Journal of the American Medical Informatics Association, 2023, **30(10)**, 1720–1724
https://doi.org/10.1093/jamia/ocad141
Advance access publication 12 July 2023
Brief Communications

Brief Communications

COVID exacerbated the gender disparity in physician electronic health record inbox burden

Lisa Rotenstein[1] and A. Jay Holmgren[2,*]

[1]Department of Medicine, Brigham & Women's Hospital, Harvard Medical School, Boston, Massachusetts, USA
[2]Division of Clinical Informatics and Digital Transformation (DoC-IT), University of California San Francisco, San Francisco, California, USA

Lisa Rotenstein and A. Jay Holmgren contributed equally to this work and share first authorship.

*Corresponding Author: A. Jay Holmgren, PhD, MHI, University of California San Francisco, 10 Koret Way, Office 327A, San Francisco, CA 94131, USA; a.holmgren@ucsf.edu

ABSTRACT

The COVID-19 pandemic was associated with significant changes to the delivery of ambulatory care, including a dramatic increase in patient messages to physicians. While asynchronous messaging is a valuable communication modality for patients, a greater volume of patient messages is associated with burnout and decreased well-being for physicians. Given that women physicians experienced greater electronic health record (EHR) burden and received more patient messages pre-pandemic, there is concern that COVID may have exacerbated this disparity. Using EHR audit log data of ambulatory physicians at an academic medical center, we used a difference-in-differences framework to evaluate the impact of the pandemic on patient message volume and compare differences between men and women physicians. We found patient message volume increased post-COVID for all physicians, and women physicians saw an additional increase compared to men. Our results contribute to the growing evidence of different communication expectations for women physicians that contribute to the gender disparity in EHR burden.

Key words: COVID, EHR burden, patient portal, gender disparity, EHR inbox

BACKGROUND

Following the HITECH Act of 2009, hospitals and ambulatory practices in the United States have broadly adopted electronic health records (EHRs) to digitize their clinical record-keeping and workflows.[1,2] While EHRs have had positive impacts on care quality, interoperability, and data access, there have been a number of unintended consequences, including an increase in "desktop medicine" burden for clinicians.[3,4] One particularly salient change associated with adoption of EHRs has been the use of web-based portals that enable patients to securely message their physician.[5] While this type of asynchronous access to care is valuable to patients, for many physicians, it represents a non-trivial amount of new work, and many feel pressured to be constantly available to respond to messages. Managing the EHR inbox has become a significant contributor to EHR-based physician burnout and decreased well-being.[6,7]

The COVID-19 pandemic exacerbated these challenges, and physician time spent in the EHR increased significantly following the onset of the pandemic, driven by an increase in electronic messages sent by patients.[8] Pre-pandemic there were known gender disparities in EHR time, with women spending more time in total and after-hours on the EHR.[9] Additionally, there is evidence of different messaging patterns for women physicians,[10] with women primary care physicians receiving more messages from both patients and team members than men.[11] In light of these pre-pandemic differences in EHR interactions and evidence that the coronavirus pandemic exacerbated multiple other demands and inequities for women physicians,[12,13] it is important to understand whether patterns of EHR-related work have also changed to better target interventions to reduce EHR burden and address the downstream impact on physician burnout and well-being. In this study, we explored whether the COVID pandemic differentially impacted the patient-initiated messaging burden of women versus men physicians.

METHODS

Data and measures

We used metadata on physician inbox messaging for the pre-COVID (August 27, 2018–September 30, 2019) and post-COVID onset (August 31, 2020–September 27, 2021) periods from the UCSF Health Epic EHR. We chose to exclude data from the onset of the pandemic to focus on patterns for the pre-COVID period as compared to the period when ambulatory workflows had somewhat stabilized after the start of the COVID pandemic. We extracted data from the Epic Clarity module for physicians in the eleven most common ambulatory specialties at UCSF, 4 primary care (internal medicine, family medicine, pediatrics, and OB/GYN) and 7 other (neurology, cardiology, dermatology, otolaryngology, hematology-oncology, nephrology, and general surgery) specialties. Data were aggregated weekly by physician with an inclusion criteria minimum of one half-day clinic (4 h) per week to remove a small number of outliers with very low clinical workloads.

Received: 8 May 2023. **Revised:** 19 June 2023. **Editorial Decision:** 7 July 2023. **Accepted:** 18 July 2023

We then excluded any physicians who did not have at least one week in both the pre- and post-COVID onset periods to facilitate comparison of patterns of physician messaging over time.

Our 2 outcome measures were (1) weekly number of inbox messages received from patients directly (including messages that were originally sent to a clinic-wide inbox pool and then forwarded to the physician inbox to be addressed, but excluding messages sent to clinic-wide inbox pools and addressed by another member of the care team without reaching the physician) and (2) messages sent to patients, whether initiated by the physician or sent in response to a patient-initiated message. We further decomposed messages sent to patients sent into (1) messages sent by the physician that were the first message within a conversation thread (physician-initiated) and (2) messages that were responses to patient-initiated conversation threads (responses to patient-initiated messages). We matched this data with UCSF Health administrative data on physician self-identified gender.

Analysis

First, we descriptively characterized physician role (resident vs attending), specialty, and clinical volume (weekly ambulatory volume and weekly scheduled patient care hours). We then measured the mean number of patient inbox messages sent (in total, physician-initiated, and responses to patient-initiated messages) and the mean number of patient inbox messages received in each week by male and female physicians. We compared means of each of these measures in the pre- and post-COVID periods by gender using 2-tailed *t*-tests with unequal variances.

However, unadjusted numbers may mask gender differences resulting from specialty, clinical volume, or seasonality. To address these concerns, we used a multivariable ordinary least squares regression model with a difference-in-differences framework to assess whether the COVID pandemic differentially impacted female physicians for both of our outcome variables, patient messages sent and received. The coefficient of interest from this model was an interaction term between physician gender and the week occurring in the post-COVID period, which estimates the additional impact of the post-COVID period on women compared to men. Both models included physician fixed effects to control for time-invariant confounders (eg, specialty, years in practice) and week fixed effects to control for seasonality. We additionally included controls for volume of ambulatory visits and number of scheduled patient care hours in each week, with robust standard errors clustered at the physician level. The study was approved by the UCSF Institutional Review Board.

RESULTS

As shown in Table 1, our sample included 544 physicians, 308 women (56.6%) and 236 men (43.4%). More women physicians as compared to men physicians were residents (21.8% of women physicians vs 13.1% of men physicians). There was additionally greater representation of women physicians in internal medicine (29.9% of women physicians vs 17.8% of men physicians), OB-GYN (11.4% of women physicians vs 2.1% of men physicians), and pediatrics (10.1% of women physicians vs 3.0% of men physicians). In contrast, there was greater representation of men physicians in cardiology (5.5% of women physicians vs 18.2% of men physicians), neurology (19.5% of women physicians vs 25.8% of men physicians), and otolaryngology (3.2% of women physicians vs 7.6% of men physicians).

In both the pre- and post-COVID periods, women physicians had more ambulatory appointments per week (mean [SD] 21.6 [14.5] appointments per week pre-COVID, 22.1 [13.9] appointments per week post-COVID) than men (18.6 [14.5] appointments per week pre-COVID, 19.3 [14.0] appointments per week post-COVID). Accordingly, they had more scheduled patient care hours as compared to men physicians both pre- and post-COVID (Table 2).

As shown in Figure 1, in unadjusted analyses, in the pre-COVID period women received 15.9 messages compared to 10.9 for men ($P < .001$) per week. They sent a mean of 17.2 messages to patients per week compared to 9.3 for male physicians ($P < .001$). In the post-COVID period, women physicians received 24.4 messages compared to 19.6 for men ($P < .001$) and sent 33.5 messages per week to patients compared to 24.7 for men ($P < .001$) (Table 3). This translated to a difference of 5.5 messages received directly from patients

Table 1. Demographic characteristics by physician gender

	Women ($n = 308$)		Men ($n = 236$)	
	n	%	*n*	%
Role				
Attending physician	241	78.2%	205	86.9%
Resident physician	67	21.8%	31	13.1%
Specialty				
Cardiology	17	5.5%	43	18.2%
Dermatology	27	8.8%	17	7.2%
Family medicine	9	2.9%	6	2.5%
General surgery	4	1.3%	7	3.0%
Heme/Onc	13	4.2%	16	6.8%
Internal medicine	92	29.9%	42	17.8%
Nephrology	10	3.2%	14	5.9%
Neurology	60	19.5%	61	25.8%
OB/GYN	35	11.4%	5	2.1%
Otolaryngology	10	3.2%	18	7.6%
Pediatrics	31	10.1%	7	3.0%

Table 2. Physician workload by gender, pre- and post-COVID onset

	Pre-COVID				Post-COVID			
	Women ($n = 308$)		Men ($n = 236$)		Women ($n = 308$)		Men ($n = 236$)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Weekly ambulatory visits	21.6	14.5	18.6	14.5	22.1	13.9	19.3	14.0
Weekly scheduled patient care hours	10.8	5.6	9.6	5.4	10.0	5.0	9.3	5.3

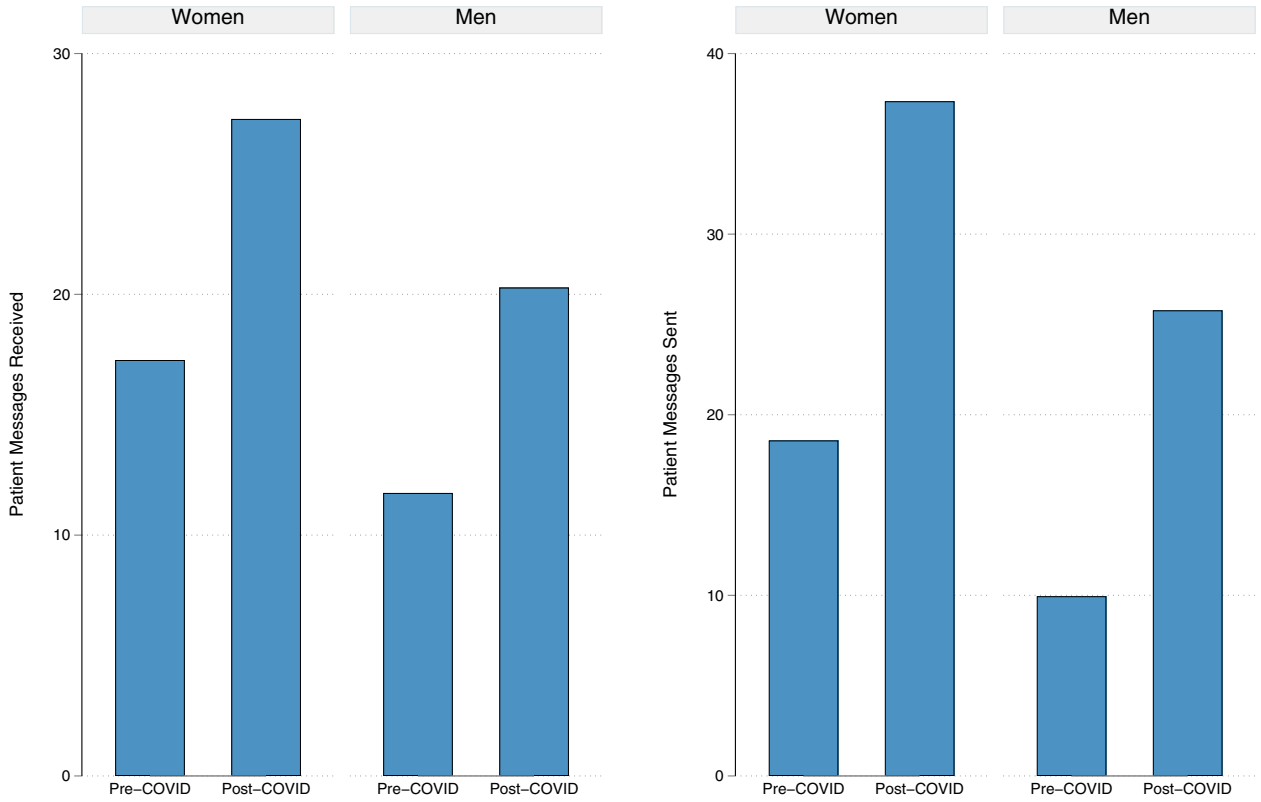

Figure 1. Weekly patient messages received and sent by gender, pre- and post-COVID onset.

Table 3. Weekly message volumes by physician gender

	Pre-COVID (August 27, 2018–September 30, 2019)						Post-COVID (August 31, 2020–September 27, 2021)					
	Women ($n = 308$)		Men ($n = 236$)				Women ($n = 308$)		Men ($n = 236$)			
	Mean	Std. dev	Mean	Std. dev	Difference	*P*-value	Mean	Std. dev	Mean	Std. dev	Difference	*P*-value
Messages received directly from patients	17.3	18.9	11.8	14.9	5.5	<0.01	27.3	25.5	20.3	22.2	7.0	<.01
Messages sent to patients	18.6	23.5	9.9	14.9	8.6	<0.01	37.4	35.2	25.8	28.6	11.6	<.01

between women and men physicians before-COVID versus a 7.0 weekly message difference after COVID. Additionally, while the difference in weekly messages sent to patients for women versus men physicians was 8.6 messages before COVID, it increased to 11.6 messages per week after COVID (Table 3). These differences were stable over time in the pre and post-COVID periods (Supplementary Appendix Figure S1).

In adjusted difference-in-differences models controlling for physician characteristics (speciality, role, and time invariant unobserved physician confounders), clinical workload (as measured by appointments and scheduled patient hours per week), and seasonality, we found that while the post-COVID period was associated with a significant increase in messages received ($\beta = 7.83$, $P < .001$) and sent ($\beta = 14.79$, $P < .001$) for all physicians, there was a greater increase for women in messages received ($\beta = 2.69$, $P = .02$) and sent ($\beta = 4.87$, $P < .01$) compared to men (Table 4). Our analysis of decomposed messages sent by physicians demonstrated that as compared to men physicians, women physicians had a significantly greater increase post-COVID in messages sent in response to a patient-initiated message. There were no significant differences in physician-initiated messages by gender post-COVID (Supplementary Appendix Table SA1).

DISCUSSION

In this study of physicians at UCSF Health, we demonstrate that COVID was associated with a significant increase in the volume of electronic patient messages, both received from and sent to patients, and that increase was significantly greater for women physicians. This increase was present even when considering physician characteristics such as specialty and clinical workload. These findings build upon a growing literature demonstrating a differential burden of EHR-related work for women physicians.[9,11]

Prior studies have demonstrated that women physicians spend more time on the EHR in total, after-hours, and on

Table 4. Multivariable difference in differences model for weekly volume of messages received from and sent to patients pre- and post-COVID, with interaction for physician gender

	Weekly messages received from patients				Weekly messages sent to patients			
	Coefficient	*P*-value	(95% confidence interval)		Coefficient	*P*-value	(95% confidence interval)	
Pre-COVID	(Reference)				(Reference)			
Post-COVID	7.83	<.01	6.38	9.28	14.79	<.01	12.05	17.53
Women physician * post-COVID	2.69	.02	0.36	5.02	4.87	<.01	0.98	8.77
Number of weekly appointments	0.23	<.01	0.14	0.33	0.35	<.01	0.18	0.52
Number of patient scheduled hours	0.06	0.56	−0.15	0.27	0.21	.21	−0.12	0.55

Note: Regression models contain additional controls for physician-level fixed effects to account for any time-invariant bias, such as specialty, age, and patient panel characteristics, as well as calendar month fixed effects to control for seasonality.

documentation.[9,14] Additionally, women physicians receive more messages from both patients and staff members.[11] Increased EHR workload, particularly after-hours, when many physicians catch-up on their inbox, has been associated with burnout.[15] Optimizing the experiences of women physicians is particularly important given a higher prevalence of burnout among women physicians,[16] evidence of better care delivered by women physicians in some circumstances,[17,18] an increasing proportion of female physicians in the workforce balanced with a projected shortage of both primary care and specialty physicians.[19] At the same time, it is critical to balance inbox work optimization with delivering high-quality care and experience for patients—especially given evidence that greater inbox time in the EHR was associated with better patient health outcomes for primary care physicians.[20]

Our findings support evidence regarding different communication expectations for women physicians. Research prior to the advent of the EHR showed that patients speak more in visits with women physicians and discuss more emotional content.[21,22] These trends have likely extended to interactions via the EHR, and our results show that patients send more messages to women physicians, requiring additional work related to reading, evaluating, and replying to message content. Our results also suggest that the disparity in messages sent by physicians is driven primarily by a larger number of responses to patient-initiated messages, rather than women physicians conducting more physician-initiated outreach to patients. These results suggest that women physicians are responding to a higher demand for communication from patients as compared to male colleagues. Future work should examine policies, technologies, and organizational interventions to alleviate differential messaging burden by gender while maintaining access to care for patients. It should also seek to better characterize the role that inbox messages play in shaping physician well-being—for example, by quantifying what proportion of messages are sent and received outside of clinic hours. For example, artificial intelligence-based message content has the potential to draft answers to patient questions in an empathetic way.[23] Future studies should seek to examine how this content may help physicians, and women physicians in particular, in their communications with their patients. Optimization of team-based care models, in which non-physician members of the team partner with physicians to contribute to care plans and patient communication, may also help balance the workload emanating from electronic inbox messaging.[24]

This study's findings should be interpreted bearing in mind some limitations, including data from a single, academic institution that may not generalize to all physicians and only examining patient messaging rather than all messages received. Further, organizations with different workflows for non-physician team members routing and answering electronic inbox messages may have different levels of gender disparities in inbox messaging. These limitations are balanced by several strengths, including consideration of physicians across multiple specialties and the longitudinal nature of our data that allows us to use physician fixed effects to control for unobserved omitted variable bias including physician skill with the EHR and preferences for messaging.

CONCLUSION

Using detailed EHR audit log data, we have demonstrated that across ambulatory specialties in an academic medical center, patient message volume increased significantly more for women versus men physicians in the post-pandemic period. Future studies should further examine the expectations underlying these differences and team and technology-based solutions that can help mitigate them.

FUNDING

This work was supported by the American Medical Association.

AUTHOR CONTRIBUTIONS

AJH secured funding and compiled statistical analyses. Both authors contributed equally to the conceptualizing the idea and analysis plan for the study, drafting the manuscript, editing the manuscript for content, and have given final approval for publication.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Journal of the American Medical Informatics Association* online.

CONFLICT OF INTEREST STATEMENT

AJH reports receiving grants from the American Medical Association for this article as well as additional funding outside the submitted work, as well as grants from the Healthcare Leadership Council. LR reports receiving grants from the American Medical Association outside the submitted work.

DATA AVAILABILITY

Underlying data from the study were generated from UCSF Health routine patient care and cannot be shared online without a legal data use agreement. Analytic code is available upon request.

REFERENCES

1. Blumenthal D. Launching HITECH. *N Engl J Med* 2010; 362 (5): 382–5.
2. Adler-Milstein J, Jha AK. HITECH Act drove large gains in hospital electronic health record adoption. *Health Aff (Millwood)* 2017; 36 (8): 1416–22.
3. Tai-Seale M, Olson CW, Li J, *et al.* Electronic health record logs indicate that physicians split time evenly between seeing patients and desktop medicine. *Health Aff (Millwood)* 2017; 36 (4): 655–62.
4. Overhage JM, McCallie D. Physician time spent using the electronic health record during outpatient encounters: a descriptive study. *Ann Intern Med* 2020; 172 (3): 169–74.
5. Sinsky CA, Shanafelt TD, Ripp JA. The electronic health record inbox: recommendations for relief. *J Gen Intern Med* 2022; 37 (15): 4002–3.
6. Hilliard RW, Haskell J, Gardner RL. Are specific elements of electronic health record use associated with clinician burnout more than others? *J Am Med Inform Assoc* 2020; 27 (9): 1401–10.
7. Adler-Milstein J, Zhao W, Willard-Grace R, *et al.* Electronic health records and burnout: time spent on the electronic health record after hours and message volume associated with exhaustion but not with cynicism among primary care clinicians. *J Am Med Inform Assoc* 2020; 27 (4): 531–8.
8. Holmgren AJ, Downing NL, Tang M, *et al.* Assessing the impact of the COVID-19 pandemic on clinician ambulatory electronic health record use. *J Am Med Inform Assoc* 2022; 29 (3): 453–60.
9. Rotenstein LS, Fong AS, Jeffery MM, *et al.* Gender differences in time spent on documentation and the electronic health record in a large ambulatory network. *JAMA Netw Open* 2022; 5 (3): e223935.
10. Linzer M, Harwood E. Gendered expectations: do they contribute to high burnout among female physicians? *J Gen Intern Med* 2018; 33 (6): 963–5.
11. Rittenberg E, Liebman JB, Rexrode KM. Primary care physician gender and electronic health record workload. *J Gen Intern Med* 2022; 37 (13): 3295–301.
12. Frank E, Zhao Z, Sen S, *et al.* Gender disparities in work and parental status among early career physicians. *JAMA Netw Open* 2019; 2 (8): e198340.
13. Roubinov D, Haack LM, Folk JB, *et al.* Gender differences in National Institutes of Health grant submissions before and during the COVID-19 pandemic. *J Womens Health (Larchmt)* 2022; 31 (9): 1241–5.
14. Tait SD, Oshima SM, Ren Y, *et al.* Electronic health record use by sex among physicians in an academic health care system. *JAMA Intern Med* 2021; 181 (2): 288–90.
15. Peccoralo LA, Kaplan CA, Pietrzak RH, *et al.* The impact of time spent on the electronic health record after work and of clerical work on burnout among clinical faculty. *J Am Med Inform Assoc* 2021; 28 (5): 938–47.
16. Rotenstein L, Harry E, Wickner P, *et al.* Contributors to gender differences in burnout and professional fulfillment: a survey of physician faculty. *Jt Comm J Qual Patient Saf* 2021; 47 (11): 723–30.
17. Reid RO, Friedberg MW, Adams JL, *et al.* Associations between physician characteristics and quality of care. *Arch Intern Med* 2010; 170 (16): 1442–9.
18. Tsugawa Y, Jena AB, Figueroa JF, *et al.* Comparison of hospital mortality and readmission rates for medicare patients treated by male vs female physicians. *JAMA Intern Med* 2017; 177 (2): 206–13.
19. IHS Markit Ltd. *The Complexities of Physician Supply and Demand: Projections From 2019 to 2034*. AAMC; 2019. https://www.aamc.org/media/54681/download.
20. Rotenstein LS, Holmgren AJ, Healey MJ, *et al.* Association between electronic health record time and quality of care metrics in primary care. *JAMA Netw Open* 2022; 5 (10): e2237086.
21. Roter DL, Hall JA. Physician gender and patient-centered communication: a critical review of empirical research. *Annu Rev Public Health* 2004; 25: 497–519.
22. Roter DL, Stewart M, Putnam SM, *et al.* Communication patterns of primary care physicians. *JAMA* 1997; 277 (4): 350–6.
23. Ayers JW, Poliak A, Dredze M, *et al.* Comparing physician and artificial intelligence chatbot responses to patient questions posted to a public social media forum. *JAMA Intern Med* 2023; 183 (6): 589–96.
24. Fogg JF, Sinsky CA. In-basket reduction: a multiyear pragmatic approach to lessen the work burden of primary care physicians. *NEJM Catalyst* 2023; 4 (5): CAT.22.0438.