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Changes in Physician Electronic Health Record Use With the Expansion of Telemedicine

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Supplemental content

IMPORTANCE Understanding the drivers of electronic health record (EHR) burden, including EHR time and patient messaging, may directly inform strategies to address physician burnout. Given the COVID-19–induced expansion of telemedicine—now used for a substantial proportion of ambulatory encounters—its association with EHR burden should be evaluated.

OBJECTIVE To measure the association of the telemedicine expansion with time spent working in the EHR and with patient messaging among ambulatory physicians before and after the onset of the COVID-19 pandemic.

DESIGN, SETTING, AND PARTICIPANTS This longitudinal cohort study analyzed weekly EHR metadata of ambulatory physicians at UCSF Health, a large academic medical center. The same EHR measures were compared for 1 year before the COVID-19 pandemic (August 2018-September 2019) with the same period 1 year after its onset (August 2020-September 2021). Multivariable regression models evaluating the association between level of telemedicine use and EHR use were then assessed after the onset of the pandemic. The sample included all physician-weeks with at least 1 scheduled half-day clinic in the 11 largest ambulatory specialties at UCSF Health. Data analyses were performed from March 1, 2022, through July 1, 2023.

EXPOSURES Physicians' weekly modality mix of either entirely face-to-face visits, mixed modalities, or entirely telemedicine.

MAIN OUTCOMES AND MEASURES The EHR time during and outside of patient scheduled hours (PSHs), time spent documenting (normalized per 8 PSHs), and electronic messages sent to and received from patients.

RESULTS The study sample included 1052 physicians (437 [41.5%] men and 615 [58.5%] women) during 115 weeks, which provided 35 697 physician-week observations. Comparing the period before to the period after pandemic onset showed that physician time spent working in the EHR during PSHs increased from 4.53 to 5.46 hours per 8 PSH (difference, 0.93; 95% CI, 0.87-0.98; $P < 0.001$); outside of PSHs, increased from 4.29 to 5.34 hours (difference, 1.04; 95% CI, 0.95-1.14; $P < 0.001$); and time documenting during and outside of PSHs increased from 6.35 to 8.18 hours (difference, 1.83; 95% CI, 1.72-1.94; $P < 0.001$). Mean weekly messages received from patients increased from 16.76 to 30.33, and messages sent to patients increased from 13.82 to 29.83. In multivariable models, weeks with a mix of face-to-face and telemedicine (β, 0.43; 95% CI, 0.31-0.55; $P < .001$) visits or entirely telemedicine (β, 0.91; 95% CI, 0.74-1.09; $P < .001$) had more EHR time during PSHs than all face-to-face weeks, with similar results for EHR time outside of PSHs. There was no association between telemedicine use and messages received from patients, whereas mixed modalities (β, −0.90; 95% CI, −1.73 to −0.08; $P = .03$) and all telemedicine (β, −4.06; 95% CI, −5.19 to −2.93; $P < .001$) were associated with fewer messages sent to patients compared with entirely face-to-face weeks.

CONCLUSIONS AND RELEVANCE The findings of this longitudinal cohort study suggest that telemedicine is associated with greater physician time spent working in the EHR, both during and outside of scheduled hours, mostly documenting visits and not messaging patients. Health systems may need to adjust productivity expectations for physicians and develop strategies to address EHR documentation burden for physicians.

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The COVID-19 pandemic triggered a variety of dramatic changes to how health care is delivered, including a sudden and rapid increase in the volume of telemedicine visits. High levels of telemedicine visits have persisted[1-4] with nearly one-quarter of US adults reporting an ambulatory telemedicine encounter via telephone or video in the latter half of 2021.[5-7] From the perspective of ambulatory physicians, telemedicine represents a fundamental shift in the composition and structure of work, which likely carries substantial implications for how they interact with the electronic health record (EHR).

Expansion of telemedicine may exacerbate preexisting challenges with EHR work. First, it may increase EHR time by changing physician workflows and reducing staff support for tasks such as rooming patients and reviewing medical history, such that the physician must spend additional time working in the EHR before and during the visit.[8-10] Second, it may increase patient-initiated secure messages due to lower-quality communication during telemedicine visits or limited scope of assessment that generate the need for follow-up interactions (eg, patient questions, physician follow-up on symptoms).[11-13] Furthermore, many physicians now deliver a mix of in-person and virtual care during a given day or week, which may introduce a type of switching cost and further increase EHR burden from balancing the demands of delivering care across different modalities. These factors may increase the amount of time spent on the EHR outside of work,[14,15] a known contributor to exhaustion and burnout among physicians.[16-19] Although recent studies have revealed that the COVID-19 pandemic increased time spent working in the EHR[12,20] and the number of electronic messages received from patients,[13,21] it is unclear how much of the increase was associated with telemedicine.

Parsing the specific effect of telemedicine is important given the persistent use of this modality with the associated opportunities to redesign approaches to EHR use, workflows, physician schedules, and payment policies that may be needed in response to increased telemedicine use. This study sought to understand the extent of the changes in EHR use at the physician-week level from before to during the COVID-19 pandemic using the following measures of ambulatory physicians' EHR-related workload: (1) time spent working in the EHR during PSHs; (2) time spent working in the EHR outside of PSHs ("work outside of work"[22]); (3) EHR time spent on clinical documentation (eg, writing clinical notes), both during and outside of PSHs; and (4) the number of patient portal messages, both received from and sent to patients. Then we assessed the extent to which the differences in each measure during COVID-19 pandemic were associated with the level of telemedicine use. Understanding the relationship between telemedicine and EHR work will inform health system leaders and policymakers regarding the need to develop strategies for sustainable telehealth approaches, ones that balance patient access to virtual care with efforts to address EHR burden for physicians.

Methods

This study was reviewed and approved by the institutional review board of the University of California San Francisco (UCSF). Informed consent was waived because all data were deidentified. We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

Key Points

Question What is the association between the level of telemedicine use and key measures of electronic health record (EHR) use—ie, time in the EHR and patient messaging volume—in the ambulatory setting?

Findings This longitudinal cohort study of 1052 ambulatory physicians at a large academic medical center during more than 115 weeks (35 697 physician-week observations) found a strong linear association between telemedicine use and physician time spent working in the EHR during and outside of patient scheduled hours. It did not find an increase in electronic messages received from patients.

Meaning The findings of the longitudinal cohort study indicate that telemedicine use is associated with greater time spent in the EHR; health systems and policymakers may need to alter productivity expectations and reimbursement policies.

Data Collection and Study Sample

The sample for this longitudinal cohort study consisted of physicians providing ambulatory care at UCSF Health, a large academic medical center. All attending and resident physicians practicing in the 11 largest ambulatory specialties: cardiology, dermatology, family medicine, general surgery, hematology and oncology, internal medicine, nephrology, neurology, obstetrics and gynecology, otolaryngology, and pediatrics. Characteristics, such as role (attending or resident), gender identity, and specialty were self-reported.

There is considerable heterogeneity in how telemedicine is offered at UCSF Health, with many clinicians having substantial autonomy to offer telemedicine visits or in-person care to patients, and patients being able to select the modality that fits their preference. We limited the study sample to physicians with at least 1 half day of scheduled ambulatory clinical hours per week to remove those with exceptionally low clinical loads who were unlikely to be representative of the broader population of ambulatory physicians.

We assessed 2 full years of data, before the COVID-19 pandemic (August 28, 2018, through September 30, 2019) and after its onset (August 31, 2020, through September 27, 2021). We chose August 2020 to begin the second study period because in-person ambulatory care had been reopened and was once again broadly available to patients.[4,12]

Measures

We constructed all measures based on data extracted from Clarity (Epic Systems) database, which captures ambulatory physician EHR time (excluding any EHR time from inpatient care), scheduled hours of patient care, and the number and distribution of visits by care modality (telemedicine vs in-person visit). Data were created at the physician-day level and aggregated to the physician-week level given that EHR work often occurs in the day(s) surrounding the encounter.

EHR Time

We constructed time-based EHR measures by calculating all time with observed EHR actions, including keystrokes and mouse clicks, with a 1-minute timeout (ie, time stopped 1 minute after the last EHR interaction) from the ACCESS_LOG (a specific table within the Clarity database). For the denominator, we measured PSHs by calculating the total time the physician was scheduled to deliver patient care during that day, eg, if a physician sees patients from 8 to 10 AM and again from 2 to 4 PM, the PSHs for that day are 4.0. Then we reported all measures using the denominator of per 8 PSHs to facilitate comparisons across different clinical volumes. The numerator for the first dependent variable was total EHR time during PSHs. The numerator for the second dependent variable was total EHR time outside of PSHs. The numerator for the third dependent variable was EHR time specifically spent on documentation either during or outside of PSHs. This measure sums all time the physician spent editing free text notes (eg, progress notes), from the moment the first key of the note is pressed until the note is saved, excluding any time not counted due to the 1-minute timeout described, in that day, within and outside of PSHs. Daily numerators and the denominator were aggregated to the physician-week level before calculating each measure.[23]

Messaging Patients

The fourth and fifth dependent variables were the number of patient EHR portal messages received from and number sent to patients each week. For total messages received, we included both messages sent directly to the physician as well as messages sent to pools that included multiple recipients including the physician, even if the message was responded to by another clinician. For total messages sent, we measured any message sent to a patient from the physician. We disaggregated this measure into messages sent (1) cold, ie, the initial message in a conversation thread or as (2) replies within a conversation thread. This disaggregation allowed us to separately evaluate the association of telemedicine with physician-initiated compared with patient-initiated message threads.

Encounter Modality

The study's primary independent variable was the proportion of a physician's scheduled ambulatory encounters in the week conducted via telemedicine. We considered completed synchronous video as well as audio-only calls as telemedicine in the numerator, with total completed ambulatory encounters in the denominator. Unscheduled telephone calls, as well as scheduled but not completed visits (no shows) were excluded. We also classified physicians' weeks into 3 categories of modality mix: entirely face-to-face (with no telephone or video telemedicine visits), mixed face-to-face and telemedicine, and entirely telemedicine (with no in-person visits). The mean (SD) proportion of visits delivered via telemedicine in mixed weeks after the onset of the COVID-19 pandemic was 45.2% (25.6%). The distribution of telemedicine in mixed weeks is available in eFigure in Supplement 1.

Statistical Analysis

We calculated descriptive statistics for the study sample in the before and after COVID-19 onset periods, including weekly appointment volume, EHR time per 8 PSHs during and outside of scheduled hours as well as EHR time per 8 PSHs specifically spent documenting (clinical notes), patient portal messages sent and received, proportion of visits conducted via telemedicine, and distribution of weeks across modality-mix categories, as well as demographic characteristics of the sample physicians, including role (attending vs resident), gender identity (self-reported; age, race, and ethnicity were not analyzed), and specialty, with 2-sided *t* tests with unequal variances to test for statistically significant differences between continuous variables and χ^2 tests for dichotomous variables. We then plotted weekly mean EHR time and patient messaging.

To assess whether the level of telemedicine explains variation in our dependent variables, we limited to the after-onset data given that telemedicine in the before pandemic period was rare and not widely offered for traditional ambulatory encounters. We created binned scatterplots that showed the continuous association between telemedicine proportion in each week and the study's EHR time and messaging measures. Each point represents the mean value of the dependent variable (y-axis) within that range of the independent variable, and the proportion of encounters delivered via telemedicine, on the x-axis. Each point was estimated using an ordinary least-squares (OLS) regression including controls for physician fixed effects, to control for time-invariant confounders, as well as volume of ambulatory encounters in that week.

We used multivariable OLS models with two-way fixed effects to estimate the association between our dependent variables (EHR time during and outside of PSHs, EHR documentation time, patient messages received and sent) with our 3 categories of weekly modality mix (all face-to-face, mixed, and all telemedicine) as our independent variables of interest. Models included physician-level fixed effects to control for unobserved time-invariant confounders (eg, specialty, time in practice, ease with using the EHR), week-level fixed effects to account for seasonality (eg, lower message volume and EHR time during holidays, secular changes over time), as well as controls for number of ambulatory encounters in each week.[24] We repeated these models for the measures of patient messages sent cold and messages in reply in an conversation thread. All models used robust standard errors clustered at the physician level.[25]

Statistical tests were 2-tailed and *P* values < .05 were considered to be statistically significant. Data analyses were performed from March 1, 2022, through July 1, 2023, using Stata, version 17.0 (StataCorp).

Robustness and Sensitivity

We conducted several tests to ensure results were robust to different analytic choices. First, we ran subgroup models for adult primary care (internal and family medicine) and nonprimary care (all other specialties) physicians to assess differences across clinical workflows. Second, we ran subgroup models for physician weeks in the top quartile of PSHs (>12.5 hours) to assess robustness to differences in volume. Third, we estimated our models by replacing the independent variable with quartiles of telemedicine intensity to ensure that the results would be robust to other definitions of week-level modality, including differences in telemedicine volume across mixed weeks (eg, a week in the third quartile vs the second quartile of telemedicine proportion.) Fourth, we used medians (rather than means) of dependent variables of EHR time to assess whether outliers were driving observed differences. Fifth, we identified physicians who were heavy users of telemedicine, defined as those in the top quartile of encounters delivered via telemedicine (mean, ≥79.3% of weekly encounters) after pandemic onset, and used a difference-in-differences model to estimate the association of the pandemic-induced adoption of telemedicine on the study outcomes. Finally, we estimated our models using lagged dependent variables of messaging in the week and 2 weeks after the index week.

Results

Sample Characteristics and Telemedicine Use

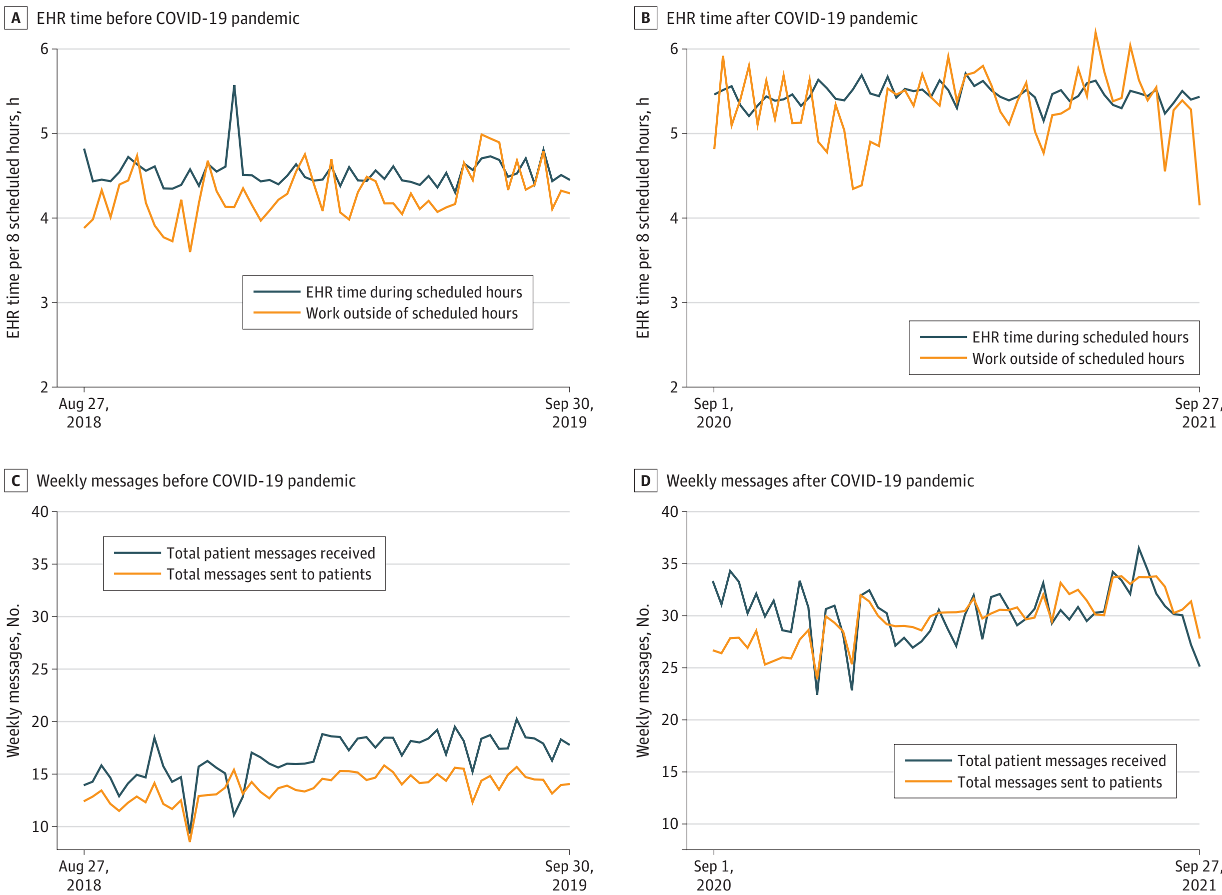
The study sample included 1052 physicians (437 [41.5%] men and 615 [58.5%] women) observed during 115 weeks, which provided an unbalanced panel of 35 697 observations.

Mean weekly ambulatory encounter volume increased slightly after the COVID-19 pandemic onset, from 19.42 to 20.06 (difference, 0.64; 95% CI, 0.35-0.93; *P* < .001; **Table 1**). Telemedicine use increased significantly, from 3.1% to 49.3% (difference, 46.2%; 95% CI, 45.7%-46.7%; *P* < .001). In the categorical measure of telemedicine use, the most common modality before the pandemic was all face-to-face (82.6% of weeks), followed by mixed telemedicine and face-to-face (17.3%), with almost no weeks consisting of entirely telemedicine visits (0.1%). After the onset of the pandemic, mixed (tele-

Table 1. Sample Descriptive Statistics of 35 697 Physician-Week Observations of 1052 Unique Physicians and Use of Electronic Health Records Before and After the Onset of the COVID-19 Pandemic

	Mean (SD)		
Measure	Before pandemic (August 27, 2018-September 30, 2019)	After onset (September 1, 2020-September 27, 2021)	*P* value
Encounters, weekly	19.42 (14.25)	20.06 (13.74)	<.001
EHR time normalized per 8 patient scheduled hours (PSHs), h			
EHR time during PSHs	4.53 (2.62)	5.46 (2.90)	<.001
EHR time outside of PSH	4.29 (4.11)	5.34 (4.94)	<.001
Total EHR time on documentation (during and outside PSHs)	6.35 (4.96)	8.18 (5.72)	<.001
Electronic messaging, No.			
Messages received from patients, weekly	16.76 (33.60)	30.33 (64.63)	<.001
Messages sent to patients, weekly	13.82 (19.46)	29.83 (31.44)	<.001
Telemedicine use			
Encounters as telemedicine (audio/telephone or video), %	(3.1) (9.3)	(49.3) (34.4)	<.001
Physician-week encounter modality, No. (%), wk			
All face-to-face	14 467 (82.6)	2010 (11.1)	<.001
Mixed face-to-face and telemedicine	3032 (17.3)	13 175 (72.4)	<.001
All telemedicine	12 (0.1)	3001 (16.5)	<.001
Physician characteristics			
Attending physician	15 320 (87.5)	15 845 (87.1)	.31
Resident physician	2191 (12.5)	2341 (12.9)	
Female gender	9989 (57.0)	10 567 (58.1)	.04
Male gender	7522 (43.0)	7619 (41.9)	
Specialty			
Cardiology	1853 (10.6)	2035 (11.6)	.07
Dermatology	1436 (8.2)	1213 (6.9)	<.001
Family medicine	618 (3.5)	774 (4.4)	<.001
General surgery	232 (1.3)	184 (1.1)	.01
Hematology/oncology	940 (5.4)	1052 (6.0)	.09
Internal medicine	4349 (24.8)	4629 (26.4)	.18
Nephrology	578 (3.3)	648 (3.7)	.17
Neurology	3878 (22.2)	3601 (20.6)	<.001
Obstetrics/gynecology	1478 (8.4)	1801 (10.3)	<.001
Otolaryngology	986 (5.6)	1170 (6.7)	.01
Pediatrics	1163 (6.6)	1079 (6.2)	.01

Figure 1. Electronic Health Record (EHR) Time and Patient Messaging Before (August 27, 2018-September 30, 2019) and After (September 1, 2020-September 27, 2021) the Onset of the COVID-19 Pandemic, Mean per Week



Weeks from September 30, 2019, to September 1, 2020, intentionally not included.

medicine and face-to-face) was the most common modality—72.4% of weeks, with a median (IQR) of 44.4% (26.6%) telemedicine encounters within those weeks; followed by all telemedicine (16.5%) and all face-to-face (11.1%).

Changes in EHR Use Over Time

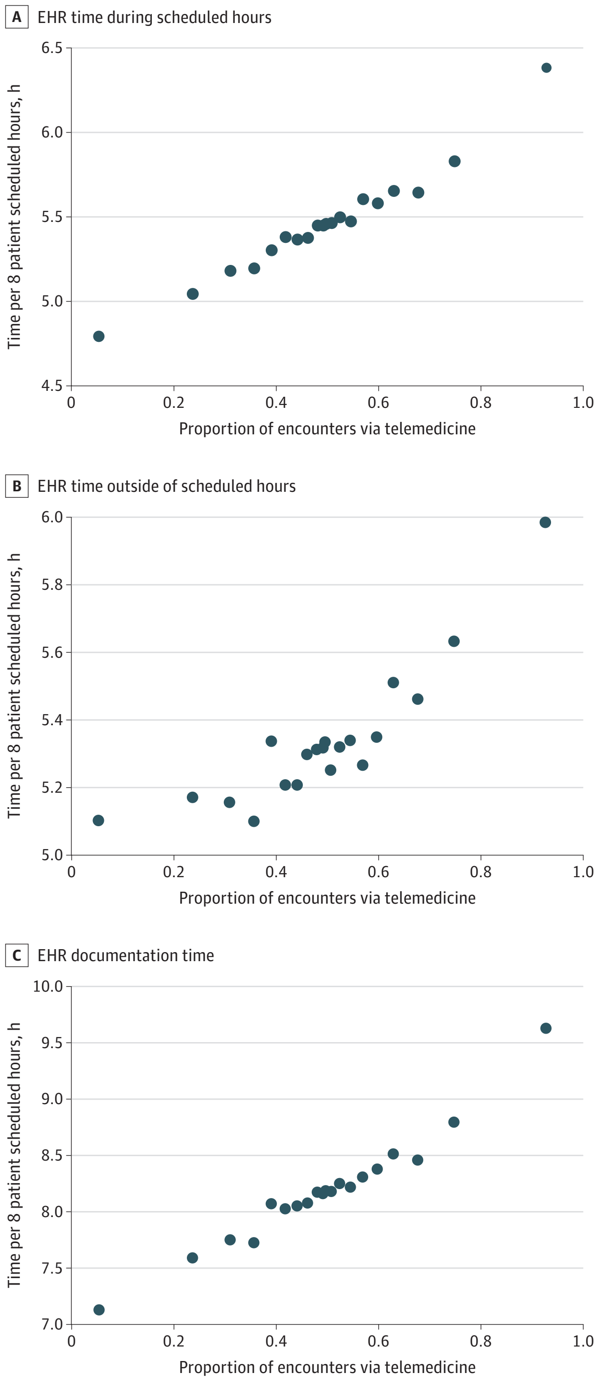
For time spent working in the EHR before the COVID-19 pandemic compared with after its onset, we observed significant increases: during PSHs increased from 4.53 to 5.46 hours per 8 PSH (difference, 0.93; 95% CI, 0.87-0.98; $P < 0.001$); outside of PSHs, from 4.29 to 5.34 hours (difference, 1.04; 95% CI, 0.95-1.14; $P < 0.001$); and documentation time during and outside of PSHs, from 6.35 to 8.18 hours (difference, 1.83; 95% CI, 1.72-1.94; $P < 0.001$) (**Figure 1**). At the same time, patient messages received by physicians increased from 16.76 to 30.33 messages (difference, 13.57; 95% CI, 12.51-14.63; $P < 0.001$), and messages sent to patients, 13.82 to 29.83 messages (difference, 16.01; 95% CI, 15.47-16.55; $P < .001$) (Figure 1).

Association Between Telemedicine and EHR Time

We found a strong, positive linear association between proportion of encounters delivered via telemedicine and EHR time, both during and outside of PSHs, as well as time spent documenting in the EHR (**Figure 2**). For patient messaging, the association of telemedicine and the number of messages received did not show an obvious association. However, we did find a strong negative association between the proportion of encounters delivered via telemedicine and the number of messages sent (**Figure 3**).

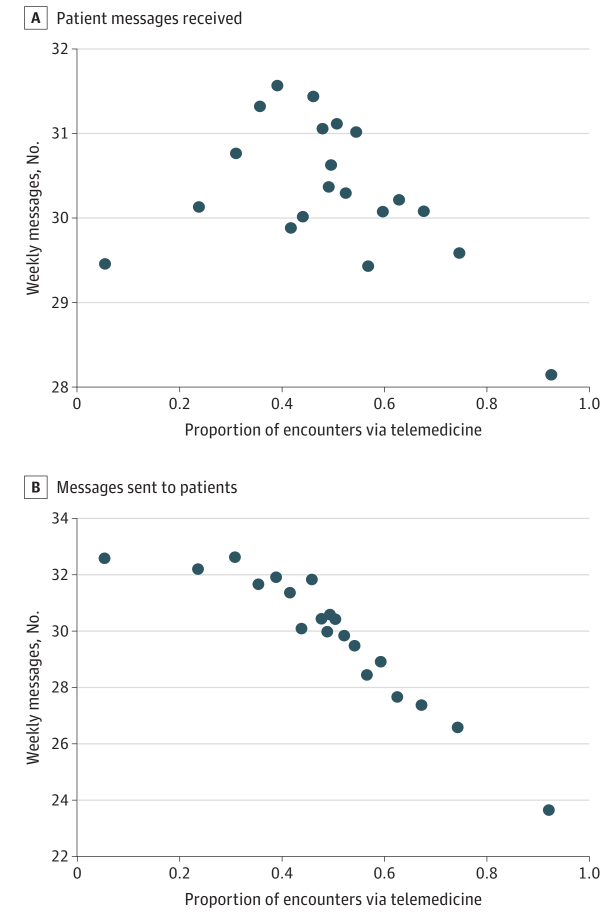
In multivariable models, physicians in mixed weeks had 0.43 additional hours of EHR time per 8 PSH during scheduled hours (95% CI, 0.31-0.55; $P < .001$), and 0.38 additional hours outside of scheduled hours compared with entirely face-to-face encounters (95% CI, 0.15-0.61; $P < .001$). We found larger effect sizes for weeks when all encounters were conducted via telemedicine, for EHR time during (β, 0.91 EHR hours per 8 PSH; 95% CI, 0.74-1.09; $P < .001$) and outside (β, 0.73 EHR hours per 8 PSH; 95% CI, 0.42-1.04; $P < .001$) of scheduled hours. When investigating the association between EHR documentation time and telemedicine, we found a strong association between the increase in EHR time in both mixed (β, 0.83 EHR hours per 8 PSH; 95% CI, 0.60-1.06; $P < .001$) and entirely telemedicine (β, 1.64 EHR hours per 8 PSH; 95% CI, 1.30-1.98; $P < .001$) weeks. In robustness tests,

Figure 2. Association Between Mean Electronic Health Record (EHR) Time and Weekly Encounter Modality Mix, After Onset of the COVID-19 Pandemic



Binned scatterplot in which each dot indicates the mean EHR time within that proportion of encounters in the week delivered via telemedicine. Controls for physician fixed effects included.

Figure 3. Association Between Mean Patient Messaging and Weekly Encounter Modality Mix, After Onset of the COVID-19 Pandemic



Binned scatterplot in which each dot indicates the mean weekly message volume within that proportion of encounters in the week delivered via telemedicine. Controls for physician fixed effects included.

we found similar results in models for primary and specialty care (eTable 1 in Supplement 1), high-volume physicians (eTable 2 in Supplement 1), using quartiles of telemedicine intensity (eTable 3 in Supplement 1), median EHR time and telemedicine (eFigure 2 in Supplement 1), using a difference-in-differences model (eTable 4 in Supplement 1), and several sensitivity analyses around documentation time, eg, using only data from 2021 (eTable 5 in Supplement 1).

Telemedicine and Patient Messaging Volume

Neither mixed (β, 0.81 messages per week; 95% CI, −0.34 to 1.96; *P* = .17) nor entirely telemedicine (β, 0.30 messages per week; 95% CI, −1.16 to 1.75; *P* = .69) weeks were significantly different than entirely face-to-face weeks for patient messages received (**Table 2**). This held true when specifying the dependent variable with lags following mixed or telemedicine weeks (eTable 6 in Supplement 1). Both mixed (β, −0.90 messages per week;95% CI, −1.73 to −0.08; *P* = .03) and entirely telemedicine (β, −4.06 messages per week; 95% CI, −5.19 to −2.93; *P* < .001) weeks were significantly negatively associated with the number of messages sent to patients (Table 2). When disaggregating messages into either physician-initiated *cold* messages compared with replies within an existing thread, we found both mixed (β, −1.08 messages per week; 95% CI, −1.48 to −0.68; *P* < .001) and

Table 2. Association of Weekly Encounter Modality Mix on Time Spent on Electronic Health Records (EHRs) and Patient Messaging, During or Outside of Patient Scheduled Hours (PSHs)

Modality[a]	Coefficient (95% CI)	*P* value
EHR time during PSHs[b]		
All face-to-face	[Reference]	
Mixed	0.43 (0.31 to 0.55)	<.001
All telemedicine	0.91 (0.74 to 1.09)	<.001
EHR time outside of PSHs[b]		
All face-to-face	[Reference]	
Mixed	0.38 (0.15 to 0.61)	<.001
All telemedicine	0.73 (0.42 to 1.04)	<.001
EHR time spent on documentation (during and outside PSHs)[b]		
All face-to-face	[Reference]	
Mixed	0.83 (0.60 to 1.06)	<.001
All telemedicine	1.64 (1.30 to 1.98)	<.001
Messages received from patient, weekly		
All face-to-face	[Reference]	
Mixed	0.81 (−0.34 to 1.96)	.17
All telemedicine	0.30 (−1.16 to 1.75)	.69
Messages sent to patient, weekly		
All face-to-face	[Reference]	
Mixed	−0.90 (−1.73 to −0.08)	.03
All telemedicine	−4.06 (−5.19 to −2.93)	.00
Messages sent to patient, cold (physician-initiated conversation)		
All face-to-face	[Reference]	
Mixed	−1.08 (−1.48 to −0.68)	<.001
All telemedicine	−3.91 (−4.62 to −3.19)	<.001
Messages sent to patient, in reply (existing conversation)		
All face-to-face	[Reference]	
Mixed	−0.04 (−0.56 to 0.48)	.88
All telemedicine	−0.37 (−0.97 to 0.22)	.22

[a] All models included physician- and week-level fixed effects with controls for weekly encounter volume not shown, with robust standard errors clustered at the physician level.

[b] All EHR time was normalized per 8 PSHs to account for differences in clinical workload.

entirely telemedicine (β, 3.91 messages per week; 95% CI, −4.62 to −3.19; *P* < .001) weeks were associated with lower messages sent cold, while there was no association between weekly modality mix and messages sent as replies. We found similar results in difference-in-differences models, although physicians with heavy use of telemedicine experienced a small increase (eTable 7 in Supplement 1).

Discussion

Using detailed EHR data, we assessed changes in EHR time and patient messaging volume after the onset of the COVID-19 pandemic and the association between EHR use and telemedicine. Time spent working in the EHR during and outside of PSHs increased significantly and stayed higher after pandemic onset, as did volume of patient messages received and sent. Telemedicine use was strongly positively associated with EHR time, during and outside of PSHs. Time spent documenting was also longer for telemedicine weeks. We found no association of patient messages received by physicians with telemedicine, even after accounting for different lag periods. However, there was a strong negative association between telemedicine use and messages sent to patients by physicians, driven by fewer physician-initiated cold messages.

The large and persistent increase in EHR time and patient messages after pandemic onset are consistent with previous studies,[12,26] suggesting that UCSF Health experienced the same trends in these measures as other health systems. To our knowledge, our results assessing these associations with various levels of telemedicine use are novel. We are aware of only 1 other study—it specifically assessed the association between EHR time after-hours and telemedicine and found that telemedicine use was associated with higher after-hours EHR time. Our results for this association are similar, which lends credibility to our findings that evaluate a broader set of measures: overall EHR time, patient messages received and sent, and documentation time. Overall, these results suggest that although telemedicine may offer a convenient option for patients, it exhibits a dramatic dose-response association with EHR time that exacerbates EHR burden for physicians.[16,18]

There are several potential mechanisms that may drive the association between telemedicine and EHR time. First, it may be that telemedicine makes documentation during the visit easier by allowing the physician to compose the note in short bursts throughout the encounter given that they are sitting in front of the computer. However, this could appear in our measures as greater documentation because the physician spends more time with the note open. For example, documenting an in-person encounter may take 5 dedicated minutes after the visit. However, a telemedicine encounter could allow the physician to parallel process the documentation and treat the patient simultaneously during a 20-minute appointment; this may record more time spent actively working in the EHR. Therefore, this increase in documentation time may not be reflective of the documentation burden experienced by the physician—it may be that 20 minutes of documentation work during the visit is preferable to 5 minutes after the visit, despite the increase in overall time spent in the EHR.

Although this may explain greater documentation time, it would not account for our finding of a large increase in EHR time spent outside of clinic hours associated with delivering care via telemedicine, which is substantial given the large volume of evidence associating EHR time outside of PSHs with physician burnout and decreased well-being.[16-19] Evidence suggests that telemedicine adoption improves appointment adherence rates,[27] which may reduce the shoulder time between appointments, which was previously used to document the visit, resulting in more EHR time carrying over into unscheduled hours. It may also be that telemedicine requires more before-visit EHR review in the absence of a physical examination, or a nonphysician staff member communicating the patient's medical history verbally. Additionally, telemedicine encounters may be less efficient, requiring time to ensure that the patient is able to see, hear, and speak with the physician—with physicians often providing ad hoc technical support which means appointments run over time. Lastly, telemedicine encounters may have less staff support for functions such as recording patient medical history, creating additional work for the physician.[28]

The findings on the association of telemedicine with messaging are encouraging in that telemedicine did not seem to generate more patient messages. This suggests that the increase in messaging after the pandemic onset was not causally linked to the simultaneous expansion of telemedicine; it may be driven by other factors such as increased awareness of the portal or higher demand for asynchronous care during the pandemic. More broadly, there may be evidence of matching patient needs with modality—ie, clinical issues addressed by telemedicine are those that can be resolved virtually and without the need for messaging-based follow-up. However, this is speculative, and it may be that follow-up care is delivered at an in-person visit rather than via messages.

Similarly, it is hard to know whether the reduction in physician-initiated cold messages to patients is encouraging or worrisome. It may be that cold messages are not needed because of good matching, with issues fully resolved during the encounter. However, it could be that the increased EHR burden limits physician time for cold messages regarding follow-up visits and outreach, with potential implications for quality of care. Lastly, differences in care delivery by modality may drive differences in messaging—telemedicine visits have been shown to have fewer diagnostic tests ordered,[29] which would eliminate the need to reach out to patients with test results. These findings make an important contribution by generating these hypotheses for future investigation.

These findings also have important implications for health system leaders and policymakers. Critically, the amount time spent on EHR work among the physicians in this study underscores the importance of reducing burden: for every 8 PSHs, physicians were spending 5 or more hours outside PSHs working in the EHR. Health systems should consider the burden of EHR time for physicians who deliver care via telemedicine, when considering scheduling, number of patients under care (ie, panel size), and productivity expectations. They may also wish to invest in supportive technology (eg, virtual scribes) or adapting workflows to allow other staff to move patients into a virtual waiting room. Future research should investigate whether team-based workflows that include nonphysician staff who may assign patients to waiting room would be effective in reducing EHR time burden for physicians.

Policymakers should be aware of the additional time required to deliver care virtually as they craft sustainable telehealth policy. If telemedicine remains durably more demanding of physician time, policymakers should consider this evidence with the same weight as they give to studies on the quality of virtual care as they are making decisions regarding coverage and reimbursement.

Limitations

We used data from a single health system, and although we include ambulatory care at UCSF Health's main academic campus as well as community practice settings, our findings may not generalize to nonacademic or higher-volume settings. Although our OLS 2-way fixed effects models controled for unobserved time-invariant physician characteristics as well as secular changes over time, there may be time-varying confounders that we were unable to address. Additionally, although we use lagged outcomes and a difference-in-differences model in eTables 4 and 7 in Supplement 1, our clinician-level measures of messaging volume may not fully capture how telemedicine visits affect patient messaging. Furthermore, our data did not allow us to assess the distribution of EHR time across nondocumentation functions such as messaging or EHR review. Given our findings that documentation time increased significantly, future studies should investigate whether physicians reduced EHR time spent in other domains to accommodate this new workload. Additionally, because our data were limited to physicians, we were unable to assess measures of team support for EHR work or how telemedicine affected nonphysician EHR users.

Conclusions

The findings of this longitudinal cohort study indicate that after the onset of the COVID-19 pandemic, physician time spent in the EHR increased substantially, as did the volume of electronic messages received from and sent to patients. Our results revealed that telemedicine was only significantly associated with 1 of these: more EHR time specifically owing to additional documentation time. Telemedicine was associated with physicians sending fewer messages to patients, suggesting that increased portal message volume after the pandemic onset was associated with other factors. Given the evidence that delivering care virtually requires more physician time working in the EHR compared with in-person visits, health systems and policymakers should carefully balance the trade-off between physician time and patient access as they plan for the future of telemedicine.

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