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Patients characteristics related to screening mammography cancellation and rescheduling rates during the COVID-19 pandemic

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ABSTRACT

Purpose: To identify patient characteristics associated with screening mammography cancellations and rescheduling during the COVID-19 pandemic.

Methods: Scheduled screening mammograms during three time periods were retrospectively reviewed: state-mandated shutdown (3/17/2020-6/16/2020) during which screening mammography was cancelled, a period of 2 months immediately after screening mammography resumed (6/17/2020-8/16/2020), and a representative period prior to COVID-19 (6/17/2019-8/16/2019). Relative risk of cancellation before COVID-19 and after reopening was compared for age, race/ethnicity, insurance, history of chronic disease, and exam location, controlling for other collected variables. Risk of failure to reschedule was similarly compared between all 3 time periods.

Results: Overall cancellation rate after reopening was higher than before shutdown (7663/16595, 46% vs 5807/15792, 37%; $p < 0.001$). Relative risk of cancellation after reopening increased with age (1.20 vs 1.27 vs 1.36 for ages at 25th, 50th, and 75th quartile or 53, 61, and 70 years, respectively, $p < 0.001$). Relative risk of cancellation was also higher among Medicare patients (1.41) compared to Medicaid and those with other providers (1.26 and 1.21, respectively, $p < 0.001$) and non-whites compared to whites (1.34 vs 1.25, $p = 0.03$). Rescheduling rate during shutdown was higher than before COVID-19 and after reopening for all patients (10,658/13593, 78%, 3569/5807, 61%, and 4243/7663, respectively, 55%, $p < 0.001$). Relative risk of failure to reschedule missed mammogram was higher in hospitals compared to outpatient settings both during shutdown and after reopening (0.62 vs 0.54, $p = 0.005$ and 1.29 vs 1.03, $p < 0.001$, respectively).

Conclusion: Minority race/ethnicity, Medicare insurance, and advanced age were associated with increased risk of screening mammogram cancellation during COVID-19.

1. Introduction

Underserved women and those with chronic medical conditions undergo screening mammography less frequently at baseline compared to Non-Hispanic whites and those without chronic diseases [1–5]. Disparities in screening mammography frequency are one possible explanation for higher late-stage presentation of breast cancer among minority women [6,7]. Furthermore, these populations, along with those with advanced age, are disproportionately affected by the COVID-19 pandemic with documented worse outcomes [8,9]. While a study confirmed that the COVID-19 pandemic further exacerbated pre-existing underutilization of diagnostic imaging among the underserved [10], there is currently no study dedicated to potential disparities in breast cancer screening during COVID-19.

During the initial peak of COVID-19 pandemic between March-June 2020, our institution and many others cancelled screening mammograms in accordance with state and Society of Breast Imaging guidelines [11]. As a result, the reported volume loss in breast imaging ranged between 87 and 99% during the early stage of the pandemic [12–14]. Delays in screening mammography between March-September 2020 were reported to result in a 60% decrease in breast cancer diagnoses by a large tertiary care institution [15]. Such delay in diagnosis was estimated by routes-to-diagnosis modeling (which assumed a decrease in breast cancer diagnosed by screening/primary care visits and an

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increase in those diagnosed by specialty/emergency visits, the latter of which is associated with worse outcome) to result in an increase in 5-year breast cancer mortality rate of up to 9.6% [16].

The purpose of this study is to identify patient and facility characteristics that impact screening mammography cancellations and likelihood of rescheduling cancelled exams prior to COVID-19, during state-mandated shutdown, and after reopening of facilities in June through August 2021.

2. Materials and methods

This study was approved by institutional IRB and was HIPAA compliant.

2.1. Practice setting

Screening mammography was offered at a variety of settings within our institution, including a tertiary care academic center, a community hospital, a specialized cancer center, three outpatient imaging centers, one urban healthcare center, and one mobile mammography van. Patients could undergo screening at any of our facilities depending on patient preference and appointment availability. Screening mammogram examinations at our institution were often scheduled up to a year before the appointment date, as patients routinely scheduled their next year's mammogram at the end of their annual screening.

2.2. Workflow during state-mandated COVID-19 shutdown

On March 10, 2020, a State of Emergency was declared in Massachusetts. On March 17, 2020, patients at our institutions were contacted by phone by our mammogram technologists and administrative staff to cancel all screening mammograms. At time of telephone conversation, the patient was offered a new appointment time in June or within 2 months of the original appointment date at any of our facilities of the patient's choosing. On May 18, 2020, Phase I of reopening of Massachusetts was announced, which included reopening of hospitals and community health centers to provide preventive care and treatment to patients at high-risk. Screening mammograms for all high-risk patients was resumed at our institution on June 1, 2020. Our high-risk patient populations were defined as those identified as positive for genetic mutations, personal history of breast cancer, family history of breast cancer, and those with irradiation to the chest. Screening exams for all patients subsequently resumed on June 17, 2020. All affiliated facilities resumed screening exams following hospital recommended social distancing and sanitation protocol. However, number and length of appointments were not changed at any of our facilities.

2.3. Data collection and analysis

Our scheduling database (Radiant, Epic, Verona, WI) was retrospectively accessed to identify scheduled screening mammograms during three time periods: state-mandated shutdown secondary to COVID-19 (3/17/2020-6/16/2020), a period of 2 months immediately after screening mammography service reopened to the general public (6/17/2020-8/16/2020), and a representative period previous to COVID-19 pandemic. For the period prior to COVID-19, similar dates on previous calendar year as reopening period were selected to attempt to capture similar patient population and control for seasonality (6/17/2019-8/16/2019).

Data was collected from electronic medical record (Epic, Verona, WI) on August 20, 2020 for all study periods. Exam status (performed, cancelled and rescheduled, vs cancelled without rescheduling) was defined as the outcome variable. “Cancelled” status included both cancelled exams and no-show events. The study period was defined as the main exposure variable. Patient variables collected were age, insurance provider, race/ethnicity, history of chronic disease, and type of facility grouped into the following levels: insurance type (Medicare, Medicaid, or other), facility type (hospital vs outpatient), and race/ethnicity (White, Non-white, or unavailable/decline). The unavailable/decline group was excluded from analysis. Chronic disease was defined as conditions that would likely increase risks of COVID-19 infection severity listed on Center for Disease Control and Infection (CDC) website as accessed on July 27, 2020, namely diabetes, chronic renal disease, cardiac disease, COPD, and stroke [9]. Electronic medical record and registry data for documented history of these conditions were recorded for each patient and grouped into presence of one or more disease(s) vs no chronic disease. Age on August 20, 2020 was collected and analyzed as a continuous variable, and summary information was presented at age quartiles in tables and figures.

The primary outcome was to determine patient variables associated with increased relative risk of screening mammogram cancellation after reopening compared to before the pandemic. First, the cancellation rate for the levels of each variable was compared within each study period. For example, for race/ethnicity, the cancellation rates for Whites vs Non-whites during pre-COVID-19 period were compared, and the cancellation rates for Whites vs Non-whites during reopening period were compared. Categorical variables (race/ethnicity, insurance type, history of chronic disease, and facility type) were compared by Pearson's chi-squared tests and age was compared by two-independent-samples *t*-tests. Second, to detect change in cancellation rate over time, the relative risk of cancellation after reopening as compared to before COVID-19 was calculated for each level of the variables and their magnitudes compared. For example, for race/ethnicity, the relative risks of cancellation after reopening compared to before COVID-19 were calculated for Whites and Non-whites, then compared. All reported relative risks have been adjusted for all other collected variables. For example, the comparison of relative risk of cancellation for race/ethnicity was controlled for age, insurance type, history of chronic disease, and facility type. Relative risks with 95% confidence intervals and relevant hypothesis tests were calculated using Poisson regression models with robust standard errors. Comparison of risk of screening mammogram cancellation between before COVID-19 and during shutdown was not performed because cancellation before COVID-19 was patient-initiated whereas cancellation during shutdown was facility-initiated.

The secondary outcome was to determine variables associated with increased risk of failing to reschedule a cancelled mammogram. Comparison was made between pre-pandemic period and period *during* COVID-19 related shutdown as well as *after* COVID-19 related shutdown. Although all exams were cancelled due to state mandated shutdown, the benefit of evaluating screening mammogram rescheduling during shutdown is to determine if heightened effort of rescheduling on the institutional part had any effect on rescheduling rate. Using the same statistical methods as above, rescheduling rates in all 3 study periods were obtained, the adjusted relative risk of failure to reschedule during the two latter periods as compared to before COVID-19 was calculated, and the magnitudes of the adjusted relative risks were compared among variable levels.

All testing was two-tailed and *p*-values less than 0.05 were treated as statistically significant. Analyses were performed using SAS 9.4 (SAS Institute, Cary NC).

3. Results

3.1. Screening mammogram cancellation

The cancellation rate of screening mammograms during the 2-month period after reopening was 46% (7663/16595), which was higher than that of pre-COVID-19 period (37%, 5807/15792, $p < 0.001$).

3.2. Age

In the pre-pandemic period, women who cancelled their screening

mammogram were younger than those who completed their exams (mean age 60.1 vs 61.1 years, respectively, p < 0.001, Table 1). After reopening, women who cancelled their exam were older than those who completed them (mean age 61.2 vs 60.6, respectively, <0.001, Table 1). The relative risk of cancellation after reopening significantly increased with age, as illustrated in incremental increase by quartile in Fig. 1 (1.20 vs 1.27 vs 1.36 for ages at 25th, 50th, and 75th quartile or 53, 61, and 70 years, respectively, $p < 0.001$).

3.3. Insurance

Before COVID-19, women with Medicaid had a higher rate of screening mammogram cancellation compared to those with Medicare and other insurances (45% vs 34% vs 37%, respectively, $p < 0.001$, Table 1). After reopening, cancellation rate among Medicaid beneficiaries remained higher than that of Medicare beneficiaries and those with other insurances (56% vs 48% vs 44%, respectively, $p < 0.001$), but the relative risk of cancellation after reopening was highest among Medicare compared to Medicaid beneficiaries and those with other insurances (1.41 vs 1.26 vs 1.21, p < 0.001, Fig. 1).

3.4. Race/ethnicity

Women identifying as Non-whites had a higher rate of screening mammogram cancellation compared to Whites both before COVID-19 and after reopening (Before: 40% vs 36%, $p < 0.001$; After: and 53% vs 44%, p < 0.001, Table 1). The relative risk of cancellation after reopening was also higher among Non-whites compared to Whites (1.34 vs 1.25, $p = 0.025$, Fig. 1).

3.5. Presence of chronic disease

Women with at least one chronic disease had a higher rate of screening mammogram cancellation compared to those without both before COVID-19 and after reopening (Before: 40% vs 36%, $p = 0.026$; After: 50% vs 45%, $p < 0.001$, Table 1). The relative risk of cancellation after reopening was higher among women with at least one chronic disease compared to those without but did not reach statistical significance (1.32 vs 1.25, $p = 0.07$, Fig. 1).

3.6. Facility type

Cancellation rate in hospitals was higher than in outpatient setting before COVID-19 (39% vs 33%, $p < 0.001$) and remained higher after reopening (49% vs 41%, p < 0.001, Table 1). However, the relative risk of cancellation in the hospital versus outpatient setting after reopening with respect to before COVID-19 were not significantly different (1.28 vs 1.25, $p = 0.58$, Fig. 1).

3.7. Screening mammogram rescheduling after reopening

Rescheduling rate during the reopening period (4243/7663, 55%, $p < 0.001$) was lower than that of pre-pandemic period (3569/5807, 61%, p < 0.001). Age and facility type were the only two variables found to be significantly associated with relative risk of rescheduling after reopening (Fig. 2). Both before the pandemic and after reopening, women who failed to reschedule their screening mammograms were younger than those who rescheduled (Before: mean 58.9 vs 60.8 years, $p < 0.001$; After: 60.9 vs 61.5 years, $p = 0.018$, Table 2), but the relative risk of failing to reschedule screening mammogram during reopening period increased with age (1.17 vs 1.22 vs 1.27 for ages at 25th, 50th, and 75th quartile, respectively, $p = 0.014$, Fig. 2). Before COVID-19, reschedule rate was higher in the hospital setting compared to outpatient setting (63% vs 58%, $p = 0.002$, Table 2). However, after reopening, reschedule rate was lower in hospital compared to outpatient setting (53% vs 60%, p < 0.001, Table 2), with a higher relative risk of failing to reschedule screening mammogram after reopening in the hospital compared to outpatient (1.26 vs 1.03, $p < 0.001$, Fig. 2).

Both before the pandemic and after reopening, rescheduling rate were lower among patients with Medicaid compared to those with Medicare and other insurance providers, among Non-whites versus Whites, and among women with at least one chronic disease than for those without (Table 2). The relative risk of failing to reschedule screening mammogram during the reopening period did not statistically significantly vary with insurance type, race/ethnicity, nor presence of chronic disease (Fig. 2).

3.8. Screening mammogram rescheduling during shutdown

Rescheduling rate during the state-mandated shutdown (10,658/13593, 78%), during which rigorous effort was made to reschedule patients, was higher than both pre-pandemic period (3569/5807, 61%, p < 0.001) and reopening period (4243/7663, 55%, p < 0.001).

Facility type was the only variable significantly associated with relative risk of rescheduling during shutdown period. Similar to that of reopening period, reschedule rate during shutdown was lower in hospitals compared to outpatient setting (78% vs 80%, $p = 0.038$, Table 2) with a higher relative risk of failing to reschedule screening

Table 1
Screening mammogram cancellation rate before vs after state-mandated shutdown for COVID-19.

Demographics	Before				After			
Exam status	Completed	Cancelled	Cancel rate (%)	P-value	Completed	Cancelled	Cancel rate (%)	P-value
Mean age in years (standard deviation, range)	61.1 (11.13, 26-101)	60.1 (11.33, 26-95)	–	<0.001	60.6 (10.95, 27-101)	61.2 (11.45, 24-101)	–	<0.001
Insurance provider (%):				<0.001				< 0.001
Medicare	2787	1465	34		2510	2325	48	
Medicaid	763	625	45		443	561	56	
Other	6435	3717	37		5979	4777	44	
Race (%):				<0.001				<0.001
Non-Whites	2174	1447	40		1413	1604	53	
White	7445	4147	36		7271	5826	44	
Unavailable/declined	366	213	37		248	233	48	
Chronic disease				0.026				<0.001
≥1 chronic disease (%)	2268	1528	40		2011	2012	50	
No chronic disease (%)	7717	4279	36		6921	5651	45	
Location (%)				<0.001				<0.001
Hospitals/cancer center	6496	4070	39		5647	5402	49	
Outpatient centers	3489	1737	33		3285	2261	41	
Total:	9985	5807	37		8932	7663	46	

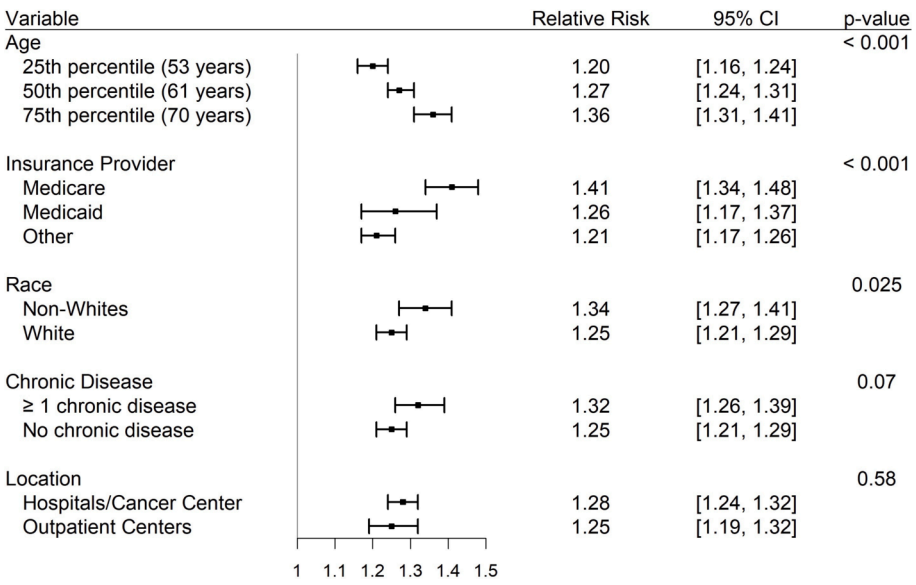

Fig. 1. Adjusted relative risk of screening mammogram cancellation before vs after COVID-19 state-mandated shutdown.
Forrest plot comparing adjusted relative risk of screening mammogram cancellation before vs after State-Mandated Shutdown for COVID-19 by patient and facility factors. Relative risks were adjusted for all other factors presented in this figure. For age (expressed in years), relative risks are presented for the 25th (53 years), 50th (61 years), and 75th percentiles (70 years) of age for illustration but the *p*-value is calculated using the continuous version of age. For all other variables, the p-value was calculated for variation in relative risk by levels of variable.

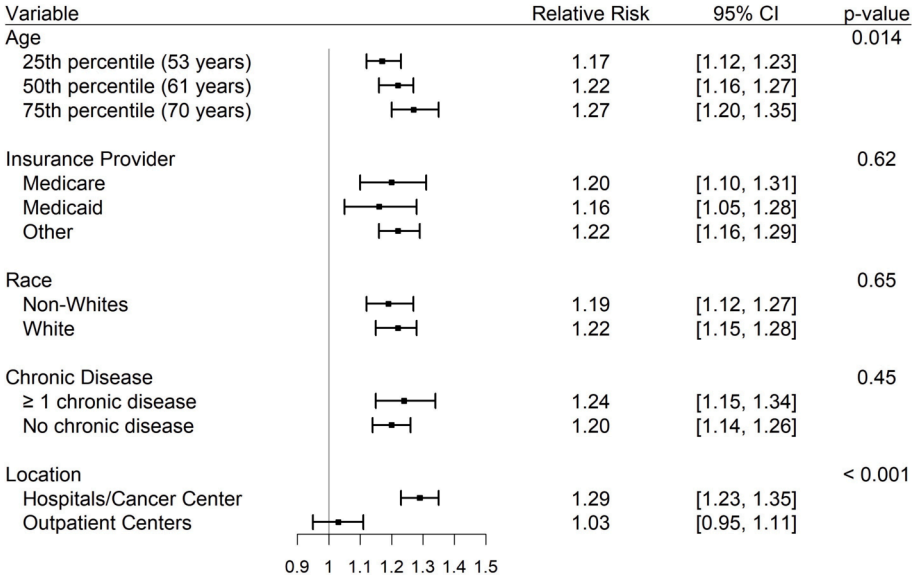

Fig. 2. Adjusted relative risk of failure to reschedule screening mammogram before vs after COVID-19 state-mandated shutdown.
Forrest plot comparing adjusted relative risk of failure to reschedule screening mammogram before vs after State-Mandated Shutdown for COVID-19 by patient and facility factors. Relative risks were adjusted for all other factors presented in this figure. For age (expressed in years), relative risks are presented for the 25th (53 years), 50th (61 years), and 75th percentiles (70 years) of age for illustration but the *p*-value is calculated using the continuous version of age. For all other variables, the p-value was calculated for variation in relative risk by levels of variable.

mammogram in the hospital compared to outpatient setting (0.62 vs 0.54, $p = 0.005$, Fig. 3). The adjusted relative risk of failing to reschedule screening mammogram during the shutdown period did not statistically significantly vary with age, insurance type, race/ethnicity, nor presence of chronic disease (Fig. 3).

4. Discussion

Our study demonstrates that age, minority race/ethnicity and Medicare insurance were each independently associated with a higher relative risk of screening mammogram cancellation after reopening from state-mandated COVID-19 shutdown, which may further exacerbate low adherence to screening mammogram for some women.

Age was found to be the only factor that was statistically significantly associated with both increased risk of cancellation and failure to reschedule after reopening of screening mammogram services. Although absolute differences in mean age in each study period were small, the study involved a large population and observed trend was also incremental by quartile. As age has been identified as one of the major risk factors for heightened severity of COVID-19 infection, patients with advanced age were recommended to take rigorous precaution against COVID-19 [9]. Higher relative risk of cancellation was also observed among Medicare patients independent of age.

Our study also demonstrated a higher relative risk of cancellation among Non-whites. Race/ethnicity is also a major risk factor of COVID-19 infection [9,17–21]. But unlike those with advanced age and/or Medicare, underserved women were already more likely to cancel and less likely to reschedule their missed screening mammogram before the pandemic; these findings were confirmed by our data and reported in previous literature [1,5,6,22–24]. This trend is postulated as one of the reasons minorities suffer from higher breast cancer mortality rates and later-stage presentation [6,7]. African Americans and Latinas are known to present with more advanced stage of breast cancer compared to non-Hispanic Whites; in addition, African-American women face higher breast cancer mortality rate despite lower breast cancer incidence compared to non-Hispanic Whites [7]. Our result confirms that disparity in screening mammography frequency persisted and is exacerbated during this global pandemic.

Table 2
Reschedule rate before, during state-mandated shutdown secondary to COVID-19, and after reopening.

Patients demographics	Cancelled exams *before* COVID-19				Cancelled exams *during* state-mandated shutdown				Cancelled exams *after* reopening			
	Rescheduled	Not	Rate (%)	P-value	Rescheduled	Not	Rate (%)	P-value	Rescheduled	Not	Rate (%)	*P*-value
Mean age in years (standard deviation, range)	60.8 (11.1, 26-95)	58.9 (11.5, 26-91)	–	<0.001	61.8 (11.1, 20-99)	60.9 (11.5, 27-119)	–	<0.001	61.5 (11.2, 28-101)	60.9 (11.7, 24-98)	–	0.018
Insurance (%):				<0.001				<0.001				<0.001
Medicare	932	533	64		3214	816	80		1340	985	58	
Medicaid	264	361	42		460	189	71		204	357	36	
Other	237	1344	64		6984	1930	78		2699	2078	56	
Race (%):				<0.001				<0.001				<0.001
Non-White	717	730	50		1575	662	70		650	954	40	
White	2754	1393	66		8775	2208	80		3465	2361	59	
Unavailable/ declined	98	115	46		308	105	75		128	105	55	
Chronic disease (%):				0.027				0.83				<0.001
≥1	903	625	59		2573	703	79		1034	978	51	
None	2666	1613	62		8085	2232	78		3209	2442	57	
Location (%)				0.002				0.038				<0.001
Hospitals	2553	1517	63		7629	2158	78		2870	2532	53	
Outpatient	1016	721	58		3029	777	80		1373	888	60	
Total:	3569	2238	61		10,658	2935	78		4243	3420	55	

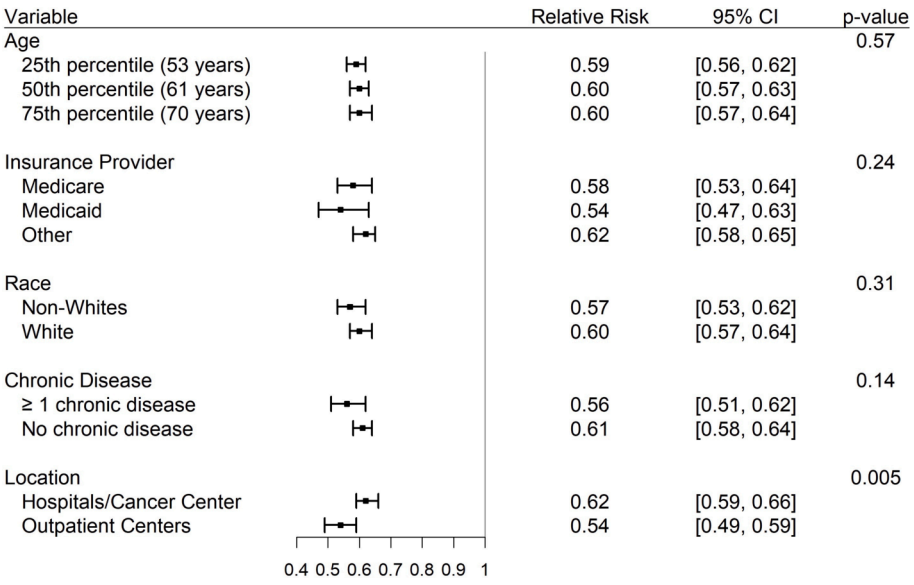

Fig. 3. Adjusted relative risk of failure to reschedule screening mammogram before vs during COVID-19 state-mandated shutdown.
Forrest plot comparing adjusted relative risk of failure to reschedule screening mammogram before vs during State-Mandated Shutdown for COVID-19 by patient and facility factors. Relative risks were adjusted for all other factors presented in this figure. For age (expressed in years), relative risks are presented for the 25th (53 years), 50th (61 years), and 75th percentiles (70 years) of age for illustration but the p-value is calculated using the continuous version of age. For all other variables, the p-value was calculated for variation in relative risk by levels of variable.

Nonetheless, our study suggests that changes in imaging workflow have potential to decrease missed screening mammography among at-risk populations. During the state-mandated shutdown, effort was made to reschedule all patients whose screening mammograms were cancelled by our institution. Possibly due to this focused effort, overall rescheduling rate during state-mandated shutdown exceeded that of pre-COVID-19 period for all patients, including minorities, those with Medicaid, and those with chronic disease(s). Although we do not currently have data to confirm that all rescheduled exams were performed, a more rigorous endeavor to reschedule missed exams may be a small step toward increasing adherence to screening mammogram guidelines. Particularly for underserved groups, efforts could be coupled with culturally sensitive educational outreach and addition of case managers/patient navigators, both of which have been shown to increase screening mammogram utilization in the underserved population [25–28].

Our study also noted that COVID-19 brought higher cancellation rate and lower reschedule rate at our inpatient hospitals compared to outpatient facilities. This finding may reflect patients' preference to distance themselves from areas where COVID-19 patients may be receiving care. This finding can also help guide recuperation initiatives—by realizing patient preferences, resources can be shifted to increase screening availability at outpatient facilities. Furthermore, a change in screening location can be suggested to patients cancelling their exam to encourage rescheduling. This conversation can be combined with other suggested reopening strategies such as pre-imaging COVID-19 symptoms screening, patient instruction on what to expect, and reassurance on measures being followed to limit exposure [29,30].

This study has limitations. Despite including many facility types, this is a single institution study in an urban medical center, and, therefore, the data may not be generalizable to all locations. As data was derived from a scheduling database, data naturally contained cancellations secondary to human error, whether from ordering provider or from scheduling staff. However, as these errors likely occurred at the same rate throughout all three time periods, they should not influence any statistical results when study periods were compared. To preserve

patients' privacy, no identifiable information was included in our dataset; therefore, an analysis accounting for individuals who may have presented in more than one periods of the study was not performed. However, given the large sample size, statistical results and interpretation would likely not be affected. Although data collected on chronic diseases was obtained both from medical record and available registry data, not all chronic medical conditions may have been well documented. In addition, on March 29, 2021, additions were made to the CDC's list of conditions that increases risk of severe COVID-19 illness [31]. These additional chronic conditions were not included in our data collection and analysis because our study time periods were prior to the addition of these conditions. Lastly, as the pandemic is still ongoing, the full impact of COVID-19 on our screening mammography population is still to be determined. Cancellation and rescheduling rates in this study were used as metrics to evaluate the negative impact of COVID-19 on population subgroups, and it is still uncertain what long term harms the delay in screening mammography caused.

In conclusion, the pandemic has resulted in increased risk of missing screening mammogram among older and underserved patients. The effect on ethnic/racial minorities is exacerbated given lower screening mammogram utilization at baseline, tendency to present with later stage disease, and disproportionate number of COVID-19 infection in this subgroup. Amplification of our efforts to reschedule missed screening and strategic allocation of resources combined with approaches tailored to the underserved may be steps toward addressing longstanding inequity.

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