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## Letter

# Recovery of cancer screening tests and possible associated disparities after the first peak of the COVID-19 pandemic

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Following the pandemic onset, a dramatic decrease in the number of cancer screening tests and ensuing diagnoses was observed (Bakouny et al., 2021; Chen et al., 2021; Patt et al., 2020). The consequent delays in diagnosis are expected to result in adverse oncologic outcomes (Hartman et al., 2020; Maringe et al., 2020). It is unknown to what extent screening pathways adapted during the pandemic, enabling the recovery of missed diagnoses.

Although the pandemic has accentuated pre-existing health disparities between socioeconomic and ethnic groups (Lopez et al., 2021; Schmidt et al., 2020), it is unclear whether changes in screening tests may disproportionately impact marginalized communities. This study aims (1) to assess temporal changes in cancer screening tests and diagnoses in the Massachusetts General Brigham (MGB) System, a large health-care system in Northeastern United States, and (2) to evaluate socioeconomic, racial, and ethnic characteristics of patients undergoing screening during COVID-19.

Cancer screening tests and diagnoses were assessed during seven 3-month periods: period 1 (March 2–June 2, 2019), period 2 (June 3–September 2, 2019), period 3 (September 3–November 30, 2019), period 4 (December 1, 2019–March 2, 2020), period 5 (first pandemic peak: March 2–June 2, 2020), period 6 (June 3–September 3, 2020), and period 7 (second pandemic peak: September 4–December 5, 2020). Screening tests

evaluated were mammography, prostate-specific antigen (PSA), colonoscopy, Papanicolaou test, and low-dose CT scan (LDCT). The percent of change in screening tests and diagnoses during pandemic periods compared with period 4 (December 2019–March 2020) was calculated as:  $(N_{\text{period}} - N_{\text{control}})/N_{\text{control}}$ . The Clopper-Pearson method was used to compute the corresponding 95% confidence intervals. Patients were geocoded to five-digit postal code areas. The impact of socioeconomic disadvantages on cancer screening was evaluated through the use of the Area Deprivation Index (ADI). A higher ADI score indicates greater disadvantage. The Neighborhood Atlas (Kind and Buckingham, 2018) was used to determine patients' national ADI percentiles. Pairwise comparisons of gender, age, race, and ADI percentiles between time periods were computed. All analyses were performed using R (v3.6.1). Ethical approval for the study was provided by Brigham and Women's Hospital.

During the assessed time periods, 382,858 patients underwent screening tests, and those patients had a mean age of 59.9 (SD:12.3 years). 58.6% of patients were female and 80.1% were non-Hispanic White. Following a substantial decrease in screening examinations from March to June 2020 ( $n = 15,453$ , compared to 60,344 and 57,502 in periods 1 and 2, respectively), the highest numbers of tests were recorded during period 7 (September–December 2020;  $n = 72,156$ ), surpassing those seen during the pre-pandemic period

(December 2019–March 2020;  $n = 64,269$ ) (Figure S1A). A similar trend was demonstrated in subsequent diagnoses: only 1,985 positive tests were reported during the early pandemic (March–June 2020), compared to 3,476 in period 7 (September–December 2020) and 3,423 from December 2019 to March 2020 (Figure S1A).

Compared to pre-pandemic times (December 2019–March 2020), an increase in tests performed during period 7 (September–December 2020) was identified across all screening types except for colonoscopy; the increases ranged from 2.0% for Papanicolaou test to 24.0% for PSA (Figure S1B). During the same time period, an increase in positive diagnoses was reported across all categories except for colonoscopy, and that increase ranged from 1.0% to 38.0% (Figure S1C). Colonoscopy tests and associated diagnoses during period 7 (September–December 2020) demonstrated a –15.0 and –30.0% decrease, respectively, compared to the pre-pandemic period (December 2019–March 2020). A decrease in the number of screening tests was seen during periods 5 (March–June 2020) and 6 (June–September 2020), ranging from –65.0 to –82.0% and from –4.0 to –44.0%, respectively, depending on screening type (Figure S1B). Assuming that the number of patients screened during each of the pandemic periods would be equal to the average number of patients screened per 3 months based on the four pre-pandemic periods analyzed, 1,187 diagnoses have been “missed”



overall from March to June 2020, while 323 were “recovered” from September to December 2020. For colonoscopy, no diagnoses were “recovered” and 38 positive diagnoses were “missed” across the three pandemic periods analyzed.

When compared to the different periods before the pandemic (periods 1–4), greater socioeconomic disadvantage (higher ADI percentiles) was seen in patients screened from March to June 2020 (period 5) only in relation to period 4 (December 2019–March 2020). A better socioeconomic status (lower ADI percentiles) was seen in patients screened from June to December 2020 (periods 6 and 7), with statistically significant changes compared to each of the four pre-pandemic periods. Looking at the different screening types, this shift in socioeconomic status was seen most importantly in patients undergoing mammography and colonoscopy.

Age variation was modest between the different time periods analyzed across screening categories, with a standardized mean difference ranging between 0.002 and 0.37 for all pairwise comparisons. Additionally, no difference in gender distribution was identified in the pandemic time periods for colonoscopy and LDCT compared to any of the preceding periods.

Significant shifts were observed in the racial distribution of patients undergoing mammography during periods 6 (June–September 2020) and 7 (September–December 2020) as compared to the 3 months before the pandemic, with higher proportions of Non-Hispanic White patients (83.2 and 82.0% versus 79.0%, respectively;  $p < 0.001$ ), and lower proportions of Non-Hispanic Black (5.2 and 5.3% versus 6.3%, respectively;  $p < 0.001$ ) and Hispanic/Latino patients (2.4 and 2.6% versus 3.3%, respectively;  $p < 0.001$ ) (Figure S1D). In absolute terms, these racial disparities were more clearly evidenced by decreased numbers of Non-Hispanic Black and Hispanic patients undergoing mammography during period 7 (September–December 2020) ( $n = 1,774$  and  $n = 867$ , respectively) compared to the 3 months preceding the pandemic ( $n = 1,859$  and  $n = 977$ , respectively), which contrasted with the increase in mammography tests in the whole group of patients. This disparity was further validated by similar significant shifts seen

during periods 6 and 7 compared to other pre-pandemic periods. The racial proportions of patients undergoing screening during the pandemic remained stable for PSA, colonoscopy, Papanicolaou test, and LDCT, as compared to the pre-pandemic periods, with no statistically significant shifts detected.

Following a dramatic decline during the first pandemic peak, we demonstrate a substantial increase in screening procedures during more recent time periods (September–December 2020), with numbers exceeding those seen before the pandemic. Of note, four pre-pandemic periods were included in order to ascertain that increases in screening numbers were due to a rebound rather than to random or seasonal variation occurring in pre-pandemic months. Although this increase will help identify “missed” cancer diagnoses, only modest numbers have been recovered. This could be explained by the relatively short follow-up, as it may be early to see a reflection in increased diagnoses. Colonoscopy was the only modality not to recover above pre-pandemic levels, perhaps reflecting the redistribution of hospital resources and the use of home-based alternatives such as fecal immunochemical testing (FIT) (Issaka and Somsouk, 2020). A better socioeconomic status (ADI) in patients undergoing screening was seen from June to December 2020, more specifically in mammography and colonoscopy, outlining a potential “delayed” effect of the pandemic in socioeconomically disadvantaged populations. We identified racial disparities within mammography testing from June to December 2020, with a significant decrease in the proportions of Black and Hispanic patients. In light of previously established low screening rates in ethnic minorities (Tangka et al., 2017), these findings are concerning and suggest the pandemic may accentuate racial disparities related to cancer screening. Study limitations include restriction to one healthcare system, which limited our ability to capture patients who transitioned care to out-of-network providers, the non-inclusion of home-based alternative tests for cancer screening such as FIT, and the possibility that these findings do not generalize to the entire US population because of the Massachusetts-centric nature of the study. These findings are in line with a

previous study that shows a substantial decrease in screening rates in the Northeastern US following the pandemic onset, with the highest screening deficit seen in mammography and colonoscopy (Chen et al., 2021). Consistently with prior reports (Chen et al., 2021), we also identified colonoscopy as the only screening modality that didn’t fully compensate. Because Massachusetts presents a high insurance rate of 97%, changes in screening tests are unlikely to be related to healthcare access. Although the overall increase in screening examinations is reassuring, the decrease in colonoscopy has yet to compensate. This highlights the importance of home-based alternatives for colon cancer screening in such particular situations. Racial disparities appear to differ between screening procedures, and they are more marked in patients undergoing mammography. Efforts to address these gaps are strongly required to ensure timely and equitable care across the patient population.

#### SUPPLEMENTAL INFORMATION

Supplemental information can be found online at <https://doi.org/10.1016/j.ccell.2021.06.019>.

#### DECLARATION OF INTERESTS

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