Resource Utilization Among Portal Users Who Send Messages: A Retrospective Cohort Study

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ABSTRACT

Purpose: To examine the association between patients' use of online health portal-based secure messaging and the likelihood of traditional encounters (office visits and telephone calls) and to identify patient characteristics associated with use of the messaging feature of health portals.

Methods: This retrospective cohort study used EHR data from 80,801 patients aged 18 and older to determine traditional encounter rates among portal users who sent at least 1 message compared to those who sent none. Association between the number of messages sent and number of traditional encounters, while accounting for other covariates (including number of traditional encounters the year before account activation and other patient characteristics) was examined using a hurdle negative-binomial (NB) model.

Results: In the year after their portal account activation, 22,789 (28%) patients sent at least 1 message (median = 3, mean = 5.38). Patients who sent messages were more likely to be female (63.9% vs 58.0%, $P<0.001$), white (92.2% vs 90.0%, $P<0.001$), and have depression (27.0% vs 24.2%, $P<0.001$) than those who sent none. We observed a positive association between sending messages and number of traditional encounters. Patients who sent messages were more likely to have a traditional encounter and have more traditional encounters in the year after account activation than those who sent none (mean 17.6 vs 11.4, $P<0.001$); they also had more in-person office visits (7.6 vs 5.0, $P<0.001$) and telephone calls (9.9 vs 6.4, $P<0.001$) when examined separately.

Conclusions: Our study adds to the growing literature that EHR messaging is associated with increased traditional resource utilization. This has the potential to add to workload while diminishing productivity and increasing the risk of staff and physician burnout. Health systems should prepare for the increased visits and calls expected as more patients use secure messaging.

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INTRODUCTION

The nature of the traditional office visit in primary care was dramatically changed by the Health Information Technology for Economic and Clinical Health (HITECH) Act, enacted by Congress in 2009 "to establish programs to improve health care quality, safety, and efficiency through the promotion of health IT, including electronic health records and private and secure electronic health information exchange."[1] Administered primarily by the Office of the National Coordinator for Health Information Technology (ONC) and the Centers for Medicare & Medicaid Services (CMS), this act defined the concept of the "Meaningful Use" of electronic health records (EHR) and contributed to their rapid adoption.

While initially EHRs were developed to serve as billing and documentation tools for physicians, many now are also linked to an online patient portal, a service that enables patients to view laboratory results, schedule appointments, or send messages through a secure interface similar to email. As of 2017, 52% of patients nationwide were offered online access to their medical record via a portal, an increase of 24% over 3 years.[2] In 2012, CMS encouraged the use of online portal-based secure messaging by requiring that 5% of an Accountable Care Organization's (ACO) patients send electronic messages to their physician before incentive payments can be collected,[3] and secure messaging systems linked to the patient portal are now a standard feature of most EHRs. Almost half (48%) of portal users have used their EHR portal to communicate with their health care

team via a secure message.[2] As a result, the volume of electronic messages received by physicians is increasing at a rapid pace, with 1 health system reporting a near tripling of messages received per provider over a 10-year period.[4]

Most frequently, patients message their provider to discuss a new health condition, a change in a previously existing condition, for clarification regarding lab results or drug dosages, or starting a new drug.[5] While almost half of patients have utilized the messaging feature of the portal, there has been less uptake among physicians; in 2016, only 26% of practicing physicians who used EHRs reported communicating with patients directly using the patient portal.

Most patients desire access to physicians via electronic messaging[6] and the use of secure patient-physician messaging has been associated with improved performance on HEDIS measures,[5] including A1c and LDL control in patients with diabetes.[7] Despite these advantages, physicians have expressed concern that patient-initiated messages may increase their workload[8] while decreasing productivity and compensation.[9] Furthermore, over half of physicians currently using patient portals did not feel that patient messaging improved efficiency.[10] A recent study showed primary care clinicians at the University of Wisconsin health system (UW Health) are currently spending almost 6 hours per day on the EHR and 20 minutes per day on the messaging feature of the portal alone.[11]

Though it has frequently been suggested that patient messages have the potential to improve physician productivity by replacing telephone calls and office visits,[12] the literature conflicts on the extent to which electronic messaging can substitute for other clinical services.[13-18] Most studies to date have compared traditional clinical encounters (office visits and telephone calls) among patients who use EHR portals (including, but not limited to, the messaging feature) with patients who do not use EHR portals and do not truly isolate the use of the messaging feature from other features of the portal. Previous research suggests that there are significant differences between portal users and nonusers,[19,20] as well as between portal users who use the messaging function and those who do not.[21,22]

Given the trend toward increasing portal messaging, the aim of this study is to further examine rates of traditional clinical encounters among patients who use EHR portals to send messages to physicians and those who have access to EHR portals but send none.

METHODS

The study was conducted at UW Health, a large Midwestern academic medical center with 349,142 members. UW Health uses Epic Systems Corporation's[23] EHR software, customized for our institution and called HealthLink. HealthLink is a fully integrated application that includes features for documentation, scheduling, order entry, and billing. The patient portal interface, MyChart, features access to online records, including laboratory and radiology reports, appointment scheduling, health maintenance reminders, and the ability to send and receive secure messages. Use of the messaging system is provided at no cost to patients, and there is no direct compensation for providers to send or respond to a message.

We conducted a retrospective cohort study to examine the relationship between sending a MyChart message and the number of traditional encounters (office visits and telephone calls) in the 12-month period after MyChart account activation. Data used for this study were extracted using the UW Health database (Clarity). The cohort comprised all adult patients 18 years of age and older who activated a MyChart account during the time period January 1, 2012 through June 1, 2016. To ensure continuous enrollment during the study period, subjects for analysis were required to have had at least 1 traditional encounter in the 1- to 3-year period both before and after the first account activation. This criterion was chosen to increase confidence in the encounter and messaging totals recorded by ensuring people were not lost to follow-up due to death or transferring to another health system. Because no patient identifiers were included in the analysis, this study was determined exempt by the University of Wisconsin Health Sciences Institutional Review Board.

We examined additional covariates, including the total number of traditional encounters in the year before activation (prior utilization). We also examined patient characteristics at time of first activation: age, sex, race/ethnicity (white, black, Hispanic, and non-Hispanic other), insurance type (private/health maintenance organization [HMO], Medicaid, Medicare, fee-for-service, contracted, paid-to-hospice, and none), and presence of chronic disease, including diabetes, hypertension, congestive heart failure (CHF), and depression, as indicated in the Clarity database at the time of first activation.

Differences in number of traditional encounters and the covariates were compared between patients who sent at least 1 message the year after activation and those who sent none. Mann-Whitney tests were used to compare continuous items, Fisher exact test was used for binary items, and chi-square test was used for categorical items.

Analyses were performed using a hurdle negative-binomial (NB) model, with logistic-link generalized linear model (GLM) modeling zeros, and a log-link truncated NB GLM modeling positive counts. Hurdle models are a class of models developed to count data with excess zeros (which are commonly encountered in health research and were present in our data due to the large number of patients who activated an account but did not send a message).

The hurdle model structure splits the interpretation of results into 2 parts. The first part (zero part) examines the association between the covariables and presence or absence of the outcome variable (whether or not a traditional encounter occurred in the year after account activation). The results are interpreted like a logistic regression in which the covariates estimate the odds of the

Table 1. Subject Characteristics for Whole Sample and by Any Messages Sent vs No Messages Sent

	Whole Sample	No Messages Sent	≥1 Message Sent	*P*-value	Test
N	80801	58015	22786		
Messenger status (%)	22786 (28.2)				
Messages sent [mean (SD)]	1.52 (5.16)	0.00 (0.00)	5.38 (8.58)		
Type of encounter [mean (SD)]					Mann-Whitney
Traditional	13.16 (15.47)	11.44 (13.90)	17.55 (18.16)	<0.001	
Office	5.76 (6.49)	5.03 (5.83)	7.61 (7.63)	<0.001	
Telephone	7.41 (10.83)	6.41 (9.73)	9.94 (12.88)	<0.001	
Prior use [mean (SD)]					Mann-Whitney
Traditional	10.25 (12.64)	9.82 (12.21)	11.34 (13.61)	<0.001	
Office	4.39 (5.30)	4.26 (5.13)	4.74 (5.69)	<0.001	
Telephone	5.86 (8.75)	5.56 (8.47)	6.60 (9.40)	<0.001	
Age [mean (SD)]	47.44 (16.55)	47.70 (16.63)	46.79 (16.31)	<0.001	Mann-Whitney
Male (%)	32579 (40.3)	24356 (42.0)	8223 (36.1)	<0.001	Fisher exact
Race/ethnicity (%)					Chi-square
White non-Hispanic	73192 (90.6)	52185 (90.0)	21007 (92.2)	<0.001	
Black non-Hispanic	2498 (3.1)	1942 (3.3)	556 (2.4)	<0.001	
Hispanic	1882 (2.3)	1431 (2.5)	451 (2.0)	<0.001	
Other non-Hispanic	3229 (4.0)	2457 (4.2)	772 (3.4)	<0.001	
Insurance (%)					Chi-square
Medicare	7751 (9.6)	5883 (10.1)	1868 (8.2)	<0.001	
Contracted	19239 (23.8)	13526 (23.3)	5713 (25.1)	<0.001	
Fee-for-Service	4095 (5.1)	2956 (5.1)	1139 (5.0)	<0.001	
HMO	41888 (51.8)	29931 (51.6)	11957 (52.5)	<0.001	
Hospice	176 (0.2)	110 (0.2)	66 (0.3)	<0.001	
Medicaid	4790 (5.9)	3508 (6.0)	1282 (5.6)	<0.001	
None	2862 (3.5)	2101 (3.6)	761 (3.3)	<0.001	
Diabetes history (%)	5075 (6.3)	3589 (6.2)	1486 (6.5)	0.079	Fisher exact
Depression history (%)	20192 (25.0)	14038 (24.2)	6154 (27.0)	<0.001	Fisher exact
Hypertension history (%)	15433 (19.1)	11215 (19.3)	4218 (18.5)	0.008	Fisher exact
CHF history (%)	719 (0.9)	535 (0.9)	184 (0.8)	0.124	Fisher exact

Abbreviations: HMO, health maintenance organization; CHF, congestive heart failure.

outcome. The second part (positive part) examines the association of the covariates with the quantity of the outcome variable (how many more or fewer traditional encounters occurred in the year after activation) and is interpreted like a Poisson regression.

Secondary analyses examined telephone calls and in-person office visits as 2 separate outcome variables. Two additional hurdle models were used to analyze each secondary outcome, with prior use of in-person office visits or telephone calls used as covariates in their respective models.

All analyses were performed using R version 3.4.4.[24] Regression analysis was performed using the "pscl" package.[25]

RESULTS

Nearly 81,000 (n=80,801) patients met the criteria for inclusion in the study. Table 1 shows the characteristics of the overall sample and details the characteristics of those who did and did not send messages. Of the total patients included in our analyses, 22,789 (28%) sent at least 1 message during the year after activation, with the median and mean number of messages sent of 3 and 5.38, respectively.

Patients who sent messages were more likely to be female (63.9% vs 58.0%, $P<0.001$), white (92.2% vs 90.0%, $P<0.001$), and more likely to have depression (27.0% vs 24.2%, $P<0.001$) than those who sent none.

Compared to those who sent none, patients who sent messages had greater odds of having a traditional encounter in the year after activation (Figure 1). As the number of messages sent increased, so did the odds of having an encounter. Patients who sent 1 message had 2.4 times greater odds of having a traditional encounter; patients sending the mean (5.4) number of messages had 10.1 times greater odds of having an encounter (Figure 2).

In addition to messaging, several other covariates were found to be significantly associated with increased odds of having at least 1 traditional encounter in the year following activation: number of encounters in the year prior to activation (prior use), black race/ethnicity compared to white (OR 1.34; 95% CI, 1.03-1.77), and presence of depression (OR 1.54; 95%, CI 1.38-1.72), diabetes (OR 1.70; 95% CI, 1.27-2.28), and hypertension (OR 1.98; 95% CI, 1.72-2.29).

The strongest predictor of having a traditional encounter in the year after account activation was number of prior encounters in the year before activation, followed by messaging.

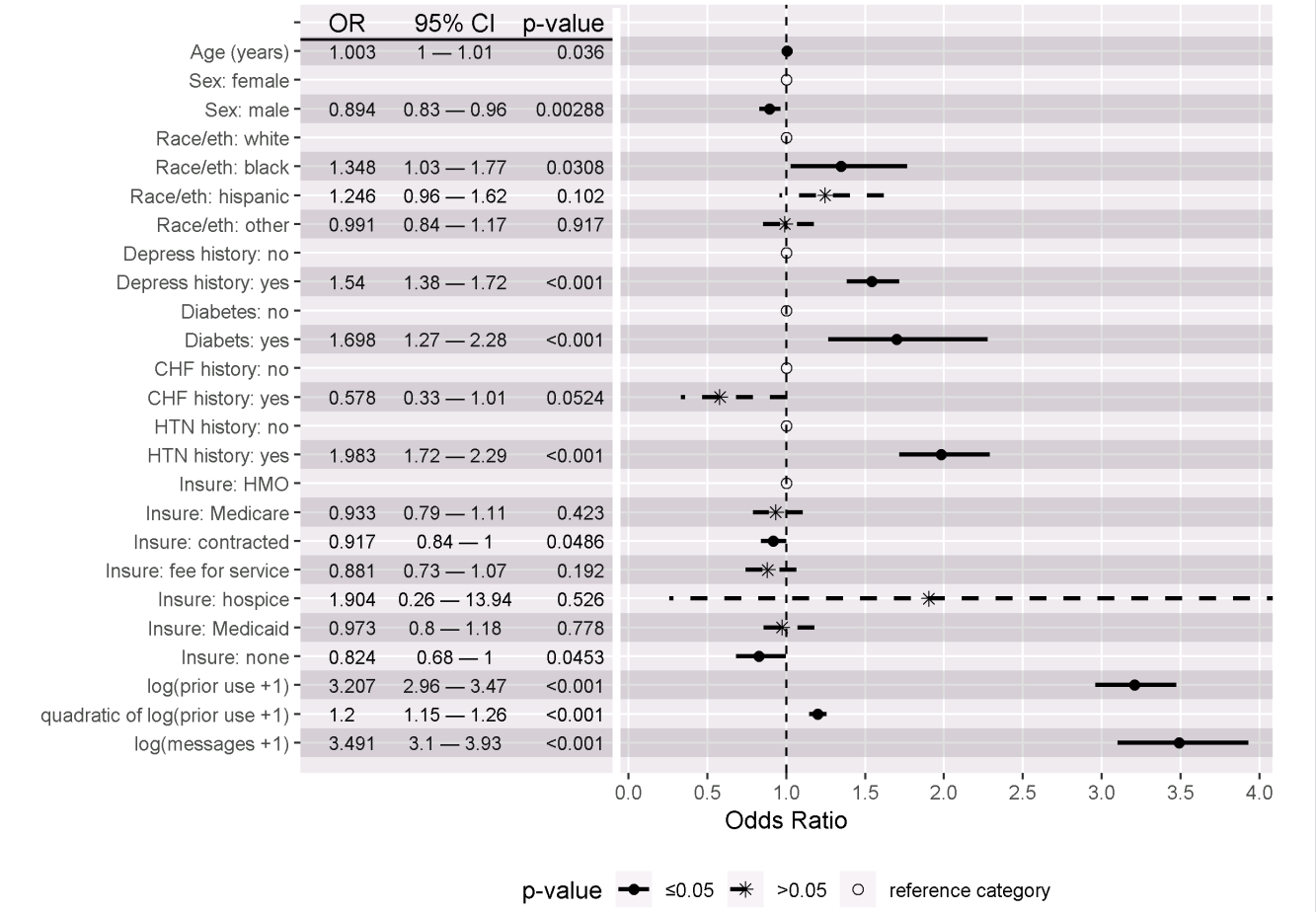
The second part of the hurdle model showed that patients who sent messages also had a greater number of traditional encounters the year after activation than those who sent none (mean 17.6 vs 11.4, $P<0.001$); they had both more in-person office visits (7.6 vs 5.0, $P<0.001$) and telephone calls (9.9 vs 6.4, $P<0.001$) when examined separately. As the number of messages sent increased, so did the number of encounters.

Figure 3 displays the expected increase in number of traditional encounters for these same increases in messaging. Compared to those who sent none, a patient sending 1 message is expected to have 21% more traditional encounters in the year after activation; a patient sending the mean (5.4) number of messages would have 65% more encounters. Findings were also consistent across secondary analyses for both office visits and telephone calls when analyzed separately.

DISCUSSION

We found that adult patients who activated a MyChart account and used it to send at least 1 message were more likely to have an office visit or a telephone call to the office in the year after

Figure 1. Odds of Having a Traditional Encounter in the Year After Account Activation by Variable



activation than those who activated an account but did not send a message. Patients who sent a message are also expected to have more traditional encounters within that year than similar patients who sent fewer or no messages, including a higher number of both office visits and telephone calls when examined separately. The effect is not subtle: patients sending just the average number of messages are expected to have around 50% more traditional encounters than patients who send none.

While number of encounters in the year prior to activation (prior use) was a strong predictor of number of traditional encounters, given 2 patients with the same level of prior use, the patient who sent a message will have a greater likelihood of an encounter, and a greater expected number of encounters, than the patient who did not send a message.

Contrary to initial expectations, we found patients who sent messages are expected to have more telephone calls in the year after account activation. We believed that patients would have a decreased likelihood of telephone calls as they show a willingness to communicate via messaging. However, we found that patients who sent messages had a higher number of traditional encounters (prior use) in the year before account activation compared to patients who did not send messages (11.34 vs 9.82), which was primarily due to a difference in prior telephone use (6.60 vs 5.56) as opposed to a difference in prior number of office visits (4.74 vs 4.26). A reasonable explanation for our finding, then, is that the expected increase in telephone calls are patient initiated: patients who were already inclined to communicate with the office will adopt secure messaging as an additional method of communication. This effect has been shown in other settings, such as the banking sector, and is termed the "gateway effect."[26] Furthermore, patients might phone in to ensure a message was received or acted upon in a timely manner. An alternative explanation is that at least some proportion of the increase in telephone calls is physician or staff generated, as the asynchronous nature of electronic communication does not always enable adequate symptom triage.

Our study design improves upon previous research in a number of ways. Because patients typically choose to activate an account at an office visit, there is an association between account activation and short-term increases in traditional encounters (typically for follow-up or management of a newly identified problem). To control for this spike, previous studies have cho-

Figure 2. Odds Ratio of Having an Encounter in the Year After Account Activation, By Encounter Type and Number of Messages Sent

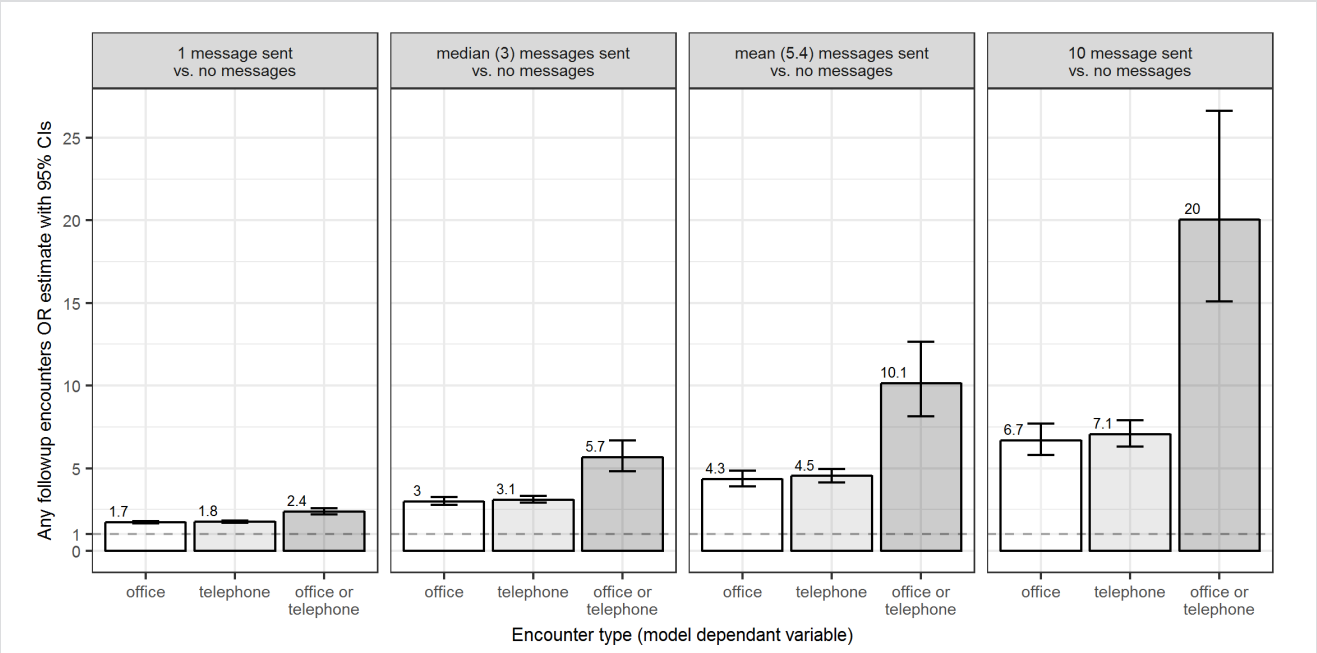
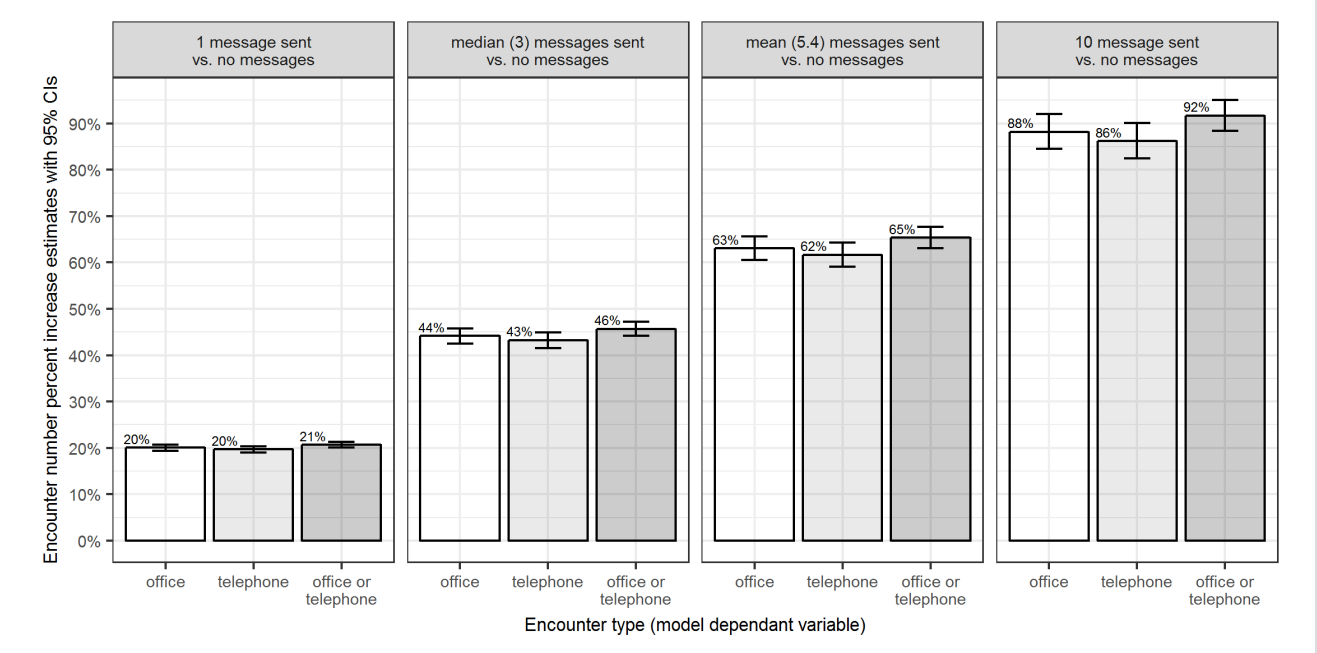


Figure 3. Expected Increase in Number of Encounters in the Year After Activation, by Encounter Type and Number of Messages Sent



sen to exclude from analysis data for a varying length of time (ranging from 30 days to 6 months) after activation. We did not believe we needed to exclude any data because enrollment in our study was predicated upon account activation and so any visit spike should theoretically be the same between groups. We believe this provides a more robust analysis in terms of actual work that the health care system will need to prepare for after an account is activated. We also developed a regression model that accounted for many factors, including demographic characteristics, insurance status, presence of chronic disease, and prior use of the health care system, and found a strong and important association between number of messages sent and number of traditional office visits. Accounting for prior use of the health care system before account activation had the added benefit of adjust-

ing for utilization effects of patient health conditions that were not directly estimated by parameters in the model.

Although it may seem more intuitive to combine telephone calls and electronic messages together as "nontraditional encounters" as neither typically generate revenue or require a visit to the office, we believed it made more sense to combine office visits and telephone calls together as traditional encounters. Office visits always occur synchronously and require the staff, patient, and provider to be present in the same place at the same time. Telephone calls, though allowing for distance, are for the most part answered in real-time and require staff availability at the time of patient demand. Electronic messages (typically sent directly to a physician or advanced practice provider) require less real-time staff input and are less likely to directly affect decisions around staffing and clinic workflow.

Our study has several important limitations. First, we did not examine the temporal association between sending messages and having a traditional encounter, so we cannot say that the observed association is causal. Second, to ensure that we had a large enough sample size for the study, we included for analysis all patients in the UW Health system, including those in both specialty and primary care. This may have introduced confounding variables as we could not determine which services the messages were sent to and which services the office visits were in. A follow-up study in a single department may help clarify these factors.

Also of note, we did not differentiate between who initiated the exchange of MyChart messages (message threads). Patients who start message threads could have different rates of traditional encounters compared to those who respond to threads started by the health care team. For example, messages sent by the office to remind patients to present for age-appropriate health screenings would logically be expected to increase encounter totals. Similarly, patient-initiated messages could be expected to have contradictory effects on resource utilization based on whether the context of the message substituted for or triggered further follow-up.

We also likely have not included all potentially relevant explanatory covariables in our models. Physician factors have been shown to affect the number of messages sent by patients,[22] and severity of acute illness may be a better predictor of use of traditional encounters than the chronic illnesses we accounted for. Unfortunately, we could not easily access this information through our EHR database. However, we believe prior utilization was an effective alternative method of adjusting for all other acute and chronic illnesses at the individual patient level.

Finally, our study sample may not be representative of a broader population. Most patients were insured during the study period, which limits generalizability to this subset of the entire patient population. Since they voluntarily chose to activate a portal account, we also assume they all had access to a computer or smart phone. The compensation system at UW Health is partially capitated, which may limit a physician's incentive to convert a MyChart message to an in-person visit. Despite this factor, which could be expected to decrease the number of expected traditional encounters, we still found a positive association between messaging and encounters.

CONCLUSION

While electronic messaging is often portrayed as having the potential to increase clinician efficiency, our study adds to the growing literature that messaging is associated with increased resource utilization (office visits and telephone calls) by patients. Messaging does not appear to serve as a simple substitution for other forms of clinical services. Instead, it may act as a gateway to increase the number of traditional clinical encounters, all of which require staff and clinician time and attention. In an era of ever-increasing burnout,[27,28] it is increasingly important to recognize additional sources of work for both providers and staff.[29] Furthermore, health systems need to be prepared for the increase in visits and calls (in addition to the obvious increases in messages) that are expected as more patients enroll in patient portals and participate in the messaging feature.

Future research should focus on which features of messages or characteristics of patients who send them are most likely to be associated with the expected increase in traditional encounters: does the content of the message itself or a gateway phenomenon explain our findings? We remain optimistic that there are certain subsets of messages that have the potential to increase clinician efficiency without a cost-prohibitive increase in staff resources compared to other categories of messages. Additionally, research should continue to focus on how messaging affects other important aspects of care, including quality of care and patient satisfaction. Further qualitative studies utilizing record reviews should be done to help elucidate the reasons that patients use portal-based messaging systems.

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