

Preventive Cancer Screenings during COVID-19 Pandemic

Document date: May 1, 2020

Purpose: Identify the impact of the COVID-19 pandemic on screening rates for cervical cancer, colon cancer, and breast cancer.

Data: These analyses include 2.7 million patients as of April 25, 2020. Data are pooled from 39 health systems representing 190 hospitals spanning 23 states.

Preliminary Observations: There is some normal year-over-year variation in screening rates for cervical cancer, colon cancer, and breast cancer. However, screening appointments in March 2020 decreased by 86-94% as compared to mean volumes over January 1, 2017 through January 19, 2020. This decrease in preventive care appointments coincides with the occurrence of the COVID-19 pandemic.

Background

On March 13, 2020, a United States national emergency was declared due to COVID-19 (9). Subsequently, the American Cancer Society recommended that no one should go to a healthcare facility for routine (non-diagnostic) cancer screening until further notification (2). Other societies such as The American Society of Breast Surgeons, the American College of Radiology, and the American Society for Colposcopy and Cervical Pathology issued similar recommendations (6,7). These societies advised patients to postpone regular cancer screening and prioritize rescheduling screening tests when healthcare facilities resume screening (2).

Screening tests for specific types of cancers can help to identify these cancers in earlier stages before signs or symptoms appear. Earlier treatment can reduce the number of people who die from these cancers in many cases. The U.S. Preventive Services Task Force recommends regular screening for cervical, breast, and colon cancers (1). Current recommendations are for biennial screenings for breast cancer with mammography for women aged 50-74 years and estimates that repeat screening results in up to 122-152 life years gained per 1,000 women screened (3). USPSTF also recommend screening for colorectal cancer at regular intervals. Regularly scheduled colon cancer screening with stool-based tests and/or direct visualization results in 181-275 life-years gained per 1,000 persons screened (4). For cervical cancer screening, over 64,000 life-years are gained per 1000 women screened every 5 years with hrHPV alone or combined with cervical cytology (5).

This paper examines the effect of the COVID-19 pandemic on the overall screening rates for these three cancer types in the United States.

Methods

Data Acquisition

A limited data set for this analysis was aggregated from longitudinal electronic medical records at 39 health systems representing 190 hospitals spanning 23 states. The sample for this analysis includes aggregated data for 2.7 million patients who had at least one encounter in each of the years 2017, 2018 and 2019.

Classifications

Patients were considered to have received a colon cancer screening on a date if they had an encounter that day with a diagnosis of colon cancer screening (SNOMED CT code 275978004 or ICD-10-CM code Z12.11). Patients were similarly identified as having received a cervical cancer screening on a date if the encounter had a cervical cancer screening diagnosis (SNOMED CT code 171149006 or ICD-10-CM code Z12.4). For breast cancer screenings, we considered patients with either an encounter with a breast cancer screening diagnosis (SNOMED CT code 268547008 or ICD-10-CM code Z12.31) or a related procedure on that date (LOINC code 24606-2 or one of SNOMED CT codes 24623002 and 384151000119104). We did not consider encounters or procedures for diagnostic cancer care.

The daily totals for each screening type spanning the time period from January 1, 2017 through April 21, 2020 were considered. Daily data was aggregated by week, with a week defined as starting on a Monday. This avoided weekly seasonality and smoothed day-to-day variation. Despite these benefits, a disadvantage of aggregating weekly data is

that there were incomplete weeks with fewer than 7 days on either end of the time series. We removed these weeks from the dataset. Week number was calculated by year, starting with 1 on the first Monday of each year. A potential disadvantage of this approach is that the number of observations per year is not constant.

We generated standard time series plots of each weekly screening volume against the Monday date on which the week started. We also generated overlaid plots by plotting the same volumes against week number in year. These plots help assess year-to-year variability and compare the COVID-19 related reduction in volume against it.

To forecast the expected number of screenings in the period after January 19, 2020, we fit a GAM (generalized additive model) to weekly screening volume with the prophet package in R 3.5.3 (6). We used 7 Fourier terms for the yearly seasonality and accounted for US holidays. The model was fitted to all the data up to January 19, 2020 (the day before the first reported COVID-19 case in the US (10)). Forecasts were obtained for January 20, 2020 through April 21, 2020, the end of our time series.

Results

The average number of patients screened per week throughout our study dates was 8,839 (SD 1816) for breast cancer, 2,895 (SD 617) for colon cancer, and 1,077 (SD 231) for cervical cancer. We get a more accurate baseline if we exclude the observations (and associated decrease in screenings) since the first US COVID-19 case was reported on January 20, 2020. The corresponding averages and SDs are 9054 (SD 1393), 2946 (SD 514), and 1091 (SD 186), respectively.

As seen in Figure 1, the weekly volumes show a slight upward trend, with increased variability at the end of each year. There are also yearly patterns related to United States holidays. For breast cancer, there is an increase in volume in November and December following Breast Cancer Awareness Month in October. The final observed weekly volumes for breast (559), colon (402), and cervical cancer (66) represent drops of 94%, 86%, and 94% respectively relative to averages prior to January 20, 2020.

Cancer Screenings in the U.S.

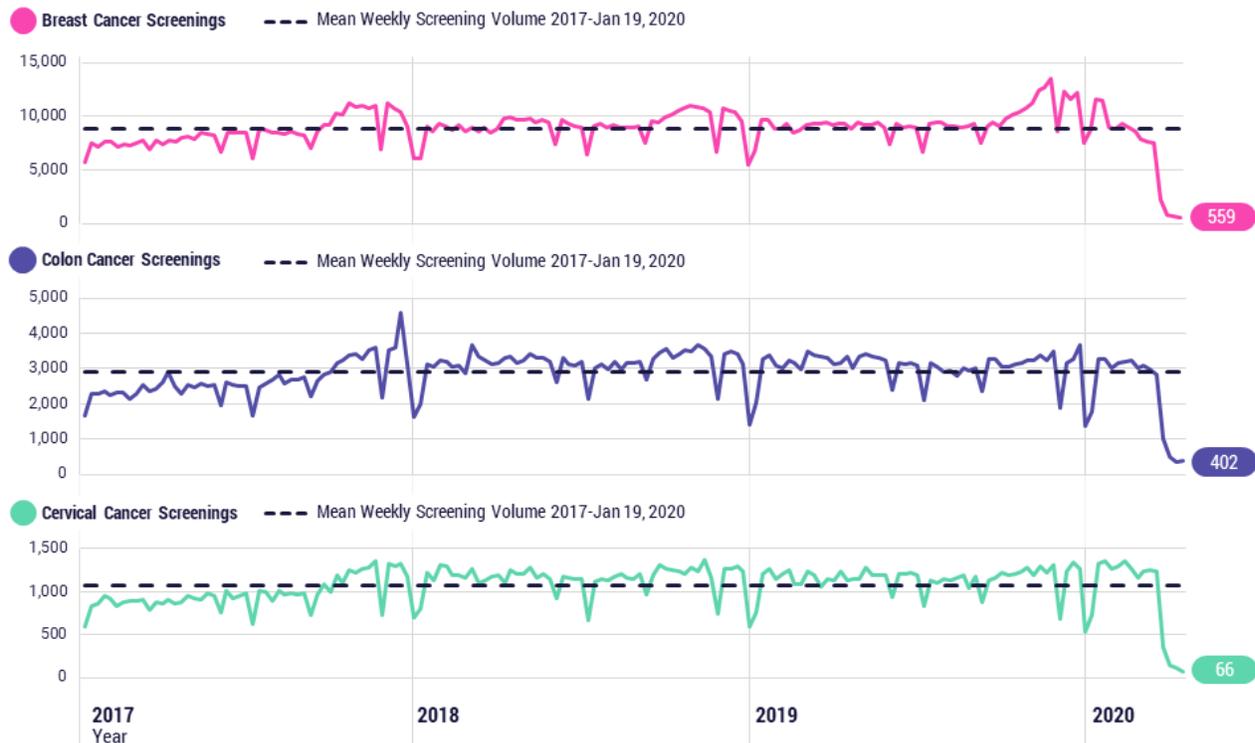


Figure 1. Weekly cancer screening volume vs. time for each type of cancer screening. Colored capsules show the last observed volume.

In figure 2 the cancer screening volumes for years 2017, 2018, 2019, and through April 21, 2020 are plotted, which provides a visual estimate of the typical variability expected in cancer screening volumes. In figures 1 & 2, the most prominent feature is the gradual and then accelerated reduction in screening volumes since approximately mid-February.

Cancer Screenings in the U.S.

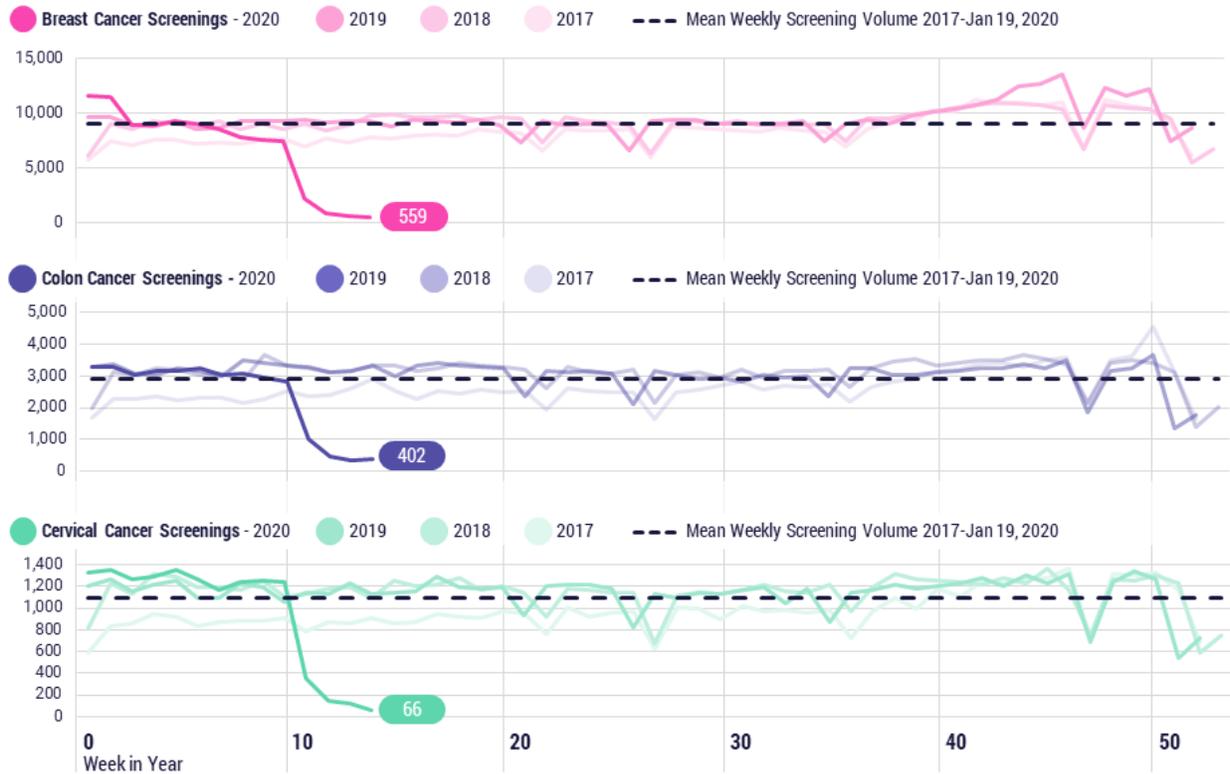


Figure 2. Weekly cancer screening volume vs. week in year for each kind of cancer screening. (11)

Figure 3 shows the observed volumes, the fitted GAM estimates and their uncertainty intervals up to April 19, 2020. It also shows the observed volumes and those forecasted by the GAM beginning with January 20, 2020. Since over 90% of the observations lie within the uncertainty intervals of the GAM model, it captures the long term, seasonal, and holiday components of each screening type. It is not unusual for isolated observations to fall outside the uncertainty bands. We anticipated the prediction bands would not capture the observed volumes. In fact, we can see that the drop in volume due to the pandemic is significantly outside of any normal variation as shown by the prediction of the GAM.

Cancer Screenings in the U.S.



Figure 3. Weekly cancer screening volumes (colored dots) vs. time. Colored line segments indicate fitted estimates from GAM model, combining long term trend, yearly seasonal, and holiday effects; beyond January 19, 2020, they represent forecasts. Lighter colored areas show the uncertainty intervals. Black segments show observed volumes after January 20, 2020.

Discussion

Preventive cancer screening for breast cancer, colon cancer, and cervical cancer follow expected spikes and dips on a yearly basis around the US. However, in March 2020, we saw a pronounced drop in screening rates for breast, colon, and cervical cancers, which we attribute to a halt in screening secondary to the COVID-19 pandemic. Screening rates for these three cancer types fell as much as 94% from their average for this time of year.

If the trend continues and centers are not able to resume testing, cancer cases could go undiagnosed for prolonged periods of time which may lead to tumor detection at a later stage. Although patients and hospital systems are advised to reschedule their preventive services as soon as possible (2), the full impact of this delay in regular screening has yet to be seen. Life years lost from delayed screening may be compared to life years gained from COVID precautions with future research.

Limitations to study and models include assumptions that health systems' testing capacities (facilities, policies, and practices) and patient populations were relatively stable.

References

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11. An earlier version of Figure 2 accidentally omitted week 1 data for 2019 breast cancer screenings, which caused all subsequent values to be shifted.

Document Date:	2020-May-1
Data Date:	2020-Apr-25

Check for [updates](#) at <https://www.ehrn.org/wp-content/uploads/Preventive-Cancer-Screenings-during-COVID-19-Pandemic.pdf>