

# The Impact of the COVID-19 Pandemic on the Volume of Mammograms in Brazil: a Forecast Analysis Based on Historical Numbers

doi: <https://doi.org/10.32635/2176-9745.RBC.2022v68n3.2566>

*O Impacto da Pandemia da Covid-19 no Volume de Mamografias no Brasil: uma Análise de Previsão Baseada nos Números Históricos*

El Impacto de la Pandemia de Covid-19 en el Volumen de Mamografias en Brasil: un Análisis de Pronóstico Basado en Cifras Históricas

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## ABSTRACT

**Introduction:** Breast cancer is the leading cause of death by cancer in Brazilian women. Data on the real impact of the pandemic on breast cancer screening and diagnosis policy in Brazil are still unknown. **Objective:** Evaluate the effect of the COVID-19 pandemic on the number of mammograms performed in the Brazilian Unified Health System (SUS). **Method:** Epidemiological, quantitative, cross-sectional study. Monthly mammograms performed at SUS through the Department of Informatics of the SUS (DATASUS) were selected. The historical volume from January 2017 to March 2020, the month following the first case of COVID-19 diagnosed in Brazil, was evaluated to build a forecast model of expected mammograms from March 2020 to December 2021. **Result:** In 2020, 1,705,475 mammograms were not performed compared to the previous year, according to DATASUS. The prediction model, based on historical values, showed a deficit of 1,635,420 mammograms. In May 2020, there was the biggest drop of the exams, representing only 20.69% of mammograms performed in the same month of the previous year. **Conclusion:** Early detection of breast cancer was one of the medical areas impacted by the restrictions and social distance policy imposed in 2020. In this sense, future government efforts will be needed to offer treatment to potential patients with late diagnosis of breast cancer, in addition to the mammograms that were not done.

**Key words:** breast neoplasms; mammography/statistics & numerical data; health policy; Unified Health System; COVID-19.

## RESUMO

**Introdução:** A neoplasia mamária constitui a primeira causa de óbito por câncer em mulheres brasileiras. Dados sobre o real impacto da pandemia na política de rastreamento e diagnóstico do câncer de mama no Brasil ainda são desconhecidos. **Objetivo:** Avaliar o efeito da pandemia da covid-19 no número de mamografias realizadas no Sistema Único de Saúde (SUS). **Método:** Estudo epidemiológico, quantitativo e de delineamento transversal. Foram selecionadas mamografias mensais realizadas no SUS após consulta ao Departamento de Informática do SUS (DATASUS). Foi avaliado o volume histórico, de janeiro de 2017 a março de 2020, mês seguinte ao primeiro caso de covid-19 diagnosticado no Brasil, para se construir um modelo de previsão das mamografias esperadas de março de 2020 até dezembro de 2021. **Resultado:** No ano de 2020, 1.705.475 mamografias deixaram de ser realizadas no Brasil em relação ao ano anterior, segundo o DATASUS. O modelo de previsão, com base nos valores históricos, mostrou um déficit de 1.635.420 mamografias. Em maio de 2020, ocorreu a maior queda na realização dos exames, representando apenas 20,69% das mamografias realizadas no mesmo mês do ano anterior. **Conclusão:** A detecção precoce do câncer de mama foi uma das áreas médicas impactadas pela política de restrição e isolamento impostos no ano de 2020. Nesse sentido, esforços governamentais futuros serão necessários para oferecer tratamento a eventuais pacientes com diagnóstico tardio de câncer de mama, além das mamografias que não puderam ser realizadas.

**Palavras-chave:** neoplasias da mama; mamografia/estatística & dados numéricos; política de saúde; Sistema Único de Saúde; COVID-19.

## RESUMEN

**Introducción:** El cáncer de mama es la principal causa de muerte por cáncer en las mujeres brasileñas. Aún se desconocen los datos sobre el impacto real de la pandemia en la política de tamizaje y diagnóstico de cáncer de mama en Brasil. **Objetivo:** Evaluar el efecto de la pandemia de covid-19 en el número de mamografías realizadas en el Sistema Único de Salud (SUS). **Método:** Estudio epidemiológico, cuantitativo y transversal. Se seleccionaron mamografías mensuales realizadas en el SUS a través del Departamento de Informática del SUS (DATASUS). Se evaluó el volumen histórico, de enero de 2017 a marzo de 2020, el mes siguiente al primer caso de covid-19 diagnosticado en Brasil, para construir un modelo de predicción de mamografías esperadas, de marzo de 2020 a diciembre de 2021. **Resultado:** En 2020, se dejaron de realizar 1.705.475 mamografías en Brasil en comparación con el año anterior, según DATASUS. El modelo de predicción, basado en valores históricos, mostró un déficit de 1.635.420 mamografías. En mayo de 2020, hubo la mayor caída en los exámenes, totalizando solo el 20,69% de las mamografías realizadas en el mismo mes del año anterior. **Conclusión:** La detección temprana del cáncer de mama fue una de las áreas médicas impactadas por la política de restricción y aislamiento impuesta en 2020. En este sentido, serán necesarios futuros esfuerzos gubernamentales para brindar el tratamiento de eventuales pacientes con diagnóstico tardío de cáncer de mama, además las mamografías que no se pudieron realizar.

**Palabras clave:** neoplasias de la mama; mamografía/estadística & datos numéricos; política de salud; Sistema Único de Salud; COVID-19.

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## INTRODUCTION

The Coronavirus disease 2019 (COVID-19) pandemic, recognized on March 11, 2020<sup>1</sup> by the World Health Organization – WHO resulted in 24 million cases and more than 600 thousand deaths in Brazil until January 2022<sup>2</sup>. As reported by WHO at the beginning of the pandemic, 90% of the countries registered one or more discontinuation of the essential health services<sup>3</sup>. The priority was refocused to urgency and emergency services causing repercussions on outpatient consultations and routine exams, delaying diagnoses of diseases as breast, cervical, prostate and colorectal cancers<sup>4</sup>.

Breast cancer is the second most common cancer affecting the Brazilian women accounting for 24.5% of all cancer cases for this population, second only to non-melanoma skin cancer<sup>5</sup>. Breast cancer adjusted by the world population in Brazil was responsible for 14.23 deaths/100 thousand women in 2019 with higher rates found at the Southeast and South regions. The early identification of breast cancer is essential to increase the odds of cure since the Ministry of Health recommends screening mammograms at every two years for women in the age-range of 50 and 69 years<sup>5</sup>.

To devise the future public health strategies to meet occasional delays, it is essential to understand the magnitude of the volume of mammograms during the pandemic. The current study has the objective of demonstrating the impact of the COVID-19 pandemic on breast cancer screening, utilizing the statistical calculation that estimates the volume of exams that could have been performed based on historical data. It attempts to reveal whether screening and diagnosis mammograms increased or reduced and analyze the potential relations.

## METHOD

Epidemiological, quantitative, cross-sectional study evaluating the impact of COVID-19 pandemic on breast cancer screening offered by the Brazilian National Health System (SUS). Data were collected from SUS' Outpatient Information System (SIA/SUS)<sup>6</sup> through the respective Computer Department (DATASUS) a deidentified public database. DATASUS discloses hospital and outpatient-based data of tests performed funded by the federal government<sup>7</sup>. As such, it is possible to control and evaluate the information sent by several municipalities, which helps health management. SUS is the mean of access to health for 71.5% of the Brazilians<sup>8</sup>; in addition, the validity of the information was certified by previous studies which utilized the platform to acquire precise and statistically relevant data to substantiate hypotheses and coordinate public health planning actions<sup>9,10</sup>.

It was possible to create forecast models of monthly means with historical data of screening and diagnostic mammograms of the Brazilian states based in the seasonality and trends. The calculation predicts future time series with existing data and the additive version of the exponential smoothing algorithm Error, Trend, Seasonal (ETS AAA).

The algorithm is useful for sets of seasonal data as mammograms that vary according to month intervals. It calculates weighted-mean of all the observations of time-series, being possible to evaluate the exponentially decreasing weights along the time. Weights depend on a constant parameter, known as smoothing parameter<sup>11,12</sup>.

Firstly, to predict the mammograms, the expected number of exams that would be performed between March 2020 and December 2021, based in available time-series data, was estimated. March 1<sup>st</sup> 2020 was assumed as the beginning of the predictions because the first COVID-19 case in Brazil was reported at the end of February<sup>13</sup>.

Historical data of 2017, 2018 and 2019 until March 2020 were the base to predict the volume of mammograms. For each month of exams predicted, a confidence interval with lower and upper values was determined and later compared with the number of mammograms that were actually reported at DATASUS. Point estimates and confidence intervals of 95% were reported, including screening also known as routine mammograms and diagnostic to investigate suspected lesions and alterations. With this, it was possible to determine the numerical difference and reach the volume of exams deterred to the next years because of the COVID-19 pandemic.

Microsoft Excel<sup>®</sup> statistical models were utilized for the analyzes, adjusting tables and graphs offered by the software package. The map of Brazil was presented in regions and Federation Units at Microsoft Excel<sup>®</sup>, with the geographic database GeoNames and the search website Bing.

As this study did not enroll any human subject, the Institutional Review Board analysis was waived in compliance with the national rules. Only public data of the Brazilian Ministry of Health were utilized and followed the criteria of the Guidelines for Accurate and Transparent Health Estimates Reporting – GATHER<sup>14</sup>.

## RESULTS

In 2017, the number of screening and diagnostic mammograms in Brazil was 4,493,832 according to SIA/SUS<sup>6</sup>. For 2018, the volume kept the trend although lower, reaching 4,295,922 tests performed, a drop of 4.40% followed by 2019 with 4,277,711 mammograms

reported, a decline of 0.42% in comparison with 2018 and of 4.80% compared with 2017 (Table 1). Even with a subtle decline of the number of mammograms, ranging between 0.5% and 4.80%, the search for this exam has never exceeded 10%. The COVID-19 pandemic (initiated

in 2020 in Brazil) caused an expressive reduction of 39.87% in relation to 2017, mainly in the first semester of 2020 from March to May as Graph 1 portrays. The biggest reduction of 79.31% of mammograms occurred in May, in comparison with 2019.

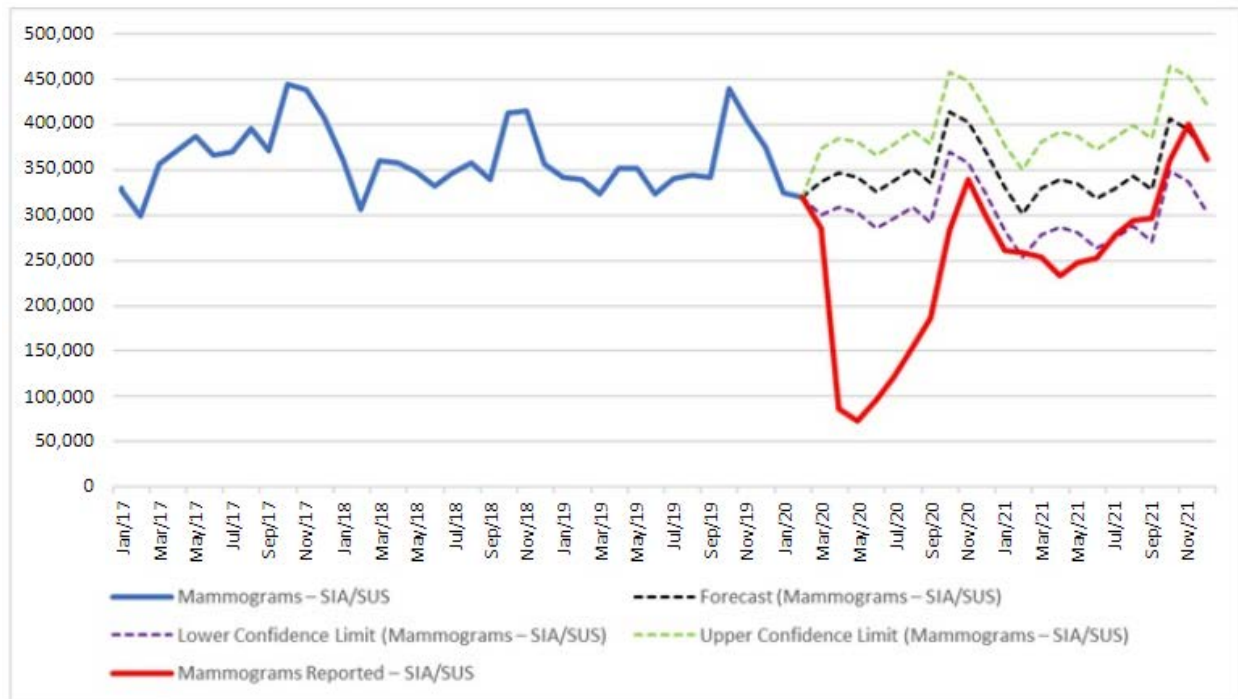
**Table 1.** SUS's outpatient screening and diagnostic mammograms per month

Month	2021		2020		2019		2018		2017	
	A	B	A	B	A	B	A	B	A	B
January	233,060	28,118	294,683	30,274	312,955	29,380	327,184	34,655	299,544	30,397
February	230,261	28,440	291,119	28,911	309,401	29,550	275,836	30,760	269,488	29,354
March	224,334	29,660	257,217	28,974	294,533	29,625	327,396	32,482	322,462	33,788
April	202,664	30,128	70,826	15,987	318,734	33,326	326,336	31,842	295,606	31,886
May	219,618	28,636	59,390	13,294	317,700	33,581	315,265	32,585	351,827	35,182
June	224,725	28,060	78,141	18,200	292,757	30,294	302,504	30,005	335,515	30,993
July	248,921	29,246	98,808	22,624	308,579	31,976	313,585	33,066	336,977	33,228
August	263,937	30,297	130,063	25,325	310,975	33,224	323,110	34,743	358,277	37,659
September	266,439	30,544	160,092	26,742	310,004	31,732	310,160	29,500	338,033	32,765
October	328,898	31,096	254,771	28,890	400,990	38,380	379,029	33,774	409,290	34,742
November	368,567	32,193	306,944	32,047	372,528	33,114	384,242	31,076	403,823	34,582
December	330,098	31,949	269,735	29,179	344,135	30,218	326,752	30,035	376,635	31,779
Total	3,141,522	358,367	2,271,789	300,447	3,893,311	384,400	3,911,399	384,523	4,097,477	396,355

Source: SIA/SUS<sup>6</sup>.

Captions: A = screening mammograms; B = diagnostic mammograms.

Note: Screening mammograms, code 0204030188, indicated for 50-69 years-old women without signs and symptoms of breast cancer. Diagnostic mammogram\*, indicated to evaluate suspected breast lesions of any age, including men, code 0204030030. (\*) Counted one per breast.



**Graph 1.** Mammograms estimated versus actual in Brazil based in historical data

Source: SIA/SUS<sup>6</sup>.

Caption: Blue line portrays historical data; purple, black and green lines, statistical forecast with lower, intermediate and upper limits, red line portrays mammograms reported during the pandemic.

However, the volume of mammograms increased during the year, moving back to trend values, but still below the mean of the last two years (Graph 1). The difference between 2019 and 2020 was 1,705,475, a decline of nearly 40% in comparison with the previous results. In 2021, the volume continued low, but the difference in relation to the year before the pandemic did not exceed 18.18%, half of the drop from 2019 to 2020 (Table 1).

Screening mammograms were the most affected with a drop of 41.65% of routine exams as the data investigated suggested, while the diagnosis mammograms reached half of this volume, with a decline of 21.84% in 2020 (Table 1). In 2021, the decline in comparison with the year before the pandemic (2019) was not as sharp, with less 19.31% of screening mammograms and less 6.77% of diagnostic mammograms.

It was possible to construct a moving average time series model based on mammograms exams per patient from January 2017 to February 2021 in Brazil. The results indicated that until February 2021, the number of mammograms reported continued below the lower limit of the confidence interval (Table 2). During the first semester of 2020, the difference between expected and actual mammograms per month was higher as anticipated, specifically in May, the steepest decline as shown in Graph 1. Although the volume of exams has grown in the next months, the results remained below the lower limit expected for the year. In 2020 alone, the drop of mammograms was of 1,635,420 based on historical time-series, a reduction of 54.09% of the expected volume for the year.

Furthermore, Piauí (-57.74%), Mato Grosso (-54.67%) and Pernambuco (-52.42%) presented the

**Table 2.** Mammograms estimated per month/year in Brazil based in historical data, lower and upper confidence limits reported versus mammograms reported by SIA/SUS

Month	Forecast	Lower limit	Upper limit	Mammograms reported	Forecast/ reported (%)
<b>2020</b>					
March	337,236	299,126	375,346	286,191	-15.14
April	340,422	301,120	379,723	86,813	-74.50
May	342,053	301,586	382,520	72,684	-78.75
June	326,666	285,058	368,275	96,341	-70.51
July	338,647	295,918	381,375	121,432	-64.42
August	352,133	308,305	395,962	155,388	-55.87
September	336,442	291,533	381,351	186,834	-44.47
October	415,055	369,082	461,028	283,661	-31.66
November	403,499	356,478	450,519	338,991	-15.99
December	370,516	322,463	418,569	298,914	-19.32
<b>Total</b>	<b>3,562,669</b>	<b>3,130,670</b>	<b>3,994,668</b>	<b>1,927,249</b>	<b>-45.90</b>
<b>2021</b>					
January	331,303	282,231	380,375	261,178	-21.17
February	302,127	252,049	352,204	258,701	-14.37
March	330,156	276,398	383,915	253,994	-23.07
April	333,342	278,650	388,034	232,792	-30.16
May	334,973	279,357	390,590	248,254	-25.89
June	319,587	263,054	376,119	252,785	-20.90
July	331,567	274,126	389,008	278,167	-16.11
August	345,054	286,712	403,396	294,234	-14.73
September	329,362	270,126	388,598	296,983	-9.83
October	407,975	347,852	468,098	359,994	-11.76
November	396,419	335,415	457,422	400,760	1.10
December	363,436	301,558	425,314	362,047	-0.38
<b>Total</b>	<b>4,125,301</b>	<b>3,447,529</b>	<b>4,803,073</b>	<b>3,499,889</b>	<b>-15.16</b>

Source: SIA/SUS<sup>6</sup>.

highest drop of exams per consultation in Brazil, including screening and diagnostic mammograms. The States with the lowest drops were Pará (-2.01%), Rondônia (-13.58%) and Maranhão (-25.01%). Only Amapá reported increase of mammograms in 2020 (Table 3), but all the five Brazilian regions presented reduction (Figure 1).

## DISCUSSION

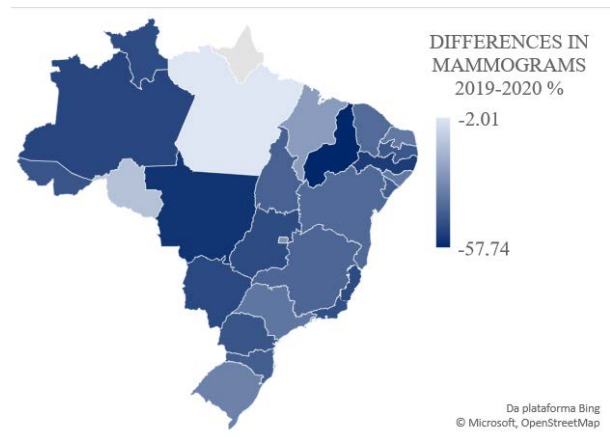
COVID-19 pandemic caused a global impact on exams and surgical procedures<sup>4</sup>. One of the most affected areas was breast cancer treatment because it involves multidisciplinary cooperation from several health caregivers provoking important delays and cancellations<sup>15</sup>. The consequences were not only to the health system, but to oncologic patients as well.

The results of the study suggested that 1,705,475 failed to be performed in Brazil in 2020 alone, a drop of 40%

**Table 3.** Mammograms comparison: 2019-2020, Brazilian States

State	2019	2020	%
Acre	4,758	2,584	-45.69
Alagoas	82,234	53,220	-35.28
Amapá	188	5,314	2726.60
Amazonas	37,139	18,707	-49.63
Bahia	300,563	181,105	-39.74
Ceará	88,718	53,604	-39.58
Distrito Federal	11,407	8,233	-27.83
Espírito Santo	94,047	49,943	-46.90
Goiás	88,137	45,462	-48.42
Maranhão	43,256	32,438	-25.01
Mato Grosso	29,870	13,539	-54.67
Mato Grosso do Sul	57,624	29,352	-49.06
Minas Gerais	454,978	268,687	-40.95
Pará	49,822	48,821	-2.01
Paraíba	65,492	36,122	-44.85
Paraná	362,723	197,470	-45.56
Pernambuco	194,609	92,599	-52.42
Piauí	61,024	25,791	-57.74
Rio de Janeiro	260,592	137,638	-47.18
Rio Grande do Norte	59,402	38,308	-35.51
Rio Grande do Sul	344,356	232,066	-32.61
Rondônia	13,250	11,451	-13.58
Roraima	4,515	2,330	-48.39
Santa Catarina	154,232	87,986	-42.95
São Paulo	1,362,358	869,740	-36.16
Sergipe	43,289	24,446	-43.53
Tocantins	9,128	5,280	-42.16

Source: SIA/SUS<sup>6</sup>.



**Figure 1.** Percentage of differences of mammograms 2019-2020  
Source: SIA/SUS<sup>6</sup>.

compared to the previous year. The steep decline of the curve begins in March because the first COVID-19 case was reported at the end of February in Brazil and the first death was confirmed two weeks later on March 12, 2020 in São Paulo<sup>13,16</sup>.

In 2020, the drop of 1,621,522 screening mammograms may represent a repressed demand for future exams; the reduction of 83,953 diagnostic mammograms is concerning which will likely result in delays of consultations and high staging grade in the future. A decline of mammograms was found for all the five Brazilian regions, two Northeast States, Piauí and Pernambuco had the biggest drop in 2019 and 2020. At the beginning of the pandemic, the mortality rate by COVID-19 was higher in less socioeconomic developed States, mainly in the Northeast and North Regions which can explain these results<sup>17</sup>. Curiously, an increase of 5,126 mammograms was reported for Amapá during the pandemic but these results were excluded from Figure 1 because problems with the flow of data might have occurred. The recent implementation of information systems which gather the country's records of mammograms as well as missing data of some municipalities at the database may explain the discrepancy of the national trend in this state, but more studies to confirm this fact are necessary.

Mammograms or breast ultrasound imply in close contact with the patients, no physical distancing is possible because the patients are at a distance between 20 to 30 cm from the professional<sup>18</sup>. A study concluded that radiologic technicians had one of the work-related highest risks of being infected (84 in 100) and ultrasound professionals, 80 in 100.

Most likely, the risk is still higher for mammogram technicians as social distancing (2m or 6 feet) is impossible to keep to position the patient<sup>19</sup>. Because of the pandemic, the breast imaging and radiology departments discussed

how to protect the patients, health professionals and maintain the Personal Protective Equipment (PPE) and ventilators to be utilized by infected patients<sup>20</sup>.

Many health centers rescheduled screening and diagnostic mammograms, or postponed breast surgeries<sup>15</sup>, consistent with the results of this study where screening mammograms declined more than diagnostic's. The interpretation of policies that every State followed resulted in non-uniform discontinuation of the patients' consultation but attempting to meet the demand of COVID-19 cases in each city.

Several medical societies issued notes and technical reports to minimize the unavoidable burden to public health to manage and coordinate pandemic's strategies<sup>21,22</sup>. In March 2020, the Society of Breast Imaging<sup>23</sup> brought up the difficult issue of offering annual screening mammogram *versus* the minimization of the impact of the pandemic on the society. The associates were concerned with the routine women used to follow and potential spread during the consultation or exam because the asymptomatic patient could be unaware of its status and put other individuals at risk<sup>23</sup>.

Given the rapid spread of the disease and WHO's recommendations on social distancing as main procedure to reduce the cases, the Society of Breast Imaging advised the delay of breast exams for "several weeks or months"<sup>23</sup>. The Canadian Society of Breast Imaging and the Canadian Association of Radiologists<sup>24</sup>, on the other hand, recommended that every mammogram and magnetic resonance imaging should be postponed for at least six to eight weeks.

In Brazil, also in March the "*Sociedade Brasileira de Mastologia*"<sup>25</sup> (SBM) disclosed a note, affirming that the oncologic conduct should be adjusted to the local reality, considering the COVID-19 pandemic risks and demands. Based in the Technical Note GVIMS/GGTES/Anvisa number 06/2020<sup>26</sup>, the SBM, the "*Sociedade Brasileira de Infectologia*" and the "*Associação Brasileira dos Profissionais em Controle de Infecções e Epidemiologia Hospitalar*" recommended additional indoor measures as alcohol 70% and surgical masks.

Mask N95 or PFF2, caps, waterproof surgical gown, gloves, goggles and face shield should be utilized based in protocols of donning and doffing for outpatient procedures as punctures and biopsies of asymptomatic patients. For symptomatic patients, the orientation was screening through remote consultation and, in urgent cases, in-person consultation should be considered cautiously after seven days counted from the day the symptoms disappeared<sup>26</sup>. Additionally, in order to ensure the follow-up of medical and surgical consultations, the SBM recommended that mastologists and hospitals

assigned areas exclusively for consultation of suspected COVID-19 patients<sup>25</sup>.

Although these recommendations favored the understanding of how the virus spread, few studies addressed the prediction and ratification of the possible difference of the volume of mammograms performed in Brazil. The present study shows how local data, simultaneous with the calculation of historical-data based national forecast can be utilized to identify gaps and offer comprehensive information to ensure that public policies meet future demands of exams and diagnoses.

In the first phase of the pandemic, the number of new cancers diagnosed declined in the United States, possibly secondary to the fact that the patients did not attend the scheduled visits and no actual drop of incidence occurred<sup>27</sup>. Eventually these cancers will be detected with bigger size or higher staging grade compared with former early screening, which can impact the prognosis. A short delay from six to 12 weeks does not affect the general results of cancer staging, while a delay of more than three months could theoretically affect<sup>28,29</sup>.

This study reports a significant decline of the number of patients submitted to mammogram during the COVID-19 pandemic. It is clear that the drop of screening and diagnostic mammograms means delay of early identification of the disease and a potential higher staging of the future disease and of the new number of cases that tend to concentrate in a short-time range. This perspective suggests that local policies should watch for a reduction of the offer of the exam and prioritize symptomatic women.

Awareness campaigns about the necessity and importance of mammograms are essential to reverse the drop of exams during the pandemic; the conclusions of the current study support this initiative because it has been demonstrated that in the month of October of each year investigated (when the awareness campaign *Outubro Rosa* for early breast cancer diagnosis occurs) the volumes of mammograms increased, strengthening the relevance of public policies.

The drop of the number of mammograms according to this study may potentially increase the incidence of deaths by breast cancer in the upcoming years in Brazil. Studies demonstrated that in the United Kingdom deaths by breast cancer in the next five years are estimated to increase 9%, secondary to the fact that 45% of the patients with symptoms of cancer were unable to seek medical care at the peak of the pandemic from March to May 2020<sup>29</sup>.

An investigation in 23 hospitals (university, community and specialized), 52 emergency rooms and 17 imaging centers in New York revealed a reduction of mammograms of nearly 94%, of magnetic resonance of

74% and ultrasound of 64%<sup>30</sup>. In another study<sup>31</sup> with six USA university-hospitals, three of them with the lowest rates of COVID-19, the mammogram volumes reduced drastically; screening mammograms were the most affected with slow pace of recovery<sup>31</sup>. The Brazilian scenario was similar because the total number of oncologic medical visits diminished 45% and surgical cases, 60% during the pandemic<sup>32</sup>. In 2020, according to a study published by the journal “*Epidemiologia e Serviços de Saúde*”<sup>33</sup> there was a drop of 25,172 oncological surgeries (-15.7%) and 552 (-0,7%) radiotherapy procedures in comparison with the last year. Timing to deliver the tests results were little impacted.

Consequently, it was possible to evaluate the effects of the pandemic on mammograms at SUS based in the model of statistical forecast adjusted to the reported data of exams carried out in this study. But more studies are required to evaluate short-term effects of the reduction of breast cancer diagnostic mammograms.

This study was exclusively based on open code data obtained at DATASUS, the volume of mammograms conducted by private clinics was not included in the study's scope. The results refer only to Brazil and should not be utilized for other countries.

## CONCLUSION

The reduction of more than two million mammograms in 2020 and 2021 is alarming. Several are the reasons the population had for not submitting to routine or diagnostic tests, causing a significant drop of the volume of mammograms: fear of COVID-19 infection, discontinuation of medical visits and reallocation of health caregivers to fight the pandemic, among others.

This study suggested that screening mammograms were the least performed due to the pandemic. The Brazilian public health system will need to conduct the delayed mammograms by increasing the call services to schedule the exams and of the clinics associated to SUS to facilitate the access. In addition, as breast cancer diagnosis will be delayed, the system will have to adjust to meet the demands of high-grade staging cancers and cases diagnosed in the same period, which can potentially overburden the health system and affect the patient's life and the society as a whole.

## CONTRIBUTIONS

Patrícia Kellen Haboski Demarchi, Eduarda Maurer, Neidi Isabela Pierini and Lara Silveira Maggi contributed to the study design, acquisition, analysis and interpretation of the data, wording and critical review. Bruno Leonardo

Lammel, Allana Cristina Victório Sirqueira and Karen Lopes contributed to the study design, acquisition, analysis and interpretation of the data. Solange de Fatima Shama Mohd Suleiman contributed to the wording and critical review. All the authors approved the final version for publication.

## DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interests to declare.

## FUNDING

None.

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Recebido em 3/2/2022  
Aprovado em 27/4/2022