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## Review Article

## The effect of COVID-19 on breast cancer care and treatment in North America: A scoping review

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## A B S T R A C T

**Background:** Breast Cancer (BC) is the most common cancer in women in the United States. The COVID-19 pandemic affected healthcare delivery throughout North America. Breast cancer diagnosis and management was similarly affected.

**Methods:** We conducted a scoping review to determine the impact of COVID-19 on BC care and the impact on patients' well-being.

**Results:** Our review found that the pandemic led to changes in screenings, biopsies, medical therapy, and surgery. Constraints of the pandemic left patients without resources to navigate the emotional toll from social distancing. There was a disparity in patients' perceptions of the impact of the pandemic on BC care.

**Conclusion:** Although the pandemic altered medical care in general, we found that the impact on breast cancer care was counterintuitively not as significant as predicted. However, the pandemic did impact breast cancer patients' mental well-being. This highlights the importance of properly communicating, in real-time, guidelines on breast cancer management to allay the fears of the general public.

## 1. Introduction

Breast cancer (BC) is the most common cancer in females in the United States with about 1 in 8 women diagnosed throughout their lifetime.<sup>1</sup> Of note, early detection and increased awareness of BC has led to 375,900 fewer deaths from 1989 to 2017.<sup>1</sup> Therefore, because timely detection plays such a crucial role in BC management and outcome, it is imperative to ensure that the early detection and screening is uninterrupted due to external factors, such as the coronavirus (COVID-19) pandemic.

The pandemic has forced healthcare professionals to tailor their recommendations for treatment and management to ensure that patients can be safely treated without also risking infection.<sup>2</sup> For instance, many practices have encouraged telehealth visits for non-emergent cases and follow-up appointments.<sup>3</sup> Others followed guidelines which stated that screenings and imaging may continue at limited capacity but should be prioritized according to medical necessity.<sup>3</sup> These changes in treatments and face-to-face visits are even more impactful in patients diagnosed with cancer because they may have higher susceptibility to infection and disease progression. Many of them use various medical treatments which may result in immunosuppression, leading to a higher risk of morbidity and mortality due to infections such as COVID-19.<sup>4-6</sup> In order to decrease the risk of adverse events for patients with cancer, but also to

decrease any delays in treatment, physicians must be able to balance management of malignancies with control of infection.

Unfortunately, the start of the pandemic was an unprecedented time with many logistical challenges. For instance, there was a decline in resources for patients in terms of the quantity of beds and respiratory devices such as ventilators and oxygen supplies. There was also a declining number of resources for healthcare workers such as personal protective equipment (PPE). Healthcare workers faced additional challenges, including mental and emotional distress and excessive work hours. These work hours were exacerbated when co-workers were also sick with the virus, thus increasing the workload and decreasing workforce capacity. These factors also contributed to an overall decrease in ICU capacity.<sup>7,8</sup>

The pandemic also led to a sense of isolation and decreased social support, as well as psychological distress in oncological patients.<sup>7</sup> Consequently, because BC widely affects the population, it is important to understand how the pandemic affected its treatment including timing of surgery, administration of chemotherapy, and timing and administration of radiotherapy. The aim of this paper is to systematically review the effect of the pandemic in North America on BC care, particularly treatment delays and modifications as well as its impact on the patient experience. We conducted a scoping review to systematically report on the latest research completed on this topic and identify areas for future

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investigation.

## 2. Methods

### 2.1. Protocol and registration

A priori protocol was developed by the authors prior to conducting the review using the Preferred Reporting Items for Systematic Reviews and Meta-analysis Protocols extension for Scoping Reviews Checklist (PRISMA-ScR).<sup>9</sup> The priori protocol was registered publicly on The Open Science Framework on June 2, 2021.<sup>10</sup>

### 2.2. Eligibility criteria

To be included in the review, studies had to be published between December 2019 and May 2021. These dates were chosen as they represent the most intense part of the pandemic. Studies had to be original research papers (any study design) from North American Centers (USA, Canada, Mexico) and/or review articles including systematic and scoping reviews, meta-analyses, narrative reviews, qualitative reviews and rapid reviews. The articles had to examine the effect of the pandemic on human subjects with a breast cancer (BC) diagnosis receiving surgery, and/or chemotherapy, and/or radiation therapy. Studies were excluded if the research was conducted outside of North America, as treatment plans and access to treatment should be comparable in order to reduce confounding. If a review article was written outside of North America, but authors used international resources to write the paper, the study was included. Additionally, other exclusion criteria included the exclusion of patients with stage 4 disease and patients with no active disease and only genetic mutations undergoing prophylactic surgery, exclusion of patients with excision of benign masses such as fibroadenoma, etc., and exclusion of qualitative works such as texts in magazines, abstracts, newspapers, as well as letters to the editor and opinion pieces. We also excluded guideline publications from various Societies outlining approaches to patients with different stages of the disease.

### 2.3. Information sources

To identify potentially relevant documents, the following bibliographic databases were searched from December 2019 to May 2021: Medline using the PubMed interface, Embase, Google Scholar, and Cochrane Central Register of Controlled of Trials. Due to the emerging nature of the COVID-19 literature, preprint studies published on medRxiv preprint server for Health Sciences, operated by Cold Spring Harbor Laboratory were also searched. Preprint studies were not included in the final set of included studies.

### 2.4. Search strategy

The search strategies were created in consultation with an experienced faculty medical librarian (BS), and further refined through team discussion. Search strategies were peer-reviewed by a second faculty librarian before being finalized. Gray literature was identified by searching for preprints in the medRxiv preprint server for Health Sciences and by carrying out an advanced Google Scholar search. Backwards citation searching was also conducted on any final included articles. The full search strategies used in this study are available in the protocol and included as a supplementary file. The final search results were exported into Rayyan QCRI review blinded screening software and duplicates were removed using EndNote citation management software followed by a manual review by the librarian research team member. Full text articles were then uploaded into Rayyan after the initial title/abstract screen for all remaining articles.

Two reviewers (SK/SK) screened results by title and abstract in Rayyan. After blinded screening of the titles and abstracts of the articles,

disagreements were tie-broken by the study's PI (SM). Reviewers then sequentially evaluated the remaining titles, abstracts, and then full text of all publications identified by our searches for potentially relevant publications independently. We resolved any additional disagreements on study selection and data extraction under advisement from SM, if needed. In addition, we determined if any additional papers needed to be added to results by reading manuscripts from inclusion criteria and extracting references from the manuscript if they were deemed to be relevant.

### 2.5. Data charting process

A data-charting form on excel was jointly developed by reviewing inclusion and exclusion criteria, as well as outcomes, by two reviewers (SK/SK) to determine which variables to extract from each full text paper. The two reviewers independently charted the data after splitting the full text articles that remained for the final data collection, and then discussed the results together.

### 2.6. Data items

Study design, changes in time to treatment, wait times, discharges, complications, and overall survival were data being extracted from papers. In addition, qualitative data on patient perspectives of the effect of the pandemic on their breast cancer (BC) journey was also extracted and displayed in the results section. Joanna Briggs Institute (JBI) Manual for Evidence Synthesis 2017 was used to critically appraise the sources of evidence that were included in the manuscript.<sup>11</sup>

### 2.7. Synthesis of results

Ten studies were selected per inclusion criteria as shown in the PRISMA diagram (Fig. 1) to be included in our scoping review. JBI Critical Appraisal Tools was used to assess the methodological quality of the studies and determine the extent to which a study has addressed the possibility of bias in design, conduct, and analysis.

## 3. Results

Various studies measured the time to intervention for breast cancer (BC) treatment during the pandemic (Table 1). Specht et al. measured the time from surgical closure to the time of discharge for patients who underwent mastectomy and reconstruction to be an average of  $5.02 \pm 1.29$  h.<sup>21</sup> Mean operative time for mastectomy with immediate breast reconstruction was  $2.52 \pm 0.55$  h. IV medications were avoided, blocks were performed, and antiemetics were administered for patient comfort. This cohort of patients did not have any readmissions or emergency department (ED) visits. Cadili et al. compared average wait times pre- and during the pandemic to determine if there were any differences in average wait times that may have been attributable to the pandemic.<sup>22</sup> In general, the average wait time between finishing surgery and initial consultation with a medical or radiation oncologist was 36 days for 2019 and 29 days for 2020. This difference was statistically significant. Complication rates for 2019 and 2020 were not statistically significant (2% vs 4%, respectively), but clinical significance cannot be determined. Other treatment wait times in comparison between the pre-pandemic (2019) and during pandemic cohorts (2020) were not statistically significant (Table 2). Hawrot et al. also measure the time of diagnosis and adjust time to treatment initiation (TTI) pre- and during the COVID pandemic.<sup>13</sup> There was an 18.8% decrease in patient volume in 2020 ( $n = 164$ ) versus 2018 ( $n = 202$ ). After adjusting for race, age, clinical stage, breast cancer subtype, and histologic subtype, authors did not find an association between time of diagnosis and TTI (44.7 in 2018 vs 44.4 day in 2020;  $P = 0.926$ ). Nyante et al. found that fewer examinations were conducted after the pandemic began. In March of 2020, a maximum reduction of screening and diagnostic mammograms occurred



## PRISMA 2009 Flow Diagram (Modified for Scoping Review)

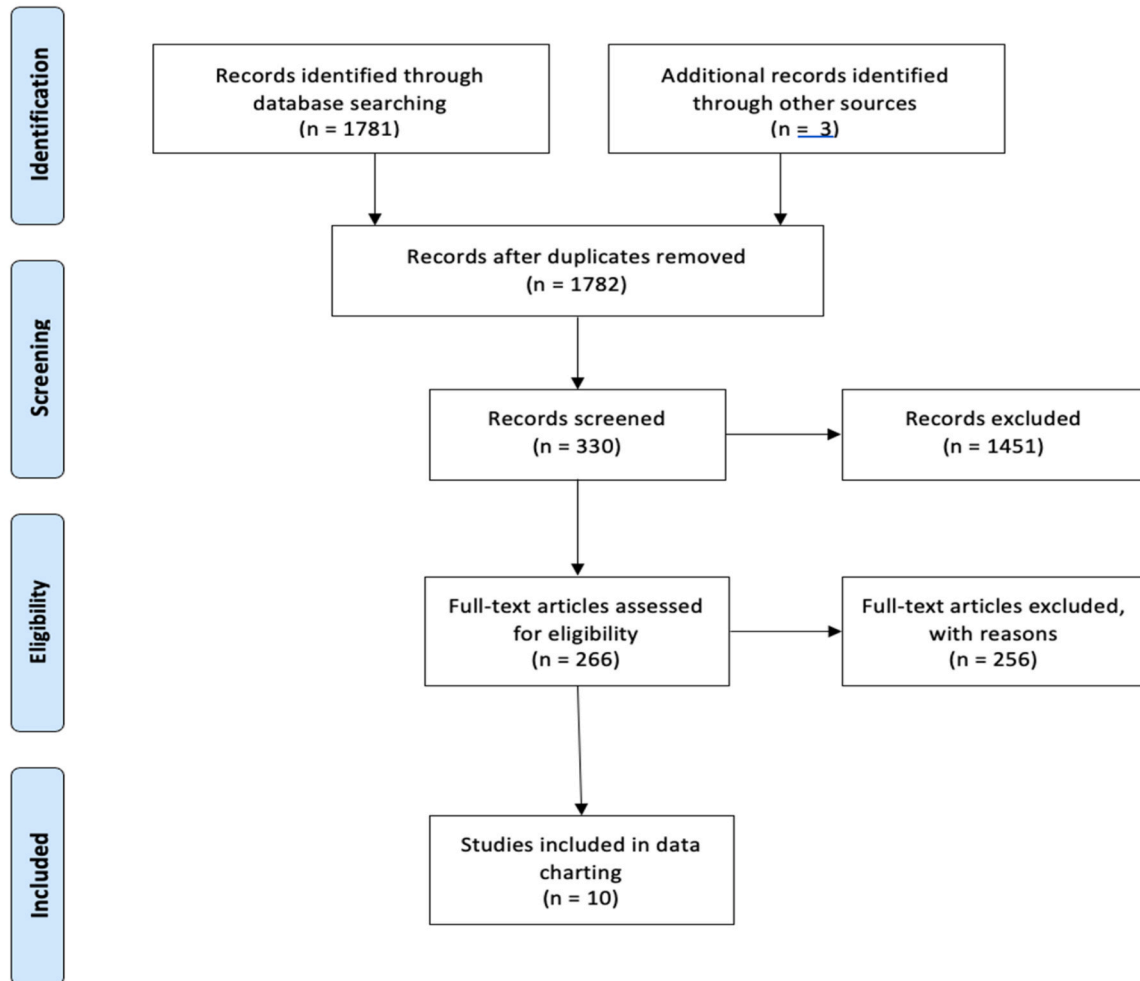


Fig. 1. Prisma flow diagram.

(−85.1%; 95% CI, −100.0%, −70.0% and −40.9%; 95% CI, −57.6%, −24.3%, respectively).<sup>12</sup> The greatest reduction of biopsies (−40.9%; 95% CI, −57.6%, −24.3%) was in May 2020. However, in terms of performing biopsies, 79% of biopsies occurred within 7 days of abnormal diagnostic mammogram, compared with 55% occurring within 7 days during the pre-COVID period ( $P = 0.002$ ).<sup>12</sup>

Johnson et al. and Obeng-Gyasi et al. measure the overall survival and mortality difference based on the delay in time to surgery.<sup>17,18</sup> Johnson et al. reported that delaying surgery for 12 weeks may decrease overall survival (OS) in BC (HR 1.46, 95% CI 1.28–1.65). Obeng-Gyasi et al. found that there was a 6–8% increased risk of mortality for each 4-week delay in time to surgery.

#### 4. Discussion

The coronavirus (COVID-19) pandemic was a highly stressful, unprecedented time, and had an impact on patients both medically and psychologically. In this scoping review we identified 10 primary studies addressing breast cancer (BC) treatment delays and/or perceptions of these delays and outcomes from the start of the coronavirus pandemic in December 2019 until May 2021. It is helpful to break down this lengthy time frame into four parts to aptly compare distribution of patient

characteristics. These time periods are based on the article by Nyante et al., included in our paper.<sup>12</sup> January 1, 2019 to March 3, 2020 is considered the pre-COVID time period. Phase I is between March 3, 2020 (when the first COVID-19 case was diagnosed in North Carolina) to March 29, 2020. Phase II is March 30, 2020 (when the state-wide stay-at-home order was made effective in North Carolina) to May 21, 2020. Phase III is May 22, 2020 (stay-at-home order lifted in North Carolina) to September 30, 2020 (end of data collection in a particular study).<sup>12</sup> It is important to note that in Phase III, although the stay-at-home order was lifted, other restrictions such as social distancing and limits on large gatherings were still firmly in place.<sup>12</sup> While wait times and time to initiation of treatment were not much different pre- and during the pandemic, there were other changes in BC management that resulted from the pandemic.

##### I. Effects on surgical care:

Some studies showed decreases in BC screening visits at the height of the pandemic while others showed that there was an uptake by phase III.<sup>8,12</sup> The former is likely due to stay-at-home mandates and the subsequent increase in screening and diagnostic mammogram use likely reflects women receiving usual care plus the women who delayed

**Table 1**  
The effects of the COVID pandemic on the medical and surgical care of breast cancer (BC).

Study	Time to Intervention (i.e. wait-times, discharge times, treatment initiation times)	Complications and Overall Survival	Study design	Critical appraisal score (%) <sup>a</sup>
Specht et al. <sup>21</sup>	Time from surgical closure to discharge for patients that underwent mastectomy and reconstruction: 5.02 ± 1.29 h Time to discharge without reconstruction: 4.15 ± 1.89 h.	No postoperative complications observed for same-day immediate breast reconstructions with 30-day post-op. No observed hematoma in 24 h post op period. No ED visits.	Quality improvement; Prospective case series (no control population)	100%
Cadili et al. <sup>22</sup>	2019 average wait: 36 days after surgery for their first medical or radiation oncology consultation for BC. 2020 average wait: 29 days (p = 0.03). Other wait-times denoted in Table 2.	2019 ED presentation: 2/99 (2%) presented post-op, both discharged home. 2020 ED presentation: 7/162 (4%) presented post-op: 5 home, 2 admitted. Not statistically significant; clinical significance cannot be determined.	Retrospective cohort study	100%
Hawrot et al. <sup>13</sup>	Time of diagnosis and adjusted time to treatment initiation (TTI) was not different pre- or during COVID (p = 0.926). Across cohorts, Black patients were treated 16 days slower compared to White patients (15.7; 95% CI, 6.9 to 24.6; P < 0.001). Of 99 patients with completed COVID delay questionnaires, 55 (55.6%) had no care delay and 44 (44.4%) had delay, of which surgery (n = 41) and radiation therapy (n = 27) were most frequent.	This article does not measure complications and changes in overall survival.	Retrospective cohort study	100%
Nyante et al. <sup>12</sup>	Pandemic-associated deficits in # of breast	Deficits of 6501 screening mammograms, 1167 diagnostic	Retrospective cohort study	100%

**Table 1 (continued)**

Study	Time to Intervention (i.e. wait-times, discharge times, treatment initiation times)	Complications and Overall Survival	Study design	Critical appraisal score (%) <sup>a</sup>
	examinations decreased over time. Utilization differed by BC risk and insurance status. 79% of biopsies occurred within 7 days of abnormal diagnostic mammogram, compared with 55% occurring within 7 days during the pre-COVID period (P = 0.002).	mammograms, and 214 biopsies. 6501 screening examinations represent approximately 33 missed cancer diagnoses.		
Johnson et al. <sup>17</sup>	Time to surgery - 12 weeks Delaying surgery for 12 weeks may decrease overall survival (OS) in BC (HR 1.46, 95% CI 1.28–1.65).	OS was decreased in stages I (HR 1.27, 95%CI 1.16–1.40) and II (HR 1.13, 95%CI 1.02–1.24), but not in stage III (HR 1.20, 95% CI 0.94–1.53)	Systematic review and meta analysis	100%
Obeng-Gyasi et al. <sup>18</sup>	Time to Surgery - 4 weeks 6–8% increased risk of mortality for each 4-week delay in time to surgery.	Delays in BC surgical care for up to 12 weeks could result in 6100 excess deaths in the US. No association between delay in time to surgery (more than or equal to 30 days) and OS or disease-specific survival.	Systematic review	27%

<sup>a</sup> As per JBI Critical Appraisal Tool Checklists.

**Table 2**  
Changes in Surgery (Cadili et al.).<sup>22</sup>

Treatment Wait-Times (average days)	Pre-Pandemic (2019) (n = 69)	During Pandemic (2020) (n = 115)	p-Value
Core Biopsy to Surgical Consult	18	18	0.98
Surgical Consult to Surgery	23	27	0.11
Core Biopsy to Surgery	40	45	0.18
Surgery to BC consult with medical or radiation oncology	36	29	0.03*
Core Biopsy to BC Consult with medical or radiation oncology	77	75	0.72

This table was adapted from “Table 2” in the manuscript by Cadili et al., 2020. \* denotes statistical significance.

screenings during the first few phases of the pandemic. Furthermore, increased availability of personal protective equipment and the installation of protective barriers at healthcare facilities allowed for increased examinations by the later phases. By phase III of the pandemic, 79% of biopsies occurred within 7 days of the abnormal diagnostic

mammogram, compared with only 55% occurring within 7 days during the pre-COVID period.<sup>12</sup> This counterintuitive change may be because fewer women made appointments for mammography services, thus leading to increased physician availability and increased number of biopsy appointment times. Despite promising data from phase three of the pandemic, many sites still saw deficits of screening mammograms, diagnostic mammograms, biopsies, and therefore missed diagnoses.<sup>12</sup> The data suggests that the onset of the pandemic led to delays especially in screening mammograms and that in future shutdowns, patients must be appropriately triaged and rescheduled to avoid missed diagnoses. Furthermore, there is a dearth of information on what exactly may have influenced a women's decision to seek screenings, such as lockdown mandates or additional barriers such as transportation and ease-of-access to care.

It is interesting to look at other changes that occurred during the pandemic. First, there was increased use of regional/local anesthesia instead of general anesthesia in 2020 in order to avoid intubation during the pandemic due to the mode of spread of the virus.<sup>13</sup> Coronavirus played a role in decision making during the peri- and post-operative care period in order to preserve the safety of patients and healthcare professionals, especially before the vaccine rollout. An additional result of the pandemic was that there was an increase in preoperative hormonal therapy rather than chemotherapy.<sup>13,14</sup> While there has been a natural increase in neoadjuvant systemic chemotherapy for triple negative breast cancer and HER2+ breast cancer since 2018, the study noted that the duration of hormonal therapy was different during COVID-19 in comparison to utilizing hormonal therapy with the intent of downstaging.<sup>13,15</sup> Another metric that physicians have to be mindful of is time between neoadjuvant systemic therapy and time to surgery. A review on the National Cancer Database found that there was no association between time to surgery and overall survival among patients on neoadjuvant therapy. However, another study showed that patients undergoing surgical management within 21 days of completion of neoadjuvant therapy had better overall survival and relapse-free survival.<sup>18</sup> More recent data shows that surgery within 6 weeks of chemotherapy may improve recurrence-free survival. Results accumulated from these multiple studies suggest that patients receiving neoadjuvant therapy may benefit from treatment within 3–6 weeks of completion of systemic therapy.<sup>18</sup>

Pandemic mandates and lockdown orders forced physicians to postpone and reschedule multiple appointments, but they were hesitant to delay certain surgeries due to possible changes in overall survival. Still, physicians used existing guidelines and improved them to navigate this tough time. A study highlighted how crucial same-day-discharge is for patient safety. In the study, there were no postoperative complications observed for same-day immediate breast reconstructions with 30-day post-op.<sup>21</sup> Constraints of the pandemic have solidified the validity of some safety measures that were already in place pre-pandemic. Inconsistencies that were found in the early phases were rectified by the latter phases to ensure standard care while minimizing contact. There is also discourse regarding the use of surgery delay as a metric for quality of care.<sup>16</sup> A meta analyses indicated that a surgical delay of 12 weeks is associated with decreased overall survival in breast, lung, and colon cancers.<sup>17</sup> The pooled HR for BC was the largest among the three cancer types, which may indicate that these patients are more sensitive to surgical delays.<sup>17</sup> Results from the stage-specific analyses for BC suggest delaying surgery by 12 weeks decreases overall survival for stage I and II disease but not stage III.<sup>17</sup> Nevertheless in stage III, the survival was worse, but the difference was not statistically significant. This study hypothesized that delaying surgery in patients with stage III BC had a negligible effect on outcome because they already experience poorer outcomes.<sup>17</sup> Thus, in future waves of COVID-19, guidelines for surgery delays according to tumor stage should be revisited.<sup>13,15,17,18</sup> Another study showed a reduction in overall survival and disease-specific survival with each 60-day increase in time to surgery reported. Again these findings were more pronounced in patients with stage I or II cancers.<sup>18</sup>

Contrary to these findings, other studies have shown no association between delay in surgery (>30days) and overall or disease-specific survival.<sup>18</sup> These inconsistent findings may in part be due to different studies that lack established benchmarks that define time to surgery. These include time from symptom to surgery, time from biopsy to surgery, or time from surgical consultation to surgery.<sup>18</sup> Despite these conflicting results, healthcare professionals should continue to make a consistent effort to decrease the time to surgery to 60 days or less with or without outside constraints such as a pandemic.

## II. Effects on Patient Perspectives:

A comprehensive table summarizes the articles in this section (Table 3). During the pandemic, physicians were tasked with trying to keep the balance between scheduling patient appointments in a timely fashion and following recommendations from official guidelines published nationally. These changes led to differences not only in clinical outcomes, but also factors experienced by the patients such as mental stability, quality of life, and internal locus of control. At the start of the pandemic especially, a dearth of information about the virus forced healthcare facilities to implement visitor regulations to keep the patients and hospital staff safe. Though these were well intended policies, they often left both patients and their loved-ones anxious. Lack of physical social support may not affect survival outcomes directly but can still have an impact on morale. Many patients, even after thorough informed consent with the physician, feel safer when they have an ally in the room. During earlier phases, surgical cases needed to be triaged and ranked. This way, emergent cases were prioritized whereas elective and less severe cases were rescheduled for a future date. For example, patients were no longer able to have immediate reconstruction or contralateral risk reducing mastectomy. This decision may have made these patients feel like less of a priority to their providers even though the true goal was to keep them safe and limit unnecessary contact. A qualitative study employed an online forum analysis to gauge patient perception of delays in their treatment plans.<sup>19</sup> The data extracted may not be representative of all BC patients because only one forum was used in the study. Furthermore, the nature of the online survey could have led to selection bias as it catered only to patients with internet access who were comfortable using technology. This may have skewed the data to reflect more responses by younger women, as noted in the study. Similarly, another study used surveys distributed through social media and email to BC patient support networks.<sup>20</sup> Patients reported the highest rate of delays in routine or follow-up clinic appointments, surgical breast reconstruction, diagnostic imaging, and lab testing.<sup>20</sup> The lowest rate of delays were seen in genetic counseling and testing and oral therapies. Although younger BC patients experience a more aggressive disease trajectory and higher rates of mortality, the data from one study showed that older BC survivors experienced lower rates of delays in treatment compared to younger patients.<sup>20</sup> The biggest limitation of these qualitative studies is that patient perception of delays during the commotion of the pandemic is not always objective, nor is it necessarily clinically significant. Still, the results of the studies are important to ensure that physicians are aware of the fears and concerns that patients experience in order to prevent them from feeling alienated during a difficult pandemic. In addition, it is obvious from the literature that patients were not informed adequately of the guidelines for care published by national organizations and used by BC surgeons and physicians. Better knowledge of these guidelines could have allayed their fears.

## 5. Limitations

We only used full-text articles in English. The geographical restrictions of this scoping review limiting publications to North America may have omitted other data that could have been useful in this analysis. We set a geographic limitation so that the socioeconomic factors, cultural differences, and healthcare resources that our patients had access to were

**Table 3**  
The effects of the pandemic the breast cancer (BC) journey: Patient perspectives.

Title	Findings	Study Design	Critical appraisal score (%)*
Lou et al., 2020 <sup>23</sup>	Participants receiving active treatment reported greater concern about infection from the SARS-CoV-2 coronavirus ( $p < 0.001$ ), higher levels of family distress caused by the COVID-19 pandemic ( $p = 0.004$ ), and greater concern that the general public does not adequately understand the seriousness of COVID-19 ( $p = 0.04$ ). Those with metastatic disease were more likely to indicate that COVID-19 had negatively affected their cancer care compared to patients with non-metastatic cancer (50.8% vs. 31.0%; $p = 0.02$ ). The most commonly reported treatment modifications included chemotherapy delays ( $N = 14$ , 53.8%), followed by delayed surgery ( $N = 5$ , 19.2%).	Cross sectional	80%
Miaskowski et al., 2020 <sup>24</sup>	Of 187 patients surveyed, 149 were diagnosed with BC. 31.6% of patients (compared to 29.6% of control) had high levels of COVID-19 related stress. While the Impact of Event Scale (IES-R) score to measure COVID-19 and cancer-related stress of 18.6 for the total sample was below the clinically meaningful cut-point, patients in the stressed group had a mean score of 36.9 (+10.1; range 24–60) which is alarmingly high and consistent with probable PTSD	Survey	80%
Papautsky et al., 2020 <sup>20</sup>	Forty-four percent of participants reported cancer care treatment delays during the pandemic. Delays in all aspects of cancer care and treatment were reported. The only variable which had a significant effect was age (97 (.95, 99), $p < 0.001$ ) with younger respondents ( $M = 45.94$ , $SD = 10.31$ ) reporting a higher incidence of delays than older respondents ( $M = 48.98$ , $SD = 11.10$ ). There was no significant effect for race, insurance, site of care, or cancer stage.	Survey	90%
Zhang et al., 2020 <sup>19</sup>	In addition to stress and concerns about COVID-19, patients were most concerned about BC diagnosis and treatment delays, especially delays of various BC surgeries. Patients did not report delays of diagnostic imaging or core-needle biopsy. This is consistent with the recommendations that urgent diagnostic imaging and biopsies should proceed as usual.	Qualitative	80%

somewhat similar. Because breast cancer (BC) is prevalent in North America, we felt that it would be better to exclude countries that may have other algorithms and approaches to treat BC based on the resources available to healthcare professionals and patients. Another limitation is

the restricted number of published articles on the subject. Due to the emerging nature of published research on this topic and COVID-19 in general, many articles may still be undergoing peer review. While the authors attempted to capture emerging research on this topic by searching the medRxiv preprint server for Health Sciences, not all authors choose to pre-publish their research on a preprint server.

## 6. Conclusion

In summary, the pandemic has led to changes in many aspects of healthcare. In the management of breast cancer (BC) specifically, there is evidence of changes and delays in screenings, biopsies, medical therapy, and surgeries. Despite the prevailing impression that the pandemic delayed the treatment of BC, our review showed that in many studies the reverse was true. Patients' perceptions of their treatment plans during this time has underscored a need for addressing not only physical concerns, but also their fears of navigating a terrifying illness during a time when it is difficult to connect with people. Our review of multiple articles has also shown us gaps in understanding where more research is needed to shed light on how the pandemic has affected different facets of our healthcare system. More studies are necessary to analyze how social determinants of health such as insurance, health literacy, transportation, and employment may affect patient care, especially during the pandemic. Further investigation on long term implications of purposeful surgical delay due to the pandemic will also be beneficial. In conducting this review, we came across many studies that attempted to quantify delays in time-to-surgery. However, not all the studies used the same metric. Organizations should publish guidelines defining the term so that in the future, there can be better comparison between studies.

## Declaration of competing interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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