The impact of COVID-19 on Breast Cancer Screening

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Introduction

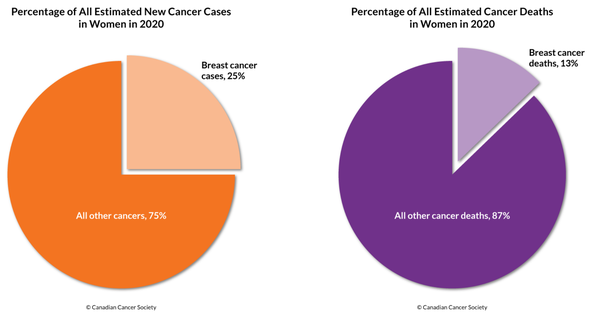


Figure 1: Estimated breast cancer statistics (2020). Retrieved from the Canadian Cancer Society[1], based on data from Brenner *et al* (2020)[2].

- Breast cancer is the most commonly diagnosed cancer and the second leading cause of cancer death in women in Canada[2]
- Early detection and treatment of breast cancer is key to reducing morbidity and mortality[3]
- Modelling studies predicted that due to the pandemic, the gap in cancer screening will lead to delayed diagnoses and disease upstaging[4-6]
- Delays in diagnosis and treatment may have detrimental effect on treatment outcomes, survival, and may increase the likelihood of metastatic disease[7-9]
- Studies have reported increased malignant node involvement in patients diagnosed with breast cancer during the COVID-19 pandemic[10], and a shift towards more advanced tumor stages[11]

Hypothesis and Objectives

- **Hypothesis:** Delays in screening mammography, changes in health-seeking behaviour and referral practices due to the COVID-19 pandemic will lead to later stage detection of breast cancers, leading to increased morbidity and mortality
- **Objective:** To determine the impact that the COVID-19 pandemic has had on the detection and diagnosis of breast cancer at the Ottawa Hospital and to understand the impact as it relates to patient morbidity and mortality.

Methods

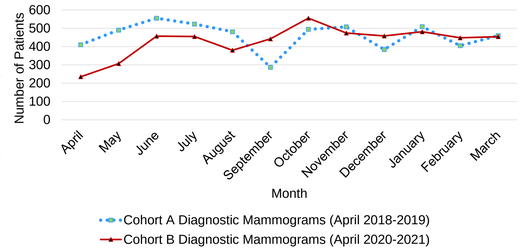
- A retrospective review of screening and diagnostic mammograms performed at The Ottawa Hospital (TOH) Breast Health Center (BHC) was conducted
- Breast cancer diagnoses made at TOH pre-COVID (Cohort A, April 2018 – 2019) and after the start of the pandemic (Cohort B, April 2020 – 2021) were compared
- Patient age, presentation, cancer type, and management for each case was recorded and compared
- Cancer and tumor stage was determined based on AJCC 8th ed.
- Imaging of high-risk patients (MRI screening), patients with known cancer diagnoses, ultrasound imaging, localizations, and clip placements were not included in analyses
- Chi-squared tests were used to calculate statistical significance, unless otherwise indicated. Microsoft Excel was used for all calculations

Results

Table 1: Baseline cohort characteristics The number of patients (n) in each category is indicated. The value as a proportion of the total screening or diagnostic mammograms for the cohort is shown in round brackets. Chi-squared tests were used to determine p-values, unless indicated. Statistically significant values are noted by "*". For patient age, square brackets denote the standard deviation, and a T-test was used to determine the p-value.

	Cohort A (April 2018 - March 2019)	Cohort B (April 2020 - March 2021)	p value
Screening mammograms	20731 (0.784)	19083 (0.782)	0.522
Diagnostic Mammograms	5711 (0.216)	5330 (0.218)	0.522
Total patients	26442	24413	
Patient Characteristics			
Average patient age			
Screening mammograms	57.55 [12.26]	60.17 [10.49]	<0.001*†
Diagnostic mammograms	55.64 [12.78]	55.96 [12.52]	0.1836†
Gender (Diagnostic Mammograms)			
Male	106 (0.019)	66 (0.012)	0.0088*
Female	5605 (0.981)	5264 (0.988)	0.0088*
Cancer diagnoses			
Cancer diagnoses (screening mammograms)	**159 (0.008)**	**116 (0.006)**	**0.056**
Breast cancer diagnoses (diagnostic mammograms)	**471 (0.0824)**	**352 (0.066)**	**0.001***

Figure 2: Diagnostic mammograms completed per patient within the study periods. The number of patients obtaining diagnostic mammograms in each month of the study period were plotted. If a patient presented several times for the same indication, only the most recent imaging date was included in the analysis.



Screening Mammogram Findings	Cohort A (April 2018 - March 2019)	Cohort B (April 2020 - March 2021)	p value
BIRADS 0	**1417 (0.068)**	**1714 (0.0898)**	**<0.001***
BIRADS 1	15888 (0.766)	11386 (0.597)	<0.001*
BIRADS 2	**4078 (0.198)**	**5979 (0.313)**	**<0.001***
Other	38 (0.0018)	4 (0.0002)	<0.001*
Diagnosed breast cancer	159 (0.0077)	116 (0.006)	0.056
Diagnostic Imaging Findings			
BIRADS Categorization			
BIRADS 0	72 (0.013)	54 (0.010)	0.221
BIRADS 1	1286 (0.225)	941 (0.177)	0.519
BIRADS 2	**2238 (0.392)**	**2316 (0.435)**	**<0.001***
BIARDS 3	**816 (0.143)**	**1048 (0.197)**	**<0.001***
BIRADS 4	1017 (0.178)	759 (0.142)	<0.001*
BIRADS 5	263 (0.046)	212 (0.0398)	0.104

Table 2: BIRADS categorization of screening and diagnostic mammograms during study periods. The number of patients (n) in each category is indicated. The value as a proportion of the total screening or diagnostic mammograms for the cohort is shown in round brackets. Statistically significant values are noted by "*". BIRADS 0: needs additional imaging; BIRADS 1: negative, BIRADS 2: benign, BIRADS 3: probably benign, BIRADS 4:suspicious for malignancy, BIRADS 5: highly suspicious for malignancy.

Cancer diagnoses from diagnostic imaging	Cohort A (April 2018 - March 2019)	Cohort B (April 2020 - March 2021)	p value
Cancer type			
DCIS	**53 (0.113)**	**70 (0.199)**	**0.001***
IDC	340 (0.722)	227 (0.645)	0.018*
ILC	44 (0.093)	30 (0.085)	0.684
Mammary carcinoma	27 (0.057)	18 (0.051)	0.699
Invasive breast cancer (IDC, ILC, mammary)	**411 (0.873)**	**275 (0.781)**	**0.0005***
Other malignancy breast	7 (0.015)	7 (0.0199)	0.581
Other malignancy non-breast	12 (0.035)	8 (0.023)	0.800
Total diagnostic imaging patients	5711	5330	
Cancer stage at diagnosis			**p value**
Stage 0	**52 (0.11)**	**70 (0.199)**	**0.0004***
Stage 1	246 (0.522)	158 (0.449)	0.037*
Stage 2	104 (0.2221)	74 (0.210)	0.715
Stage 3	38 (0.081)	31 (0.088)	0.705
Stage 4	**18 (0.038)**	**24 (0.068)**	**0.053**

Table 3: Cancer diagnoses from diagnostic imaging. The number of patients (n) in each category is indicated. The value as a proportion of the total cancer diagnoses made from diagnostic mammograms for the cohort is shown in brackets. Chi-squared tests were used to determine p-values, unless indicated. Statistically significant values are noted by "*".

Characteristics of diagnosed cancers	Cohort A (April 2018 - March 2019)	Cohort B (April 2020 - March 2021)	p value
Tumor stage			
Tis	**52 (0.11)**	**65 (0.185)**	**0.003***
T1	222 (0.471)	155 (0.44)	0.377
T2	140 (0.297)	85 (0.241)	0.076
T3	29 (0.062)	24 (0.068)	0.702
T4	15 (0.032)	14 (0.0398)	0.542
Node status			
N0	249 (0.529)	178 (0.506)	0.514
N1	107 (0.227)	70 (0.199)	0.328
N2	16 (0.034)	15 (0.043)	0.519
N3	14 (0.0297)	9 (0.0256)	0.720
Tumor grade			
1	86 (0.183)	53 (0.151)	0.225
2	210 (0.446)	134 (0.381)	0.061
3	**119 (0.253)**	**115 (0.327)**	**0.020***

Table 2: Characteristics of cancers identified from diagnostic mammograms during the study periods. The number of patients (n) in each category is indicated. The value as a proportion of the total cancer diagnoses made from diagnostic mammograms for the cohort is shown in brackets. Chi-squared tests were used to determine p-values. Statistically significant values are noted by "*".

Discussion

- Fewer cancer diagnoses were made during the pandemic
  - Suspension of screening mammography in March 2020
  - Decreased volumes of imaging procedures
  - Changes in health-seeking behaviors of patients
- Average age of screening mammogram patients increased in Cohort B
- The number of patients presenting for diagnostic mammography caught up to pre-pandemic levels
  - Increased number of technologists
- Expected cancer upstaging due to the pandemic
  - Increased BIRADS 4,5 classification of imaging
  - Higher cancer, tumor, or node stage
  - Instead: recorded more BIRADS 2 and 3 diagnostic mammogram findings
- Increase in proportion of ductal carcinoma *in situ* diagnoses in Cohort B compared to Cohort A
  - Cancer stage 0 and tumor stage (Tis) also increased
  - Invasive breast cancer diagnoses were decreased in Cohort B (78.1% of total cancer diagnoses vs 87.3% of Cohort A)
- More stage IV cancers (metastatic breast cancer) and an increased tumor grade in Cohort B
- Analysis did not include ultrasound-only imaging, or "second opinion" cases from the community
- Analysis of cancer diagnoses in future years may reflect the hypothesized upstaging due to delays from the pandemic

Conclusions

- Fewer cancer diagnoses were made based on screening and diagnostic mammography
- Further analysis to be conducted, taking into account ultrasound imaging and second opinion cases for a complete understanding of the effect of COVID-19 on breast imaging
- Understanding the effect of the pandemic on breast cancer diagnoses will highlight the importance of cancer screening programs and early-stage diagnosis

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