COVID Impact on Physician EHR Workload: A Hidden Epidemic?

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ABSTRACT

OBJECTIVE: To examine whether electronic health record (EHR) workload for primary care and other physicians was associated with increases in COVID-19 cases by region of the United States (US).

MATERIALS & METHODS: Retrospective data analysis of Epic EHR workload measures for almost 500,000 outpatient physicians and other physicians across the US from May 2019 to May 2022.

RESULTS: The association of COVID-19 disease rates on time in the EHR varied by specialty. For primary care physicians, increases in regional disease prevalence were associated with significant increases in the time spent in the In Basket as well as "pajama time" (time outside of scheduled work hours); for other specialties, increases in COVID rates were associated with smaller increases in In Basket time and some region-specific decreases in pajama time. For all participants, regardless of specialty, overall EHR workload increased over the course of the pandemic.

DISCUSSION: Increases in COVID-19 cases were associated with increased EHR workload for outpatient physicians across the US, with the greatest impact on primary care physicians performing asynchronous patient care tasks. These findings capture the experience of almost half a million physicians and illuminate how mitigating burnout from a global pandemic likely also extends to efforts to reduce EHR workload.

CONCLUSION: Our results show direct impacts of COVID-19 rates on physician workloads, particularly in primary care, and can hopefully inform future efforts to manage workload should another pandemic occur.

KEYWORDS: physician workload; electronic health record; COVID-19; primary care; burnout

BACKGROUND AND SIGNIFICANCE

Healthcare workers faced numerous and diverse challenges during the SARS-CoV-2 (COVID) global pandemic. As the world endured changing information, new fears, novel restrictions, and daily frustrations, physicians also navigated limited resources, evolving science, and anxiety about exposure, among many other concerns.[1,2] In a remarkably short time, many, if not most, health systems either implemented or significantly expanded telehealth offerings.[3] This rapid transformation from in-person care to virtual care allowed physicians to continue ministering to their patients during periods of stay-at-home orders and ongoing needs for physical distancing. As parts of the healthcare system shifted to virtual visits and asynchronous care, an unexpected burden arose in the form of the electronic health record (EHR).[4]

Health systems and EHR vendors made significant efforts to expand the use of patient portals, which were in many cases under-utilized prior to the pandemic.[5] With the shift away from the traditional model of in-person periodic visits, some encounters were replaced by telehealth directly, and many additional elements of patient care, such as blood pressure and diabetes management, started to be managed asynchronously.[3] This shift, and the resulting volume of work, often coming in the form of messages in the EHR inbox, has been implicated as one of the drivers of physician burnout both during the pandemic and in the time since the US public health emergency ended.[6-9] Prior work has identified the impact of pandemic-related stress on the intent of physicians to either reduce work hours or leave practice completely.[10]

Even outside of the effects of the COVID pandemic, a growing body of literature has explored variations in the time that different physicians spend on discrete EHR tasks, including documentation and responding to patient messages, as well as the impact of EHRs on physician well-being.[11-19] Outpatient physicians now spend a majority of their scheduled patient care time in the EHR, in addition to the hours they log in the EHR outside of clinic. Primary care physicians are especially hard hit, spending 50% more time in their inbox compared to physicians in other outpatient specialties.[16] Given the impact of EHRs on physicians, some healthcare organizations have made efforts to improve efficiency and decrease the time burden of documentation.[11,13,20] For example, the adoption of team-based documentation may reduce time spent writing notes, but only for the highest-intensity adopters.[11] Use of transcription or dictation may also reduce note-writing burden.[18] Unfortunately, other EHR "efficiency tools" like templates and copy/paste have not been shown to consistently foster efficiency or reduce documentation time and likely also contribute to note bloat.[11,12,14,18]

To date, few studies have explored the impact of disease surges on specific EHR workload elements across the country; rather, they have focused on a single region or healthcare system, have examined only patient calls and messages, or have compared pre- and post-pandemic values in aggregate without incorporating disease prevalence.[3,5,9,21-25] We sought to explore the impact of the COVID pandemic on EHR workload volume in a large national sample to better understand the impact of the pandemic on primary care and other medical specialties.

We hypothesized that increases in COVID prevalence by region would be associated with significant increases in EHR workload metrics, particularly time in EHR system, time spent in In Basket, "pajama time," and time spent in clinical review. We worked with EPIC to obtain aggregated and de-identified EHR use data for almost 500,000 physicians across the US from 2019 to 2022. Our hope is that by better understanding the association between weekly disease rates and EHR workload that we can better prepare to support the healthcare workforce in the future.

MATERIALS AND METHODS

Study Design and Data

To examine the effect of weekly COVID-19 rates on our EHR-specific workload measures, we employed longitudinal regression models with region and physician specialty fixed effects. This analysis used retrospective user-level EHR data from the Epic data warehouse, spanning from May 2019 to May 2022. EHR systems, including EPIC Systems Inc. (Verona, WI), collect a significant amount of data regarding use of the system and the volume of various tasks and other elements that are managed by a variety of practitioners. These data include information on physicians' practicing region, specialty, appointment volume, and time spent in various activities and functions within the EHR. We included data prior to COVID onset to establish baseline EHR use patterns. The Epic workload data was available for monthly time periods from May 2019 to April 2021 and for weekly time periods from May 2021 to May 2022.

From the Centers for Disease Control and Prevention, we received weekly data on the number of new COVID cases.[26] From the United States Census, we received population statistics to calculate COVID rates per 100,000 people.[27] In the analytic dataset, we matched the weekly COVID rates to the weekly EHR workload data, when available. When only monthly Epic workload data was available, we held the workload variables constant across the weeks in each month. We excluded March-April 2020 from the regression analysis because adoption of telehealth into the EHR varied between systems and in some cases the public health emergency allowed for documentation in other systems or even on paper.[21]

Cohort

Physicians included in this cohort were aligned to a facility using Epic as their EHR. Physicians came from 42 states; Washington, D.C. was not included. Though all individuals were classified as physicians, we are aware that many institutions give this role within the EHR to other clinical roles that are purely independent, including podiatrists and optometrists. We suspect that due to the large number of physicians included that these small number of additional clinical roles will have minimal impact on our findings. These states were grouped into eight regions based on census-designations, with slight adjustments based on data size and availability, as detailed in **Table 1**, along with

Table 1. Sample characteristics (N=470,731 physicians)

	Frequency	Percent	Mean	Median
Specialty				
Primary care	127,248	27.0%	—	—
Medicine subspecialty	70,527	15.0%	—	—
Surgery	77,073	16.4%	—	—
Other	109,250	23.2%	—	—
Unknown	86,633	18.4%	—	—
Regions[†]				
Northeast	106,327	22.6%	—	—
Midwest: East North Central	79,128	16.8%	—	—
Midwest: West North Central	17,326	3.7%	—	—
South Atlantic	61,598	13.1%	—	—
South Central	58,543	12.4%	—	—
Mountain	15,372	3.3%	—	—
Pacific: Subset	33,899	7.2%	—	—
Pacific: California	98,538	20.9%	—	—
COVID Rate per 100,000	—	—	156.9	69.6
Appointments per Day	—	—	8.9	7.3
Time in System per Day[‡]	—	—	110.0	97.1
Time in Orders per Day[‡]	—	—	45.4	37.0
Time in In Basket per Day[‡]	—	—	12.1	7.7
Time in Clinical Review per Day[‡]	—	—	18.3	14.8
Pajama Time per Day[‡,§]	—	—	25.1	9.3

[†] Regions are comprised of the following states:
Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island
Midwest: East North Central: Illinois, Indiana, Michigan, Ohio, Wisconsin
Midwest: West North Central: Iowa, Kansas, Minnesota, Missouri, Nebraska, Oklahoma
South Atlantic: Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia
South Central: Alabama, Arkansas, Louisiana, Kentucky, Mississippi, Tennessee, Texas
Mountain: Arizona, Colorado, Nevada, Utah, Wyoming
Pacific: Subset: Hawaii, Oregon, Washington
Pacific: California: California
[‡] Each time metric was calculated in the Epic system as the number of minutes divided by the total number of days that the physicians logged in during the reporting period.
[§] Pajama time is defined as minutes spent in the EHR outside of weekdays between 7 a.m and 5:30 p.m. or outside scheduled hours on weekends or non-scheduled holidays.

participants' other demographic characteristics. Physicians are divided into five mutually exclusive specialty groups (Primary Care, Medicine Subspecialty, Surgery, Other, and Unknown). Though the unknown group is difficult to determine, the Other group included specific roles such as neurology and behavioral health specialties, meaning that it is very unlikely that primary care physicians were inadvertently included in this group. We excluded non-outpatient and non-physician specialties (e.g., dentistry) from the dataset. These specialties included: speech language pathology, dentistry, emergency medicine, diet and nutrition, radiology, pharmacology, podiatry, optometry, hospital medicine, intensive care medicine, genetics, pathology, and lab.

Outcomes and Covariates

Statistical analysis focused on EHR-specific outcomes calculated at the weekly level, chosen due to their direct relevance to physician workload and potential burnout. Each outcome can be described as the average time spent within the EHR by an individual practitioner. Outcomes included minutes spent in In Basket (e.g., reviewing or acting on results and messages), minutes spent in Clinical Review (such as reviewing the patient's chart prior to an appointment), minutes spent in System (i.e., total time a physician is actively logged into their EHR), minutes spent in orders, and pajama time (minutes spent in the EHR outside of weekdays between 7 a.m. and 5:30 p.m. or outside scheduled hours on weekends or non-scheduled holidays).

Each outcome was calculated in the Epic system as the number of minutes divided by the total number of days that the physician logged in during the reporting period. Data for two of these outcomes were only available for the last two years of the study period: data for pajama time started in July 2020 and data for time spent in orders started in November 2020. In all analyses, we controlled for a physician's workload by including their appointments per day.

Statistical Analysis

The analysis used longitudinal-data linear regression models with physician specialty and time-fixed effects (10). These models are stratified by region, and statistical analyses were conducted at the person-week level. Statistical significance is determined at the 99% level. The general specification of the model can be seen in the following equation:

$$yiws = \beta 0 + \beta 1 Ratew + \beta 2 Xiw + \gamma w + \zeta s + \varepsilon iws.$$

Here, y_{ijws} is an outcome experienced by an individual i working during week w belonging to specialty s. In each of the regressions, the primary explanatory variable ($Rate_w$) indicates the rate of new COVID cases per 100,000 people during week w in the region of interest. X_{iw} represents the average number of daily appointments for individual i during week w. The γ_w represents week fixed effects, and ζ_s represents physician specialty fixed effects. Analyses were performed using STATA MP 11.2 (College Station, TX). Regression models exclude observations where the outcome variable is equal to zero.

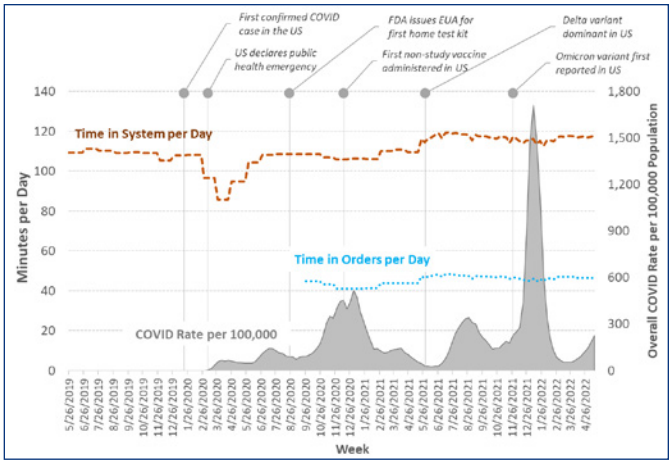
This study used de-identified data (both at the individual physician level and the health system level) and was approved by the Lifespan Health System Institutional Review Board.

RESULTS

Table 1 displays the demographics of our study sample. Primary care physicians comprise the largest portion of our sample, followed by physicians with other or unknown specialties. Regionally, the Northeast contains the most physicians, followed by California. **Table 1** also shows the average COVID rate, the mean appointments per day per physician, and the average time within various EHR work elements. The mean total time in Epic is 110 minutes per day, with more than half of this time being spent in Orders and Clinical Review.

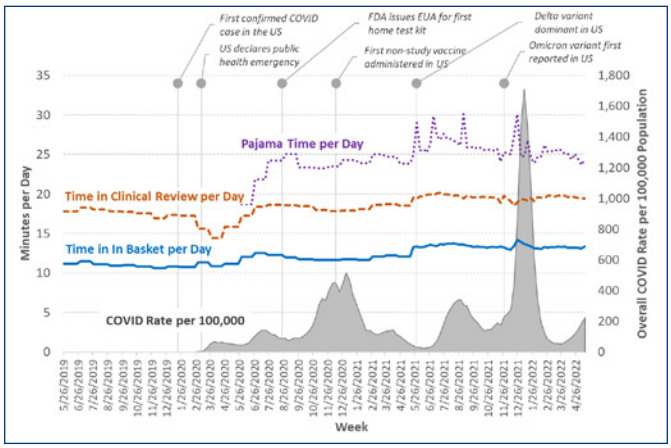
Figure 1 depicts how the average overall time spent in the EHR (Time in System) and the Time in Orders changed in relation to the aggregate mean COVID rate. Time in System decreased in March of 2020, but rebounded after a couple months, with an increase noted in May of 2021, when the EHR workload data in our dataset switched from monthly to weekly time periods. Time in Orders remained relatively consistent until May of 2021, when it also increased.

Figure 1. COVID rates vs. overall time in the system and time in orders —all regions combined



These observations hold for the outcomes depicted in **Figure 2**, which displays time in Clinical Review, time In Basket, and Pajama Time, which measures time spent in the EHR outside of scheduled working hours. Among these variables, Pajama Time in particular increased from May through August of 2020, and continued to increase through the end of the study period.

Figure 2. COVID rates vs. time spent in clinical review, time spent in in-basket, and pajama time—all regions combined



Tables 2 and **3** display regression estimates for Time in System and Time in In Basket, respectively. Primary care physicians serve as the reference group for the by-specialty interaction estimates, and the specialty coefficients have already been transformed in reference to primary care physicians. Time in System [**Table 2**] varied by specialty and by region. Within the Northeast, for example, an increase in the COVID rate of 1 per 100,000 people was associated with a 0.0012 minute per day decrease in time in the system for primary care physicians. Medicine sub-specialists observed a 0.0005 minute per day increase in time in system, and surgeons observed a –0.0001 minute per day decrease. In the Western Midwest, however, that same increase in COVID rate corresponded with a 0.0014 minute per day increase in time spent in the EHR system for primary care physicians, and 0.0001 and 0.0006 minute per day increases for Medicine subspecialists and surgeons, respectively.

Table 2. Time Spent in System (minutes per day) May 2020–May 2022

Coefficients	Northeast	Midwest East	Midwest West	South Atlantic	South Central	Mountain	Pacific Subset	California
COVID Rate (per 100,000)	–0.0012	0.0001‡	0.0014	–0.0010	–0.0002	–0.0024	0.0016	0.0002
COVID Rate * Specialty								
Primary care	ref	ref	ref	ref	ref	ref	ref	ref
Medicine subspecialty	0.0005	0.0016	0.0001	0.0003	0.0008	0.0008	0.0046	–0.0012
Surgery	–0.0001	0.0014	0.0006	0.0004	0.0007	0.0012	0.0022‡	–0.0011
Other	–0.0011‡	–0.0002‡	–0.0008	–0.0014	0.0004	0.0004	–0.0007	–0.0017
Unknown	–0.0034	–0.0021	–0.0009	–0.0030	–0.0021	–0.0013	0.0009‡	–0.0014
Appointments per day	2.401	3.675	3.508	2.937	3.093	3.724	2.778	0.006
Constant	87.339	74.935	76.022	78.892	76.250	81.269	99.328	0.061

Abbreviations: Midwest East = Midwest's East North Central division; Midwest West = Midwest's West North Central division; Pacific Subset = Hawaii, Oregon, and Washington.
‡ Indicates p-values >0.01. All other coefficients were significant at p<0.01.

Table 3. Time Spent in In Basket (minutes per day) May 2020–May 2022

Coefficients	Northeast	Midwest East	Midwest West	South Atlantic	South Central	Mountain	Pacific Subset	California
COVID Rate (per 100,000)	0.0019	0.0029	0.0030	0.0020	0.0022	0.0010	0.0037	0.0000
COVID Rate * Specialty								
Primary care	ref	ref	ref	ref	ref	ref	ref	ref
Medicine subspecialty	0.0010	0.0013	0.0010	0.0012	0.0009	0.0009‡	0.0019	-0.0018
Surgery	0.0006	0.0008	0.0006	0.0005	0.0004	0.0006	0.0012	-0.0023
Other	0.0005	0.0006	0.0006	0.0004	0.0005	0.0010‡	0.0011	-0.0022
Unknown	0.0009	0.0019	0.0020	0.0013	0.0014	0.0009‡	0.0031	-0.0017
Appointments per day	0.093	0.155	0.161	0.125	0.120	0.109	0.107	0.001
Constant	10.519	9.509	10.484	9.035	9.355	11.555	12.755	0.012

Abbreviations: Midwest East = Midwest's East North Central division; Midwest West = Midwest's West North Central division; Pacific Subset = Hawaii, Oregon, and Washington.
‡ Indicates p-values >0.01. All other coefficients were significant at p<0.01.

Results for time spent in In Basket [**Table 3**] were more uniform across regions and specialties. Within the Northeast for example, an increase in COVID rate of 1 per 100,000 people corresponded with a 0.0019 minute increase in time in In Basket for primary care physicians a 0.0010 increase for Medicine subspecialists, and a 0.0006 increase for surgeons. This pattern held across regions with the exception of California.

Supplemental tables

[Note: Supplemental tables are available by emailing corresponding author.]

Results for our other three outcomes (time in clinical review, pajama time, and time in orders) can be found in the supplement [**Tables S.1–S.3**]. Generally, increases in the COVID rate were associated with modest increases in time spent in clinical review, with a few region-specific exceptions for primary care physicians [**Table S.1**]. Increases in the COVID rate were associated with increases in Pajama Time for primary care physicians but decreases in Pajama Time for other specialties [**Table S.2**]. Finally, increases in the COVID rate were associated with decreases in time spent in orders for all specialties [**Table S.3**].

DISCUSSION

This study is the largest exploration of the impact of the COVID pandemic on physician EHR workload to date. We identified an association COVID rates and the amount of time physicians spent performing In Basket tasks, regardless of specialty. For primary care physicians, we also found a significant association between COVID rates and the time spent in the EHR outside of work hours (using Epic's updated "pajama time" metric).

Prior research has described the profound increase in In Basket volume due to the pandemic, as well as the fact that In Basket volume has continued to increase, despite an end to the public health emergency. Other literature has also highlighted the impact of inbox work after work on physicians' intent to reduce clinical effort or depart altogether.[28] Our study adds to this literature by analyzing different types of EHR tasks and by including multiple specialties, which, in turn, allows us to highlight the disproportional impact on primary care physicians across virtually every region of the country. A major strength of our study is the size and breadth of the study population. Though the magnitude of our estimates may be small, when applied to the entirety of our sample population, and then extrapolated to the entire practitioner community, the minutes become an incredibly large number of hours spent in the EHR, with a substantial impact on physicians across the country. This is particularly important considering the multiple efforts to decrease burden that occurred at the same time as the pandemic, including changes to ambulatory evaluation and management documentation requirements in 2021.[29]

Primary care shortages are at crisis levels in many areas of the US. Our findings provide useful context and highlight the critical importance of reducing and redistributing EHR-related tasks before they drive even more primary care physicians out of the field. Patients need to maintain electronic access to their EHR data and to their care teams, so efforts to manage EHR workload should focus on strategies that are simultaneously patient-centered and supportive of physician well-being. Additionally, the pandemic has likely exacerbated existing gender disparities in EHR burden among ambulatory physicians, with women physicians receiving an even greater proportion of patient messages compared to men.[25] Given the large sample size, translating what appear to be small coefficients to actual impact can be challenging. In the In Basket, for primary care physicians in the Northeast an increase of 500 per 100,000 in the COVID infection rate correlated to an increase of 0.95 minutes of In Basket time per PCP per day. This involved over 101,000 added minutes across all PCPs in New England.

Perhaps the most concerning finding is that the time spent in the EHR per day rose during the pandemic for all physicians, and it did not decrease, even as the pandemic progressed and reached an endemic state. This finding rings true for many physicians who find themselves working longer hours with the increase in In Basket volume and work outside of traditional visits.[15,22,24] Both the time spent in clinical review and time in In Basket also persistently remained higher than pre-pandemic levels, which is not surprising as these are significant parts of ambulatory clinical workflows. While regression estimates provide mixed results on time in system in relation to COVID rates, specific EHR areas (like In Basket) show more consistent evidence of increased EHR engagement.

We also identified interesting patterns of EHR work volume during traditional holiday periods for physicians in the US. This work volume, labeled pajama time, consistently increased during major holidays like Thanksgiving, Christmas, Memorial Day, and Independence Day. Given the significant spikes in pajama time, physicians may be working to catch up on their EHR and patient care work during holidays periods that are otherwise designated as time off, when they do not have patient visits scheduled. As recently illustrated, physician burnout rates are tightly linked to the inability to disconnect from clinical work and to lacking appropriate coverage for this work when away.[30] Though patients may need to access their physicians on holidays or weekends, the work volume in these times seems to be rising without a clear solution.

Our study does have several limitations. Due to limitations on our computational processing capacity, we had to break up the country-wide data into regions for the

regression analyses. Though we know that these regions did progress through the pandemic in ways that were relatively similar, we would have liked to present the regression analysis over the entire population. In addition, some data had to be provided by region to avoid identifying a particular healthcare system when there were very few systems in a given state. We also were not able to include data from a few large healthcare systems that operate in numerous states given that the data is only attributed within the Epic database according to the headquarters location. Lastly, the granularity of specialty attribution for physicians included in the dataset varied between regions, likely because of variable specificity in individual health systems. This limited our between-specialty comparisons and led to the rather large subgroups of "other" and "unknown."

CONCLUSION

This is the largest study that we are aware of focusing on the impact of the COVID-19 pandemic on EHR workload, with the inclusion of physicians across the US in multiple specialties. While individual impacts may be relatively small, the collective workload represented in the data and associated with COVID rates comprises a substantial burden on healthcare workers across the country. In addition, our findings on specific areas of EHR workload can guide health systems and individual practices to focus on reducing burdens on their physicians both now and in a future pandemic or other large health event.

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