 2020 [48.46 d (SEM3.241) vs. 60.41 (SEM1.86), $P=0.006$]. There was no difference in the time-to-surgery [35.45 d (SEM4.24) vs. 47.03 (SEM2.89), $P=0.061$] or radiation [66.41 d (SEM5.142) vs. 74.17 (SEM2.665), $P=0.234$; Fig. 5A].

For colorectal cancer, there was no significant decrease in time-to-treatment in 2020 compared with 2016-2019 [20.07 d (SEM2.137) vs. 24.99 (SEM1.160), $P=0.071$; Fig. 5B]. Time-to-surgery was shorter in 2020 compared with prepandemic [27.04 d (SEM3.957) vs. 44.75 (SEM2.865), $P=0.007$]. There was no difference in the time-to-chemotherapy [58.86 d (SEM3.745) vs. 62.18 (SEM2.217), $P=0.527$] or radiation [68.09 d (SEM12.63) vs. 78.44 (SEM5.779), $P=0.497$; Fig. 5B].

Time-to-treatment for breast cancer was not significantly different in 2020 compared with prepandemic years [55.00 d (SEM1.753) vs. 56.60 (SEM0.744), $P=0.395$; Fig. 5C]. Time-to-surgery [101.81 d (SEM3.989) vs. 94.20 (SEM1.607), $P=0.066$] and time-to-chemotherapy [77.38 d (SEM3.995) vs. 81.23 d (SEM1.831), $P=0.398$] were also not significantly different. The time-to-radiation [154.04 d (SEM5.799) vs. 167.25 (SEM2.517), $P=0.046$] and time-to endocrine-therapy [129.56 d (SEM4.962) vs. 158.27 (SEM2.304), $P<0.001$] were significantly shorter in 2020 compared with prepandemic (Fig. 5C).

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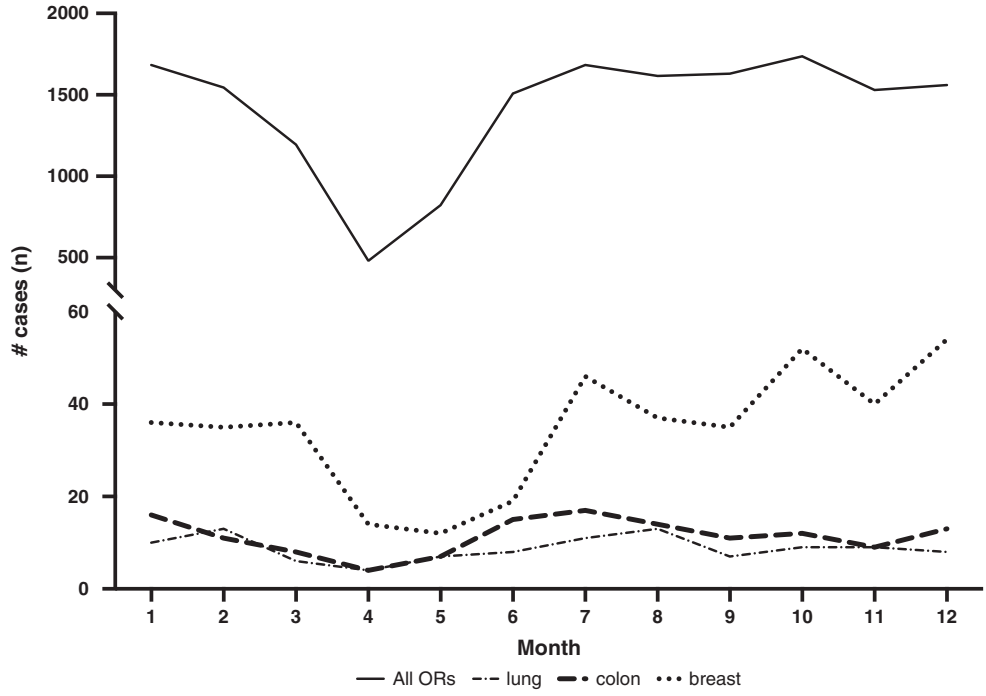

FIGURE 4. Total operative volume at our tertiary care center in 2020.

DISCUSSION

The COVID-19 pandemic strained the health care system in unprecedented ways. Oncologists were tasked with balancing the treatment of potentially aggressive malignancies against exposing their vulnerable patients to infection. In our study, we focused on lung, colorectal, and breast cancer to represent common and potentially aggressive malignancies with clear guidelines and management algorithms both for screening and treatment.

We were surprised to find no decrease in the number of screening CTs and mammograms in 2020. Colonoscopy was the only screening test that had a significant decrease during the pandemic year, possibly due to patient or provider reluctance to obtain this test, as it is an invasive procedure that requires preparation. Our findings align with other studies, which showed a decrease in colorectal screening in 2020 and more focally from March to June 2020.[16–20] Of note, screening CTs for lung cancers is the newest of these screening modalities. In the years leading up to the pandemic, our institution saw a steady increase in the number of screening CTs, corresponding with the development of our institution's lung cancer screening program (Supplemental Fig. 1, Supplemental Digital Content 1, http://links.lww.com/AJCO/A426). Although we do not see fewer CTs in 2020, the lack of expected rise is likely due to the pandemic, as several other groups saw a decrease in screening CTs.[10,17,18] The lack of increase seen in Q3 for colonoscopies and Q4 for mammograms may be due to the fixed maximum capacity of our institution to accommodate an increase in demand for screenings.

While patients were able to get their screening tests, a less encouraging finding was the decreased number of new lung and breast cancer cases in 2020. The overall decrease is likely due to significantly fewer diagnoses from April to June 2020 without a compensatory increase in later months. This may represent the trickle-down effect of CDC stay-at-home orders, which contributed to fewer routine visits, and the lack of an available vaccine until December 2020.[17–19,21,22] This decrease in cancer cases during this time period was also seen by other groups, including a VA study that saw a decrease in the number of colorectal, lung, bladder, and prostate cancer during the early pandemic months without a compensation later in the year.[23–25] We found no significant difference in race or distribution of patients based on average income of their zip codes, which are important socioeconomic factors that typically put certain populations at higher risk of losing access to cancer care.[26–29] However, we did see more lung and breast cancer patients from zip codes below the median income during the pandemic year. This may be due to an increase in furloughed workers during the pandemic peak, allowing lower-income patients to seek out medical care during hours they would typically be working. Future studies should investigate the impact of social disparities on patients during the pandemic.

This study is based on the experience of our tertiary care hospital in Camden, NJ, a city within the greater Philadelphia area. This region is uniquely abundant in the presence of several high-volume academic centers. While we presume that many patients chose to stay near their local hospitals for cancer care during the pandemic, the effect of other tertiary care centers in PA on our findings is likely minimal due to state-specific insurance access. Interestingly, we saw an increase in the proportion of colorectal and breast cancer patients who presented from counties neighboring our hospital during the pandemic year, which may be the sequalae of our hospital's ability to act as a safety-net hospital when smaller hospitals were strained. These other institutions in southern NJ collectively shared the burden of care for COVID patients, allowing our institution to maintain complex oncologic care.

There was widespread concern that a decrease in screening and case volume in 2020 would have dramatic consequences. One computational model used the National Canadian Cancer Registry to predict a 2.0% increase in cancer

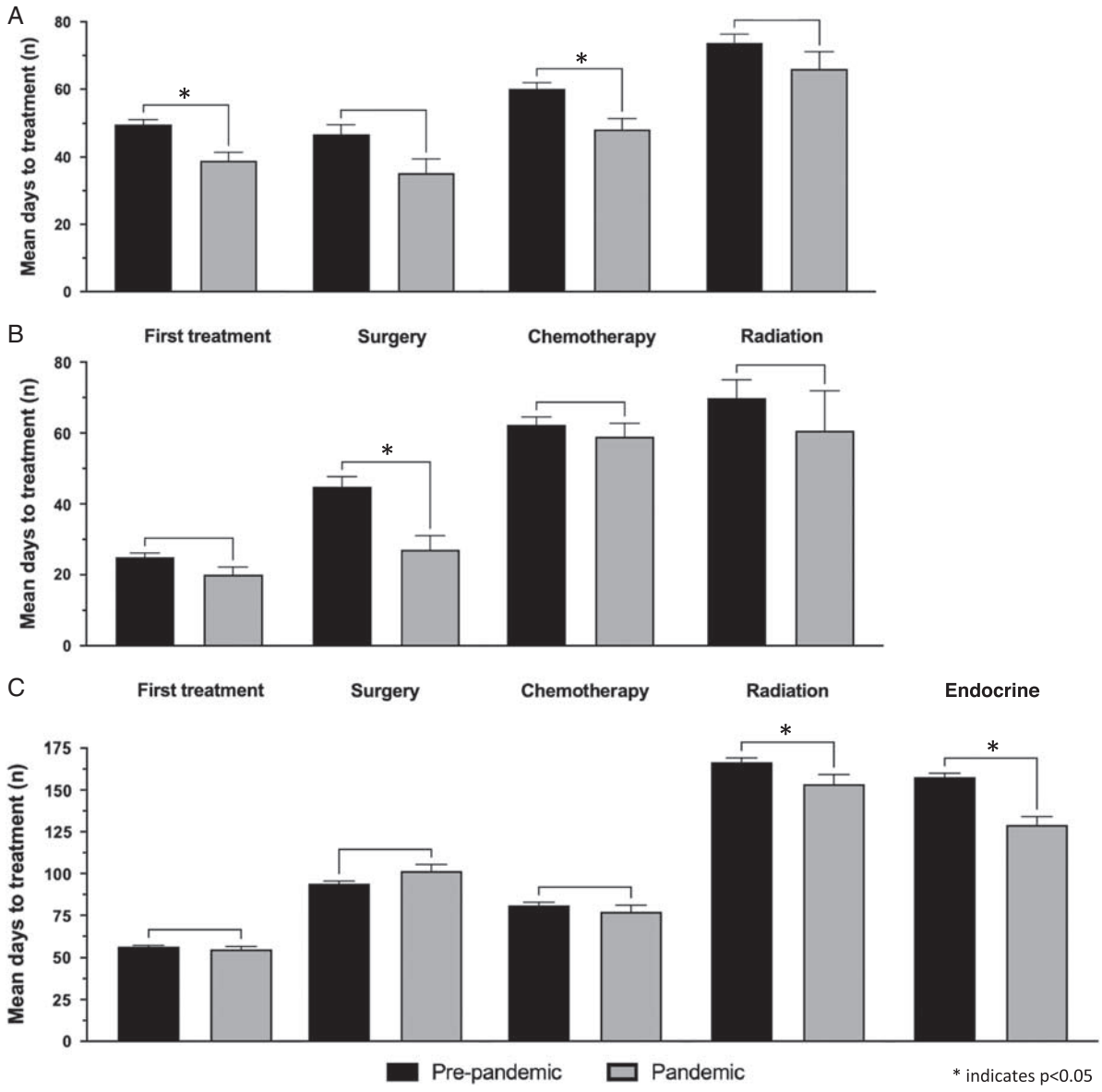

FIGURE 5. Mean time-to-treatment (days) from the initial diagnosis of lung (A), colorectal (B), and breast (C) cancer to first line of therapy and specific therapies. Error bars represent SEM.

deaths over the next decade, particularly for lung, colorectal, and breast cancer.[12,13,30] Notably, this model assumed a delay in surgery, which we did not observe. Some early studies have found an increase in lung nodules suspicious for malignancy and a decrease in DCIS with an increase in node-positive breast cancer after a disruption in screening.[10,11] However, we did not observe any change in stage distribution for lung, colorectal, or lung cancer. This was similar to an observational study in the UK of colorectal adenocarcinoma pathology specimens in early 2020 and early 2021 that saw no change in T or N stage compared with previous years.[31] It is likely too soon to see the true impact of the pandemic on stage migration.

We saw a greater proportion of lung cancer patients who received surgery and immunotherapy in 2020 compared with previous years. ACS and Thoracic Surgery Outcomes Research statements recommended continuing surgeries for patients at a high risk of disease progression within 3 months. As a tertiary care cancer center, we have a large volume of high acuity diseases at presentation that underwent upfront surgery during the pandemic based on these guidelines.[8] The increasing proportion of immunotherapy is likely a result of recent advances in its use as adjuvant therapy.[32–34] For colorectal surgery, recommendations supported continuing surgeries if possible, with delays no longer than 4 to 6 weeks.[3,35,36] In specific cases, neoadjuvant therapy was recommended for stage III and some stage II cancers.[37] This was reflected in our data, which showed no difference in the proportion of patients who underwent surgical resection in 2020 compared with prepandemic years.

Consensus guidelines for breast cancer by ACS and the COVID-19 Pandemic Breast Cancer Consortium suggested deferral of surgery for DCIS for 3 to 6 months and reservation of surgery for higher risk patients.[3,9] In our institution,

decreased proportions of patients underwent surgery and immunotherapy compared with previous years, and more patients were initiated on endocrine therapy as a bridge to definitive therapy. There was a shorter time-to-radiation and ET with a longer time-to-surgery, suggesting that oncologists were opting for upfront nonoperative management. This coincides with the findings of Filipe et al,[38] who saw a 40% decrease in surgical volume in early 2020, especially for lower stage cancers.

Despite initial concerns that cancer patients would not receive adequate treatment during COVID, our study did not find a delay in cancer care.[17,39] Colorectal and breast cancer did not see a difference in time-to-treatment from initial diagnosis, and lung cancer saw a shorter time-to-treatment. There was a shorter time-to-surgery for colorectal cancer, shorter time-to-chemotherapy for lung cancer, and shorter time-to-radiation and ET for breast cancer. Though we saw a dip in screening tests and diagnoses, the lack of treatment delay speaks to the resiliency of healthcare delivery during the pandemic.

Our study does have some limitations. Our data was confined to the months immediately following the first pandemic peak in 2020, which limited our ability to identify any long-term outcomes. We utilized a retrospective tumor registry for data collection, thus restricting the granularity of certain aspects of patients' treatments, including the type of chemotherapy. When comparing our findings to other studies, it is important to factor in the different acuity phase levels of the pandemic. Each phase was based on the real-time COVID census and available resources, which inherently introduced variance in the guideline-based cancer care provided to patients. As the largest tertiary health center in the southern NJ region, our triage level was consistently mid-to-high acuity during Spring 2020 and is likely reflective of institutions that took care of similar communities. Unfortunately, we are unable to comment on the impact that the pandemic had on patients at community cancer centers. Future investigations utilizing national databases, which contain multi-center data, would provide better insight into the impact of facility type on patient outcomes during the pandemic. In addition, the impact of COVID-19 on patients already undergoing cancer care at our institution was beyond the scope of our study but would be an interesting future investigation. Our hospital did take immediate steps to increase the accessibility to telemedicine encounters and in-person appointments, as appropriate, to ensure that patients continued to have appropriate cancer surveillance. Lastly, while we did not identify any cancer "upstaging" in 2020, there may be a delay that could become more apparent in the coming years.

CONCLUSION

Cancer care during the pandemic was challenging, but our study shows the resilience of the oncologic community. In 2020, there was no difference in the number of screening CTs or mammograms performed, although we did see a decrease in new lung and breast cancer cases. Despite a decrease in the number of colonoscopies, there was no change in the overall number of new colorectal cancer diagnoses. The time-to-treatment for colorectal and breast cancer was unchanged; for lung cancer, the time-to-treatment was shorter than prepandemic. This data reinforces the work of multiple healthcare agencies that generated consensus guidelines to direct the care of cancer patients and supports the ability of a tertiary cancer center to provide high-quality care to patients during a pandemic.

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