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Cancer Evaluations During the COVID-19 Pandemic: An Observational Study Using National Veterans Affairs Data

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Introduction: Fewer cancer diagnoses have been made during the COVID-19 pandemic. Pandemic-related delays in cancer diagnosis could occur from limited access to care or patient evaluation delays (e.g., delayed testing after abnormal results). Follow-up of abnormal test results warranting evaluation for cancer was examined before and during the pandemic.

Methods: Electronic trigger algorithms were applied to the Department of Veterans Affairs electronic health record data to assess follow-up of abnormal test results before (March 10, 2019–March 7, 2020) and during (March 8, 2020–March 6, 2021) the pandemic.

Results: Electronic triggers were applied to 8,021,406 veterans' electronic health records to identify follow-up delays for abnormal results warranting evaluation for 5 cancers: bladder (urinalysis with high-grade hematuria), breast (abnormal mammograms), colorectal (positive fecal occult blood tests/fecal immunochemical tests or results consistent with iron deficiency anemia), liver (elevated alpha-fetoprotein), and lung (chest imaging suggestive of malignancy) cancers. Between prepandemic and pandemic periods, test quantities decreased by 12.6%–27.8%, and proportions of abnormal results lacking follow-up decreased for urinalyses (–0.8%), increased for fecal occult blood tests/fecal immunochemical test (+2.3%) and chest imaging (+1.8%), and remained constant for others. Follow-up times decreased for most tests; however, control charts suggested increased delays at 2 stages: early (pandemic beginning) for urinalyses, mammograms, fecal occult blood tests/fecal immunochemical test, iron deficiency anemia, and chest imaging and late (30–45 weeks into pandemic) for mammograms, fecal occult blood tests/fecal immunochemical test, and iron deficiency anemia.

Conclusions: Although early pandemic delays in follow-up may have led to reduced cancer rates, the significant decrease in tests performed is likely a large driver of these reductions. Future emergency preparedness efforts should bolster essential follow-up and testing procedures to facilitate timely cancer diagnosis.

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INTRODUCTION

Reductions in both early and overall new cancer diagnoses have been found during the coronavirus disease 2019 (COVID-19) pandemic.¹ Because cancer rates are unlikely to have changed, these findings suggest increased numbers of patients experiencing delayed cancer diagnoses.² Some decreases in cancer diagnoses may derive from reductions in

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healthcare services observed during the pandemic for everything from routine preventive care, such as screening,^{3–5} to treatment for more serious medical issues, including chemotherapy and surgery.^{6,7} However, one hypothesis is that the pandemic also impacted cancer diagnosis by reducing the timeliness of follow-up of abnormal test results that warrant evaluation for cancer. To examine this hypothesis, national data from the Department of Veterans Affairs (VA) was leveraged to compare delays in follow-up of abnormal test results before and during the first year of the COVID-19 pandemic. To measure these delays, recently developed metrics that employ electronic triggers (e-triggers) were used to estimate the frequency of missed follow-ups of abnormal tests.

METHODS

Study Sample

National electronic health record (EHR) data from VA's data warehouse were used to assess follow-up care received by veterans throughout the U.S. before and during the COVID-19 pandemic. Although the VA population is predominantly male and has more comorbidities than the general population,⁸ the VA is a relatively closed system (about one third of VA veterans also use community care),⁹ providing a fairly accurate perspective on the care received by a large cohort of patients. The WHO's pandemic declaration date¹⁰ was used to delineate 1 year each of prepandemic and pandemic data (March 10, 2019–March 7, 2020 and March 8, 2020–March 6, 2021, respectively). This study had VA IRB approval with exempted informed consent.

Measures

Previously developed and validated e-trigger algorithms, which scan vast amounts of clinical data from the EHR to identify patients with potential safety events were used.¹¹ E-triggers used in this study identified abnormal test results (i.e., red flags) that warrant diagnostic evaluation for 5 cancers, including bladder (urinalysis with high-grade hematuria), breast (abnormal mammograms), colorectal (positive fecal occult blood tests/fecal immunochemical tests [FOBTs/FITs] or results consistent with iron deficiency anemia [IDA]), liver (elevated alpha-fetoprotein), and lung (chest imaging suggestive of malignancy) cancers.^{12–15}

Follow-up action was identified using Current Procedural Terminology codes or appropriate follow-up appointments and considered delayed after 60 days, except for mammograms with Breast Imaging-Reporting and Data System 3 and chest imaging (where action after 7 months and 30 days was considered delayed, respectively). Appropriate follow-up actions (e.g., specialist visit or biopsy) and delay cut offs were determined by literature review and expert consensus. E-trigger development, validation, and detailed criteria are described elsewhere.^{11–15} Outcome measures for each time period included overall test quantity, abnormal test results quantity, the proportion of abnormal test results lacking appropriate and timely follow-up, and time (days) to follow-up.

Statistical Analysis

Prepandemic versus pandemic data were compared for each test type, including overall and abnormal test result quantities using descriptive statistics, proportions of abnormal test results with delayed follow-up using tests of proportions, and times to follow-up using Kaplan–Meier survival analyses. Multiple comparisons were controlled for using family-wise Bonferroni adjustments (each analysis type was treated as 1 family, resulting in significance levels of $p < 0.05/6 = 0.0083$). Statistical process control charts were used to examine whether the pandemic resulted in significant increases in delayed follow-up proportions at particular points throughout the study period (March 10, 2019–March 6, 2021). *Significant increases* were defined as data points exceeding upper control limits of 3 SDs above the mean. Analyses were conducted using StataMP 15.

RESULTS

E-triggers were applied to 8,021,406 veterans' EHRs. Between prepandemic and pandemic periods, overall test quantities decreased by 12.6%–27.8% depending on test type, and the number of tests with abnormal results decreased by 12.5%–22.6% depending on test type (Table 1). The proportions of abnormal test results lacking follow-up decreased from the prepandemic to the pandemic period for urinalyses (–0.8%, $p < 0.001$), increased for FOBT/FIT (+2.3%, $p < 0.001$) and chest imaging (+1.8%, $p < 0.001$), and remained constant for others (Table 1). Survival analyses showed that the median time to follow-up of abnormal test results decreased significantly during the pandemic for all cancer-related test types examined, except for alpha-fetoprotein (Table 1). Control charts suggested significant increases in the proportions of tests with delayed follow-up at 2 stages: early (around the transition from prepandemic to pandemic periods) for urinalyses, mammograms, FOBTs/FITs, laboratory results consistent with IDA, and chest imaging and late (30–45 weeks into the pandemic) for mammograms, FOBTs/FITs, and laboratory results consistent with IDA (Figure 1).

DISCUSSION

Compared with prepandemic levels, the numbers of tests performed and resultant abnormal test results warranting additional testing for the 5 cancers studied were significantly reduced during the COVID-19 pandemic. However, follow-up of such results was similar except for brief periods around the beginning of the pandemic and around 30–45 weeks. This suggests that tracking of such results was not a primary issue. These findings further suggest that imminent increases in late-stage diagnoses of cancers might be expected. It is thus imperative for healthcare organizations to quickly initiate outreach to patients needing evaluation to prevent collateral damage from undiagnosed conditions, such as cancer.

Table 1. Test Quantities and Follow-Up for Abnormal Results Warranting Evaluation for Cancer Before and During COVID-19

Test type (potential cancer)	Number of overall tests			Number of tests with abnormal results			Proportion of abnormal results without follow-up			Median time to follow-up (days)		
	Prepandemic ^a	Pandemic ^b	Difference, %	Prepandemic	Pandemic	Difference, %	Prepandemic, %	Pandemic, %	Difference, %	Prepandemic	Pandemic	Significance of difference (p-value)
Urinalysis (bladder)	7,048,552	5,088,865	-27.8	133,566	106,558	-20.2	8.7	7.9	-0.8	140	119	<0.001
Mammogram (breast)	237,943	200,019	-15.9	34,425	29,578	-14.1	19.7	19.4	-0.3	116	99	<0.001
Fecal occult blood tests or fecal immunochemical tests (colorectal)	479,493	419,297	-12.6	50,069	43,787	-12.5	31.4	33.7	2.3	111	106	<0.001
Laboratory results consistent with iron deficiency anemia (colorectal)	11,580,170	8,905,037	-23.1	158,637	122,807	-22.6	22.6	22.3	-0.3	149	131	<0.001
Alpha-fetoprotein (liver)	130,371	101,649	-22.0	7,844	6,073	-22.6	3.1	3.4	0.3	111	93	0.02
Chest imaging (lung)	2,082,428	1,566,687	-24.8	49,258	38,131	-22.6	33.0	34.8	1.8	98	93	<0.001

Note: Boldface indicates statistical significance after family-wise Bonferroni adjustment (each column of significance tests is treated as 1 family, resulting in a significance level of $p < 0.05/6$ or $p < 0.0083$).

^aPrepandemic: March 10, 2019–March 7, 2020.

^bPandemic: March 8, 2020–March 6, 2021.

Furthermore, because it remains uncertain how long the pandemic will continue or what future national or international health crises await, organizations should take action to ensure that essential follow-up and testing procedures are reliably maintained. This could include patient-directed campaigns to highlight the importance of avoiding postponing essential evaluations.

Lack of follow-up of abnormal test results had a biphasic pattern during the pandemic. Although delayed follow-up was expected early in the pandemic because of diverted attention and overburdened systems,¹⁶ the later period of delayed follow-up suggests increased strain on healthcare services as patients reentered the healthcare system. Moreover, contrary to expectations, time to follow-up decreased between these early and late peaks, resulting in an overall decreased median time to follow-up. This could relate to increased availability of diagnostic testing between these 2 peaks because of low demand.

This study’s findings are consistent with reports that cancer rates have dropped by 13%–23% in the same population in a similar timeframe.^{17,18} These findings also show how national EHR data and algorithms to detect care gaps can elucidate temporal impacts of the pandemic on care, including collateral care processes.¹⁹

Limitations

This study is limited by the pre-versus post-study design and an inability to directly assess causal effects of the COVID-19 pandemic on test result follow-up. In addition, this study is limited by the use of e-triggers that have inherent limitations (e.g., e-trigger positive predictive values ranged from 56% to 82%^{12–15}). Furthermore, VA is a relatively closed system, and these findings may not generalize to other healthcare systems. In addition, the biphasic delays were interpreted posthoc, and future work is needed to confirm their significance. Finally, the use of WHO’s pandemic declaration date may not exactly correspond to changes in clinical care. Nonetheless, a sensitivity analysis conducted in which each period started and ended 2 weeks earlier showed no substantive changes from these findings.

CONCLUSIONS

Diagnostic testing was significantly impacted by the COVID-19 pandemic, potentially leading to reductions in both early and overall new cancer diagnoses and resulting in increases in delayed cancer diagnoses. Although early pandemic delays in follow-up of abnormal test results warranting evaluation for cancer may have led to some reduction in some of these cancer

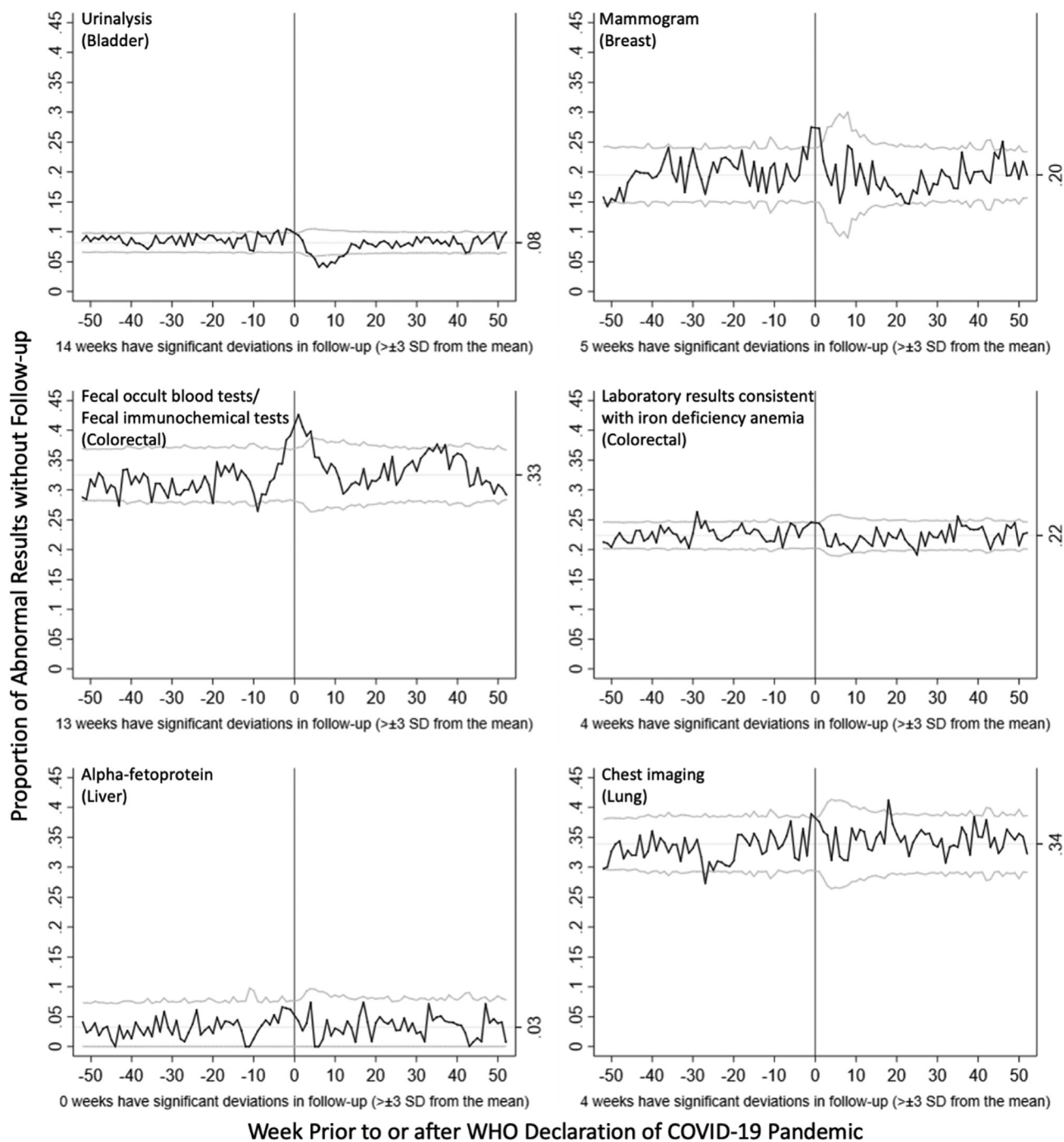


Figure 1. For test results that warrant further evaluation for cancer, control charts show significant deviations in the proportions lacking follow-up before and during the COVID-19 pandemic. Note: Black lines indicate the proportions of tests with delayed follow-up over time. Gray lines represent the upper and lower control limits, which are shown without stabilization (i.e., limits change as the sample size at each point changes). The vertical line at 0 of each x-axis indicates the transition from prepandemic to pandemic periods.

diagnoses, the significant decrease in overall tests performed is likely a larger driver. Future emergency preparedness efforts should bolster essential follow-up and testing procedures to facilitate timely cancer diagnosis.

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CREDIT AUTHOR STATEMENT

Ashley N.D. Meyer: Conceptualization, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing - original draft. Hardeep Singh: Funding acquisition, Resources, Supervision, Writing - review and editing. Andrew J. Zimolzak: Conceptualization, Methodology, Validation. Li Wei: Data curation, Investigation, Software, Validation. Debra T. Choi: Conceptualization, Methodology. Abigail Marinez: Project administration. Daniel R. Murphy: Conceptualization, Methodology, Supervision, Validation, Writing - review and editing.

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