Ann Surg Oncol (2022) 29:6189–6196
https://doi.org/10.1245/s10434-022-12139-2

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY

ORIGINAL ARTICLE – BREAST ONCOLOGY

Impact of COVID-19 Restrictions on Stage of Breast Cancer at Presentation and Time to Treatment at an Urban Safety-Net Hospital

Kelly A. Kapp, MD[1], An-Lin Cheng, PhD[2], Catherine M. Bruton, RHIA, CTR[3], and Nasim Ahmadiyeh, MD, PhD[1,3,4]

[1]Department of Surgery, University of Missouri Kansas City School of Medicine, Kansas City, MO; [2]Department of Biomedical and Health Informatics, University of Missouri Kansas City School of Medicine, Kansas City, MO; [3]University Health (formerly Truman Medical Centers), Kansas City, MO; [4]Department of Surgery, University Health/Truman Medical Center, Kansas City, MO

ABSTRACT

Background. COVID-19 disrupted health systems across the country. Pre-pandemic, patients accessing our urban safety-net hospital presented with three-fold higher rates of late-stage breast cancer than other Commission-on-Cancer sites. We sought to determine the effect of the COVID-19 pandemic on stage of breast cancer presentation and time to first treatment at our urban safety-net hospital.

Methods. An Institutional Review Board-approved cohort study of newly diagnosed breast cancer patients was conducted at our safety-net hospital comparing a COVID cohort (March 2020–February 2021, $n = 82$) with a pre-COVID cohort (March 2018–February 2019, $n = 90$). Demographic information, stage at presentation, and time to first treatment—subdivided into time from symptom to diagnosis and diagnosis to treatment—were collected and analyzed for effect of COVID pandemic.

Results. Cohorts were similar in age, race, and payor. More patients had late-stage disease during COVID (32%) than pre-COVID (19%, $p = 0.05$). There was a significantly longer time to first treatment during COVID ($p = 0.0001$) explained by a significantly longer time from symptom to diagnosis ($p = 0.0001$), with no difference in time from diagnosis to treatment.

Conclusion. It was significantly more likely for patients to present to our safety-net hospital with late-stage breast cancer during COVID than pre-COVID. There was longer time to first treatment during COVID, driven by the increased time from symptom to diagnosis. Patients may have perceived that care was inaccessible during the pandemic or had competing priorities, driving delays. Efforts should be made to minimize disruption to safety-net hospitals during future shut-downs as these are among the most vulnerable patients.

Healthcare services were disrupted throughout the country in response to the COVID-19 pandemic. In March of 2020 the Centers for Disease Control recommended the postponement of elective surgeries and medical procedures in order to conserve resources.[1] Responses varied from state to state, city to city, and within healthcare systems as providers and the population dealt with the unanticipated SARS-CoV-2 pandemic. What services were suspended and which procedures were deemed elective was made by individual physicians and hospitals with uncertainty about the duration of the pandemic and about the consequences on care. In the early stages of the COVID outbreak, the American Society of Clinical Oncology recommended screening mammograms be temporarily postponed in an effort to conserve health system resources and to decrease virus exposure.[2] Patients at our safety-net hospital (SNH) pre-pandemic have historically had a much lower rate of screening mammograms than the national average.[3] In addition, the patients accessing our safety-net hospital have a three-fold higher rate of late-stage breast cancers at

First Received: 29 March 2022
Accepted: 24 June 2022
Published Online: 29 August 2022

N. Ahmadiyeh, MD, PhD
e-mail: ahmadiyehn@umkc.edu

presentation compared with women accessing other Commission-on-Cancer accredited centers across the country.[3] While initiatives had been undertaken to improve the safety-net population's late-stage presentations[4], we were concerned that the pandemic might further discourage our vulnerable safety-net population from getting breast cancer screening and timely breast care.

At the start of the pandemic and the stay-at-home orders, both the public and health systems/physicians were trying to adapt to this public health emergency. The American Medical Association issued a COVID-19 public memo to providers in March 2020 delineating "four key answers for your patients." This referenced surgical providers stating that something that is done for purely screening purposes is "elective," and that things that are done for conditions that have been present for some time, "may be able to wait another few weeks or another couple months."[5] We were concerned that many primary care providers and patients at our safety-net hospital chose to reschedule or completely forego screening or care for a new breast complaint not only during the initial peak weeks of the pandemic but throughout the city-wide shut-down period. We therefore felt it was critical to evaluate the possible significance and potential secondary enduring consequences of the rapidly implemented changes in care during the COVID 19 pandemic, especially for vulnerable patients who are already significantly behind in accessing care.

Here we sought to determine the effect, if any, of the COVID-19 pandemic on stage of breast cancer presentation and time to first treatment at an urban safety-net hospital. We hypothesized that the pandemic would be associated with an increase in late-stage breast cancers at diagnosis among an already vulnerable safety-net population, and expected there would be delays in care.

METHODS

An Institutional Review Board-approved cohort study was conducted at an urban safety-net hospital in Kansas City, Missouri. The COVID cohort spanned March 2020 through February 2021. This encompasses the period which begins with the first COVID-19 stay-at-home orders[6] through the time when all restrictions were lifted including stay-at-home orders, restrictions on business hours, and face-mask mandates.[7] This was compared with a pre-COVID control cohort in the comparable months from March 2018 through February 2019, so as not to overlap with the period when the first CDC confirmed case was identified in the United States (January 2020).

Our Institutional Cancer Registry was used to identify all patients who presented with breast cancer during the study periods. This was a single institute retrospective study at our urban safety-net hospital. There were 90 patients with a new breast cancer diagnosis in the pre-COVID cohort March 2018-February 2019. There were 82 patients identified with breast cancer during the COVID-restricted period March 2020-February 2021. We collected data on time intervals between symptom onset and diagnosis, as well as time from diagnosis to first treatment. Symptom onset was defined as the first abnormal breast-related sign or symptom recorded in the Electronic Medical Record as described by the patient, or when a patient without a clinical symptom had an abnormal screening mammogram, whichever came first. Time at diagnosis was the date the biopsy confirming cancer was performed. First treatment was defined as the day the patient either started chemotherapy, endocrine therapy, or surgery, whichever came first. The clinical stage of cancer at presentation and demographic information of age, race, and payor were also extracted from the cancer registry for each patient. Late-stage disease was defined as Stage III or IV disease following the AJCC 8th edition staging system.[8] Multivariate logistic regression model statistical analysis, SAS version 9.4, was used to determine whether the COVID time period or other socio-demographic variables were associated with late-stage disease at presentation, or in the time to first treatment. Mann-Whitney U tests were conducted to find out if there was a statistically significant difference between pre-COVID and COVID time periods on days to first treatment, days from symptom to diagnosis, and days from diagnosis to treatment (SAS Institute, Carry, NC).

RESULTS

Both cohorts had similar baseline characteristics (Table 1). The mean age at diagnosis was 54.8 in the control cohort and 55.1 in those diagnosed during COVID. Breakdown of the populations by self-identified race showed that pre-COVID, 41% of the patients were White, 48% were Black, and 7% were Hispanic; while during COVID 39% were White, 45% were Black and 12% were Hispanic. The payor mix was also similar in the two cohorts. In the pre-COVID control cohort, 57% of the patients had Medicaid or no insurance, while 24% had Medicare and 19% had private insurance. Of the breast cancer patients that presented during COVID, 60% had Medicaid or no insurance, 22% had Medicare and 18% had private insurance. Patients were more likely to present with late-stage disease in the COVID cohort. During COVID, 31.7% of the breast cancer patients presented with Stage III or IV disease, while over the same months in the pre-COVID time period only 18.9% of the breast cancer patients presented with late-stage disease $p = 0.05$, (Table 1 and Fig. 1).

TABLE 1 Differences between patients' age, insurance status, self-reported race, stage at diagnosis, and time to first treatment in pre-COVID and COVID cohorts, showing number (n) and either percent (%), mean, or median for each category. Chi-squared or *t*-statistic and the *p*-value for each measure also shown

Variables	pre-COVID		COVID		Chi squared/ *t*-statistics	*P* value
	n	%, mean or median	*n*	%, mean or median		
Race						
Self-described						
White	37	41	32	39	0.088	0.7803
Black	43	48	37	41		
Hispanic	6	7	11	12		
Other	4	4	2	2		
Insurance						
None	20	22	11	14	3.4835	0.3229
Private	17	19	15	18		
Medicaid	31	35	38	46		
Medicare	22	24	18	22		
AGE (mean)	90	54.8	82	55.1	− 0.189	0.851
Stage						
Stage 0-II	73	81	56	68	3.7601	0.0525
Stage III and IV	17	19	26	32		
Median TIME (days) to						
First treatment	90	29	82	48	− 4.419	**<0.0001**
Symptom to diagnosis	90	13	82	27	− 6.185	**<0.0001**
Diagnosis to treatment	90	14	82	15	2.716	0.606

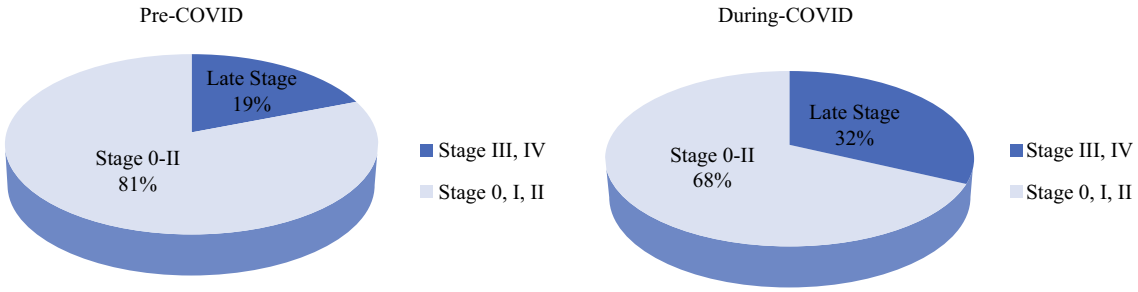

FIG. 1. Pie Chart showing percent of newly diagnosed breast cancer patients presenting with late-stage disease (Stage III and IV) during two time periods: pre-COVID (March 2018 to February 2019) and COVID-restricted (March 2020 to February 2021). Unadjusted $p = 0.05$; multiple logistic regression after accounting for race and payor, $p = 0.03$

Statistical analysis using multiple logistic regressions conducted while controlling for race and insurance showed that a patient was 1.2 times more likely to present with late-stage disease during COVID restrictions as compared to pre-COVID, $p < 0.05$ (Table 2). The data revealed that there was a longer time to first treatment during COVID (mean 65 days, median 48 days) than pre-COVID (mean 32 days, median 29 days), $p < 0.001$), Table 1 (Fig. 2). The days from symptom to diagnosis more than doubled from pre-COVID (mean 14, median 13 days) to during COVID (mean 42, median 27 days), $p < 0.0001$ (Table 1 and Fig. 3). A significant difference was not found in the time from diagnosis to treatment pre-COVID (mean 18 days, median 14 days) versus during COVID (mean 23 days, median 15 days, $p = 0.606$) (Table 1 and Fig. 3). Statistical analysis found no significant difference in the delay in time from symptom to diagnosis or diagnosis to treatments based on race or different payor status (Kruskal-Wallis test, SAS System).

The delay in time from first symptom to diagnosis persisted unabated throughout the COVID-restricted period, from initial stay-at-home order, continuing through the first local peak of cases, and persisting through the second COVID peak in Kansas City during the winter 2020–2021 (Fig. 4).

DISCUSSION

The Centers for Disease Control voiced concern in June of 2021 that the pandemic may lead to increased cancer health disparities among women, who already experience health inequities, as they noted an 87% decline in screening

TABLE 2 Multiple logistic regression conducted to examine the effect of COVID on late-stage disease while controlling for self-reported race and insurance. Races were grouped into White and non-White (self-identified). Odds ratio, confidence interval, and *p* values shown

Effect	Odds ratio	Confidence interval		*P* value
		Lower limits	Upper limits	
COVID vs Pre-COVID	2.255	1.072	4.742	**0.0320**
Private insurance vs No insurance	0.169	0.046	0.621	0.0700
Medicare vs No insurance	0.434	0.172	1.097	0.5962
Medicaid vs No insurance	0.265	0.087	0.808	0.3484
White vs non-White	1.1.08	0.526	2.334	0.7866

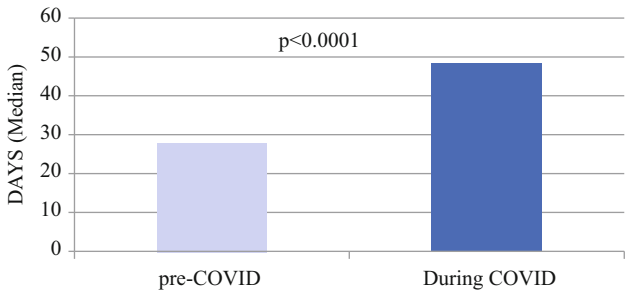

FIG. 2. Bar graph showing median number of days from first symptom onset or abnormal mammogram to first treatment, pre-COVID (March 2018–February 2019) and during COVID restrictions (March 2020–February 2021)

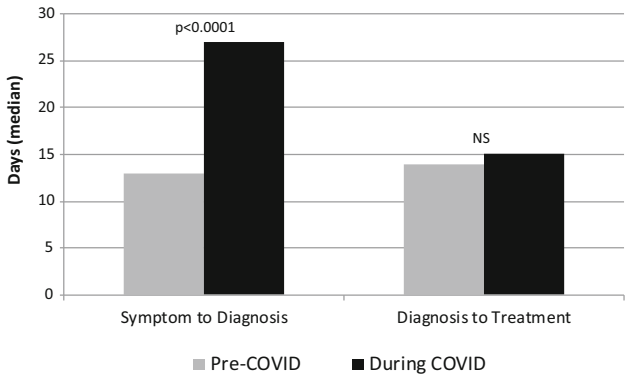

FIG. 3. Bar graph showing median time in days to first treatment broken down into two components: time from symptom onset to diagnosis and time from diagnosis to first treatment pre-COVID (March 2018–February 2019) and during COVID-restricted time periods (March 2020–February 2021), relevant *p*-value shown, *NS* means not significant

mammograms in April 2020 compared with the previous five Aprils.[10] Alarmingly, we found that late-stage breast cancer was 1.2 times more likely to occur during the COVID pandemic than during the pre-pandemic period in our safety-net patients in Kansas City, Missouri. Nationwide, a 51% decline in newly identified breast cancer diagnoses in March of 2020 during the first weeks of the pandemic was reported.[11] Kaufman et al. provided an update of the data from the National Cancer Institute through March 2021 showing that there was a rebound in the summer months to pre-pandemic levels, but the levels of new cancer diagnoses fell back to 80% of pre-pandemic numbers for the following two quartiles.[12] The data were not evaluated by race, income, or access to care.

Nationally, investigations not geared toward safety-net populations did not find the same degree of breast cancer care problems related to COVID as in our vulnerable subset. A tertiary referral center study found no statistically significant difference in stage of breast cancer before and during COVID.[13] They reported that 8% of their patients presented with stage III or IV disease in the year before COVID and 11% presented with Stage III or IV disease in the comparable months during COVID, which was not a statistically significant change. Another large, six-hospital health system study found no difference in late-stage disease at diagnosis between a 2018 cohort and a comparable 2020 COVID cohort.[14] These studies at tertiary centers that were not evaluating safety-net populations, found little if any significant change in late-stage cancer presentation during COVID. In contrast, patients presenting to our urban safety-net hospital during the 12 months of city-wide COVID restrictions were 1.2 times more likely to present with late-stage breast cancer when controlling for race and payor status, than in the comparable months the year prior to the pandemic ($p < 0.05$). This is an important finding, showing that the vulnerable patients who accessed care at our safety-net hospital, who are already known to have a higher than average late-stage breast cancer presentation, were disproportionately sensitive to the COVID pandemic restrictions compared with the nation as a whole. Corroborating our concern, an urban-center study in Boston found that the proportion of patients diagnosed with late-stage disease was 6.6% in their pre-COVID cohort but the proportion had almost doubled to 12.6% in their 2020 COVID cohort, with those with lower income and medical comorbidities disproportionately affected.[15]

While we are uncertain about the generalizability of our findings, it is reasonable to consider that similar processes may have been at work in other safety-net settings across the country, and that their subset of patients may also have had trouble accessing breast cancer care during COVID restrictions with resultant delays in diagnosis. Our study is limited by its retrospective nature. While we did not find

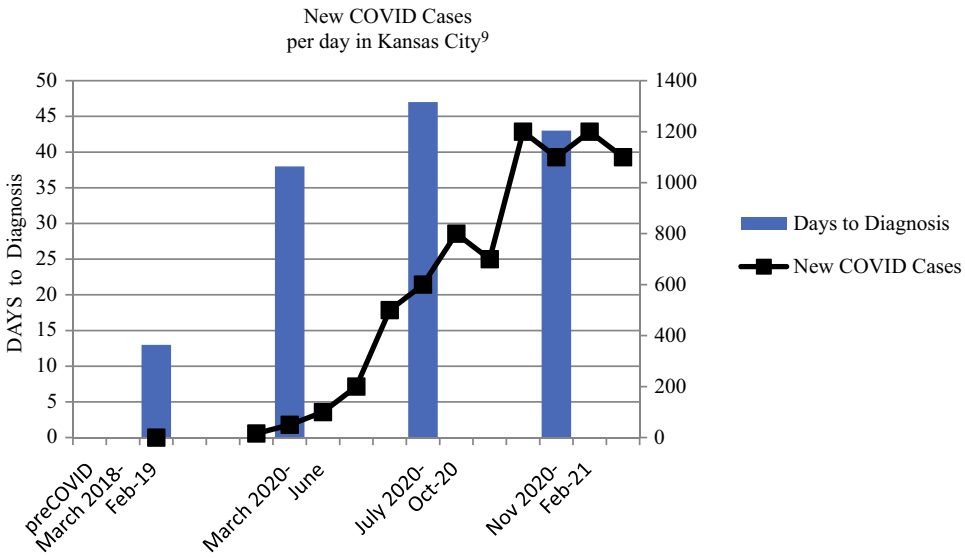

FIG. 4. Bar graph showing median time in days to diagnosis pre-COVID and during COVID. The COVID-restricted period is broken down into 4-month intervals with an overlay showing the number of new COVID cases in the Kansas City area during respective time periods[9]

differences between the pre-COVID cohort and the COVID cohort with regard to age, insurance status, or race (Table 1), there may have been other unmeasured differences between the women seeking care at our safety-net pre-COVID and those seeking care during COVID. It is also conceivable that fear of contracting COVID-19 resulted in selection bias where women with palpable tumors sought care while those who were asymptomatic and would have been picked up by mammogram at an early stage, did not seek care, thus resulting in an "inflation" of late-stage cancers. The overall number of breast cancers diagnosed and treated at our institution during COVID, however, were only down by eight, as compared to pre-COVID, suggesting that selection bias alone is unlikely to account for the significant increase in late-stage cancers seen. Finally, although we cannot attribute any causality to this, we did find a doubling of median time from first symptom to diagnosis during COVID as compared to pre-COVID.

This significant increase in late-stage breast cancer at our SNH during the COVID pandemic may have been mediated by delays in seeking care. While time from first symptom or abnormal mammogram to first treatment was increased overall during COVID than during pre-COVID, this was driven primarily by a significant delay in diagnosis. There was no delay in treatment once a diagnosis of breast cancer was made. Our multidisciplinary oncology clinic and our breast clinics did not stop seeing patients in person at any point in the pandemic, and while appropriate use of neoadjuvant systemic therapy, including endocrine therapy, was employed to delay the need for surgery when personal protective equipment was in limited supply, according to recommended guidelines[16], surgery for breast cancer was allowed to proceed when indicated. The fact that our time from diagnosis to treatment did not change during the pandemic suggests that institutional factors may not be the primary cause of the delays experienced by patients in obtaining a diagnosis, although difficulty in accessing breast imaging and biopsy was not directly studied.

The delay in diagnosis could have been related to any number of the following: delays in patient seeking care, difficulty in accessing available primary care or initial evaluation for breast complaint, or delay in accessing or reduced availability of breast imaging or breast biopsy. Even though screening mammograms were significantly down during the pandemic[17–19], it is unlikely that Stage III or IV cancers were not diagnosed because of lack of screening mammogram in the months prior. It is more likely that patients were symptomatic and either delayed seeking care or experienced barriers once trying to access care to get a diagnosis.

A retrospective study looking at breast cancer patients in New York City found that during the first 4 months of the pandemic 38.3% of their patients experienced a delay in care. While their study did not specifically focus on a safety-net population, they found significant socioeconomic and racial disparities occurring in the patient population with Medicaid payor and non-White race being independent risk factors for delay in care during COVID.[20] Study of the SEER-Medicare database found non-White race to be a significant predictor of delays in diagnosis.[21] During the COVID-19 restrictions, in our safety-net population, we found a doubling in the median time from symptom onset to diagnosis. Interestingly, we did not find race to be significantly associated with delays in diagnosis in our study. Among our safety-net population diagnosed with breast cancer during the COVID-restricted months,

those who were White were just as likely as those who were non-White to present with a delay in breast cancer diagnosis. This is interesting because even *pre-pandemic*—when analyzing factors associated with excess late-stage breast cancer diagnoses within our safety-net population—race was not statistically significant either.[3] It seems that the disparities that our safety-net patients, as compared to non-safety-net patients, faced before the pandemic were simply magnified and increased during the pandemic.

Furthermore, the increased time to diagnosis persisted throughout the pandemic period, not showing rebound to pre-pandemic levels in the summer months, as was reported in some other studies.[12] A National Cancer Database review found delays in time to treatment for breast cancer care to be higher in vulnerable populations, specifically those with lower income.[22] These patient populations historically are disproportionately affected by crowded living conditions, transportation difficulties, family member dependents, job loss, educational inequalities, language barriers, and medical and mental health comorbidities. [23.] This is consistent with the barriers Katz et al. found contributing to delays in seeking timely breast cancer care which, in addition to variables already mentioned, included fear of housing loss, inability to pay for other needs such as food, and timing inconvenience when the patient is trying to maintain a job.[24] These barriers no doubt increased for many during the pandemic, and likely more so for our safety-net patients than non-safety-net patients.

A modeled scenario of breast cancer mortality related to COVID-19 disruptions in healthcare found a 1% increase over the next decade due to the first 6 months of the pandemic.[25] They found reductions in screening use and delays in diagnosis of symptomatic cases contributed the most to excess deaths and that if the disruptions persisted for 12 months, the mortality would be doubled. Data have shown that the recovery of breast cancer screening and diagnostic services has not been equal for all women, with a slower rebound in use among racial minority and vulnerable women as of July 2020.[18] The impact of the pandemic on cancer outcomes may disproportionately affect women in underserved populations and exacerbate health inequities. While we will not know the implications of the COVID pandemic on breast cancer mortality for some time, the US National Cancer Institute modeled a conservative estimate of 10,000 excess deaths in the next decade based on disruptions to breast and colon cancer screening and care during the first 4 months of the pandemic alone.[26] As we know, mortality is not the only important variable affected by a later stage at diagnosis and delays in diagnosis. Late-stage diagnosis of breast cancer carries with it increased morbidity as well, with increased use of chemotherapy and more extensive surgeries and treatments.[27] While beyond the scope of the current work, it would be important to study the impact, if any, of the pandemic and later-stage at diagnosis on recurrence-free survival, increased use of chemotherapy, and quality of life measures.

Critical concern exists that the positive effects of the care restrictions during the COVID pandemic may have paradoxical long-term negative consequences impacting breast cancer care, particularly for the vulnerable safety-net patient. Recurrent restrictions fluctuating for 2 years may have further disenfranchised those at risk. The public communications to decrease viral spread and provide for urgent needs of the critical may have proved confusing, challenging, and potentially inequitable for the safety-net population. This continues to be a problem as recently as January of 2022 when COVID variant cases surged in some areas, causing some healthcare systems throughout the country and in our state to once again limit elective surgical cases.[28,29] Additionally, the US Department of Health and Human Services renewed again, for the eighth time, the public health emergency initially instituted in January 2020, extending it through April 2022 for now.[30]

CONCLUSION

Even before the pandemic, women accessing our safety-net hospital were significantly more likely than women at other Commission on Cancer sites across the country to present with late-stage breast cancer. Here we have shown that the pandemic further exacerbated this problem among our safety-net women, making it significantly more likely that they presented with late-stage breast cancer during COVID restrictions than before the restrictions. We also showed a likely mediator of this later-stage of presentation during the pandemic to be delays in diagnosis, with no corresponding delays in treatment. While our breast clinics never closed and we demonstrated that patients got timely treatment once diagnosed, there may have been a perception on the part of patients that care was not accessible during this time. Furthermore, fear, stressors, and competing priorities may have contributed to delays in seeking care. Every effort should be made to minimize disruption to safety-net hospitals and the perception of inaccessibility of care during future shut-downs or public health crises as these patients are already among our most vulnerable.

REFERENCES

1. CMS Adult Elective Surgery and Procedures Recommendations: Limit all non-essential planned surgeries and procedures including dental until further notice. March 2020. Centers for Medicare and Medicaid Services. https://www.cms.gov/files/document/covid-elective-surgery-recommendations.pdf Accessed 27 Jan 2022.

2. American Society of Clinical Oncology. ASCO Special Report: A Guide to Cancer Care Delivery During the COVID-19 Pandemic. Asco.org/sites/new-www.asco.org/files/content-files/2020-ASCO-Guide-Cancer-COVID19.pdf.
3. Ahmadiyeh N, Mendez MA, Cheng AL. Factors associated with late-stage breast cancer diagnosis in an Urban safety-net hospital. *J Health Care Poor Underserved*. 2020;31(3):1152–65. https://doi.org/10.1353/hpu.2020.0087.
4. Nanda AD, Mann MP Cheng A, Moormeier J, Ahmadiyeh N. Impact of phone-call and access-enhancing intervention on mammography uptake among primary care patients at an urban safety-net hospital: a randomized controlled study. *Ann Surg Oncol.* 2020. https://doi.org/10.1245/s10434-020-08884-x.
5. Murphy B. COVID-19 and elective surgeries: 4 key answers for your patients. 30 Mar 2020. AMA Physician Resource Center. COVID-19 and elective surgeries: 4 key answers for your patients| COVID elective surgery|AMA (ama-assn.org).
6. Tran C. Kansas City Issues Citywide Stay-at-Home Order. *National Law Review.* 12(28) Jan 28, 2022 https://www.natlawreview.com/article/kansas-city-issues-citywide-stay-home-order.
7. Kansas City lifts some COVID-19 Restrictions. Kansas City lifts some COVID-19 restrictions—ABC17NEWS. 19 Feb 2021. https://abc17news.com/news/missouri/2021/02/19kansas-city-lifts-some-covid-19-restrictions/Kansas City lifts some COVID-19 restrictions–ABC17NEWS Accessed 22 Mar 2022.
8. Giuliano AE, Edge SB, Hortobagyi GN. Eighth edition of the AJCC cancer staging manual: breast cancer. *Ann Surg Oncol*. 2018;25:1783–5. https://doi.org/10.1245/s10434-018-6486-6.
9. Moore K, Kansas City Metro Daily Average for new COVID-19 Cases Surpasses peak for Summer 2020, The Kansas City Star. https://www.kanscity.com/news/coronavirus/article253140433.html
10. CDC Online Newsroom. Sharp Declines in Breast and Cervical Cancer Screenings https://www.cdc.gov/media/releases/2021/p0630-cancer-screenings.htm Accessed 22 Mar 2022.
11. Kaufman HW, Chen Z, Niles J, Fesko Y. Changes in the number of US patients with newly identified cancer before and during the coronavirus disease 2019 (COVID-19) pandemic. *JAMA Netw Open*. 2020;3(8):e2017267–e2017267.
12. Kaufman HW, Chen Z, Niles JK, Fesko YA. Changes in newly identified cancer among US patients from before COVID-19 through the first full year of the pandemic. *JAMA Netw Open*. 2021;4(8):e2125681. https://doi.org/10.1001/jamanetworkopen.2021.25681.
13. Tonneson JE, Hoskin TL, Day CN, Durgan DM, Dilaveri CA, Boughey JC. Impact of the COVID-19 pandemic on breast cancer stage at diagnosis, presentation, and patient management [published online ahead of print, 2021 Nov 23]. *Ann Surg Oncol*. 2021;1–9. https://doi.org/10.1245/s10434-021-11088-6.
14. Hawrot K, Shulman LN, Bleiweiss IJ, et al. Time to treatment initiation for breast cancer during the 2020 COVID-19 Pandemic [published correction appears in JCO Oncol Pract. 2021 Nov;17(11):694]. *JCO Oncol Pract*. 2021;17(9):534–540. https://doi.org/10.1200/OP.20.00807.
15. Lloyd, MR, Stephens, SJ, Hong, JC, James, TA, Mehta, T, Recht,A, Spiegel, D. The Impact of COVID 19 on Stage at Diagnosis. *J Clinical Oncol.* 39(15). https://doi.org/10.1200/jco.2021.39.15_suppl.528.
16. Dietz JR, Moran MS, Isakoff SJ, et al. Recommendations for prioritization, treatment, and triage of breast cancer patients during the COVID-19 pandemic. The COVID-19 pandemic breast cancer consortium. *Breast Cancer Res Treat*. 2020;181(3):487–97. https://doi.org/10.1007/s10549-020-05644-z.
17. Velazquez AI, Hayward JH, Gregory B, Dixit N. Trends in breast cancer screening in a safety-net hospital during the COVID-19 pandemic. *JAMA Netw Open*. 2021;4(8):e2119929. https://doi.org/10.1001/jamanetworkopen.2021.19929.
18. Sprague BL, Lowry KP, Miglioretti DL, Alsheik N, Bowles EJ, Tosteson AN, Rauscher G, Herschorn SD MD, Lee JM, Trentham-Dietz A, Weaver DL Stout NK, Kerlikowske K. Changes in mammography use by women's characteristics during the first 5 Months of the COVID-19 Pandemic, *JNCI: J National Cancer Inst*. 2021;113(9):1161–1167. https://doi.org/10.1093/jnci/djab045.
19. DeGroff A, Miller J, Sharma, K Sun J, Helsel W, Kammerer W, Rockwell T, Shew A, Melillo S, Uhd J, Kennev K, Wong F, Saraiva M, Richardson LC. COVID-19 impact on screening test volume through the National Breast and Cervical Cancer early detection program, January–June 2020, in the United States. *Prev Med.* 2021;151:106559. https://doi.org/10.1016/j.ypmed.2021.106559.
20. Satish T, Raghunathan R, Prigoff JG, et al. Care delivery impact of the COVID-19 pandemic on breast cancer care. *JCO Oncol Pract*. 2021;17(8):e1215–24. https://doi.org/10.1200/OP.20.01062.
21. Kovar A, Bronsert M, Jaiswal K, et al. The waiting game: How long are breast cancer patients waiting for definitive diagnosis? *Ann Surg Oncol*. 2020;27:3641–9. https://doi.org/10.1245/s10434-020-08484-9.
22. Khorana AA, Tullio K, Elson P, Pennell NA, Grobmyer SR, et al. Time to initial cancer treatment in the United States and association with survival over time: an observational study. *PLOS One*. 2019;14(3):e0213209. https://doi.org/10.1371/journal.pone.0213209.
23. Dickman SL, Himmelstein DU, Woolhandler S. Inequality and the health-care system in the USA. *Lancet*. 2017;389(10077):1431–41. https://doi.org/10.1016/s0140-6736(17)30398-7.
24. Katz ML, Young GS, Reiter PL, Battaglia TA, Wells KJ, Sanders M, Simon M, Dudley DJ, Patierno SR, Paskett ED. Barriers reported among patients with breast and cervical abnormalities in the patient navigation research program: impact on timely care. *Women's Health Issues Official Publ Jacobs Inst Women's Health*. 2014;24(1):e155–62. https://doi.org/10.1016/j.whi.2013.10.010.
25. Alagoz O, Lowry KP, Kurian AW, Mandelblatt JS, Ergun MA, Huang H, Lee SJ, Schechter CB, Tosteson A, Miglioretti DL, Trentham-Dietz A, Nyante SJ, Kerlikowske K, Sprague BL, Stout NK, & from the CISNET Breast Working Group (2021). Impact of the COVID-19 pandemic on breast cancer mortality in the US: estimates from collaborative simulation modeling. *J National Cancer Inst*. 113(11):1484–1494. https://doi.org/10.1093/jnci/djab097.
26. Sharpless NE. COVID-19 and cancer. *Science*. 19 June 2020;368(6497):1290. https://doi.org/10.1126/science.abd3377.
27. Soojin A, Wooster M, Valente C, et al. Impact of screening mammography on treatment in women diagnosed with breast cancer. *Ann Surg Oncol*. 2018;25(10):2979–86.
28. BJC Cancels elective surgeries: COVID Cases 'Beyond What We Have Seen' | News Blog (https://www.riverfronttimes.com) https://www.riverfrontitimes.com/newsblog/2022/01/05/bjc-cancels-elective-surgeries-covid-case-beyond-what-we-have-seen. Accessed 22 Mar 2022.
29. New York State Department of Health Updates List of Impacted Hospitals and Regions Due to Limited Stagged Patient Bed Capacity as Determined by Executive Order. 8 Jan 2022. https://www.health.ny.gov/press/releases/2022/2022-01-08_hospital_bed_capacity. Accessed 22 Mar 2022.
30. Assistant Secretary for Preparedness and Response US Department of Health and Human Services USA Healthcare.Gov. Renewal of Determination That a Public Health Emergency

Exists https://www.phe.gov/emergency/news/healthactions/phe/Pages/COVID-19July2021.aspx. Accessed 22 Mar 2022.