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Authors
Lyles, Courtney R
Sarkar, Urmimala
Schillinger, Dean
et al.

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Refilling medications through an online patient portal: consistent improvements in adherence across racial/ethnic groups

Courtney R. Lyles[1,2,3], Urmimala Sarkar[1,2], Dean Schillinger[1,2,3], James D. Ralston[4], Jill Y. Allen[5], Robert Nguyen[5], Andrew J. Karter[3]

ABSTRACT

Objective Online patient portals are being widely implemented; however, no studies have examined whether portals influence health behaviors or outcomes similarly across patient racial/ethnic subgroups. We evaluated longitudinal changes in statin adherence to determine whether racial/ethnic minorities initiating use of the online refill function in patient portals had similar changes over time compared with Whites.

Methods We examined a retrospective cohort of diabetes patients who were existing patient portal users. The primary exposure was initiating online refill use (either exclusively for all statin refills or occasionally for some refills), compared with using the portal for other tasks (eg, exchanging secure messages with providers). The primary outcome was change in statin adherence, measured as the percentage of time a patient was without a supply of statins. Adjusted generalized estimating equation models controlled for race/ethnicity as a primary interaction term.

Results Fifty-eight percent of patient portal users were white, and all racial/ethnic minority groups had poorer baseline statin adherence compared with Whites. In adjusted difference-in-difference models, statin adherence improved significantly over time among patients who exclusively refilled prescriptions online, even after comparing changes over time with other portal users (4% absolute decrease in percentage of time without medication). This improvement was statistically similar across all racial/ethnic groups.

Discussion Patient portals may encourage or improve key health behaviors, such as medication adherence, for engaged patients, but further research will likely be required to reduce underlying racial/ethnic differences in adherence.

Conclusion In a well-controlled examination of diabetes patients' behavior when using a new online feature for their healthcare management, patient portals were linked to better medication adherence across all racial/ethnic groups.

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Keywords: race/ethnicity, diabetes, electronic health records, medication adherence

INTRODUCTION

Patient access to electronic health record (EHR) information through secure websites, called online patient portals or personal health records, is rapidly expanding.[1,2] This is due, in large part, to federal incentives that help healthcare systems increase health information technology use and achieve "meaningful use" (MU) objectives for patient portals. This expansion is part of national health reform, taking place under the Affordable Care and Health Information Technology for Economic and Clinical Health Acts. Specifically, MU provides financial incentives for healthcare delivery systems that: 1) implement EHRs and 2) encourage patients and families to use patient portals for tasks such as viewing visit summaries, refilling medications, and sending secure email messages to providers.[3,4] Because of the widespread uptake of MU across systems and providers, patient portal access will be one of the first health technologies to reach diverse patient populations throughout the United States. Portals may be particularly beneficial for patients with chronic illnesses such as diabetes, because these individuals have many self-management and care coordination needs that are often unmet by brief and relatively infrequent in-person office visits.[5]

Although patient portal implementation is moving forward quickly, the introduction of this new technology may exacerbate existing healthcare disparities, such as those based on race/ethnicity or socioeconomic status. The "inverse care law" postulates that new healthcare interventions disproportionately benefit those patients with the most resources.[6] Drivers of the inverse care law include: 1) differential uptake of patient portal technology and 2) differential effectiveness of the portal across particular patient subgroups, eg, racial/ethnic subgroups. To date, several studies, including those by our own group, have documented substantial racial/ethnic differences in patient portal uptake and use, primarily within large, integrated delivery systems that have provided patients with access to portals for over a decade.[7–11] These differences in patient portal use across different races/ethnicities persist even after accounting for: 1) logistical barriers such as computer/Internet access and 2) patient-provider communication or recommendations that patients register for and use the portal website.[10] While several studies have indicated that patient portals may improve patients' access to care[12] as well as some self-care processes and outcome measures,[13–17] we are not aware of any study that examines the differential impact of portal use on health behaviors across races/ethnicities.

In a diverse population of diabetes patients, we examined the impact of patients initiating the use of the online medication/prescription refill function (referred to as "refill function use" hereafter) in the patient portal on changes in patients' medication adherence. Specifically, we evaluated whether certain racial/ethnic subgroups experienced greater or lesser benefits from refill function use.

Correspondence to Courtney Lyles, PhD, Assistant Professor, University of California San Francisco, Division of General Internal Medicine at San Francisco General Hospital, UCSF Center for Vulnerable Populations, 1001 Potrero Ave., Building 10, Ward 13, San Francisco, CA 94110, USA, Courtney.Lyles@ucsf.edu, Tel: (415) 206-6483

METHODS

Study Setting

This study was conducted with a cohort of existing patient portal users at a large, integrated healthcare system, Kaiser Permanente Northern California, that has a racially/ethnically diverse membership. For this analysis, patients were selected from Kaiser Permanente's Type 2 Diabetes Registry, from the years 2006 through 2012.[18–22] The racial/ethnic breakdown of the Diabetes Registry in 2012 was as follows: 36% White, 7% Black, 19% Latino, 15% Asian, 3% Other (including Pacific Islanders), and 19% Unknown/Not Reported.

In addition to online refilling, the patient portal at www.kp.org allows all registered Kaiser Permanente patients to perform tasks such as viewing their medical history and visit summaries, viewing laboratory results, scheduling appointments, and exchanging secure email messages with providers. This portal has been available to all Kaiser Permanente patients in Northern California since 2005 and is widely promoted to Kaiser Permanente's membership. Sixty percent of all adult members of the Kaiser Permanente system were registered patient portal users as of December 31, 2012, the end of our study period.

Sample Selection and Exposure Definition

For this study, we selected all diabetes patients who were prescribed statins for the entire study period and who refilled those prescriptions exclusively within Kaiser Permanente (~96% of all prescriptions are filled internally in this system). We chose to examine a single medication class – statins (HMG-CoA (3-hydroxy-3-methyl-glutaryl-CoA reductase) reductase inhibitors) – because this is the predominant class of lipid-lowering therapy, which is very widely and consistently prescribed to diabetes patients to reduce cardiovascular morbidity.[23]

Among the statin users selected for this study, we limited our analysis to *ongoing* portal users (ie, those who used one of the kp.org MyChart features at least once prior to the study period). To examine a dose-response relationship, we categorized refill function use into two groups: 1) those patients initiating and refilling medications exclusively online during the study period ("exclusive users") and 2) those patients initiating and refilling medications at least once online during the study period ("occasional users").

We then compared refill function users with those who used other online portal features but *did not* use the refill function. We required each subject in the reference group to have completed at least one online task during the study period (eg, used the patient portal to send a secure message, view a laboratory result, or schedule an appointment online) but ordered all their statin medication refills in-person at pharmacies or via the telephone refill system (which, like the online system, included either mail-order or pick-up options). This made the exposed and reference groups more comparable, because subjects from both groups were routine portal users, with some level of basic computer literacy and access to the Internet. Additional details about the cohort creation have been published previously.[24]

Outcome Assessment

Our primary outcome of interest was pre-post change in statin medication adherence during three consecutive refilling intervals. Medication adherence was estimated by the well-validated continuous medication gap methodology, which uses pharmacy utilization data to calculate the percentage of time that patients lack a supply of medication.[25,26] We report patients' percentage of time without a supply of statins as a continuous outcome.

For the exposed group, we evaluated changes in medication adherence from before and after patients started using the portal website to refill their medications. For each subject in the reference group, the timing of the pre-post periods was matched to the calendar time for a randomly selected subject in the refill function user group. This evaluation in the reference group allowed us to calculate "background" or temporal changes in statin adherence.[27]

Effect Modification by Race/Ethnicity

We examined whether the influence of using the online refill function on changes in medication adherence differed across racial/ethnic groups. We used a six-category self-reported assessment of patient's race/ethnicity, obtained from the EHR: 1) White/Non-Hispanic, 2) Black/Non-Hispanic, 3) Latino, 4) Asian, 5) Filipino (because this subgroup was large enough to examine separately from the Asian group), and 6) Other/Mixed Race/Unknown.

Covariates

In adjusted models, we included covariates that could confound the relationship between refill function use and statin adherence, using a rule-based analysis of a directed acyclic graph.[28–30] Covariates included age (in years), gender, number of chronic medications (total count), number of kp.org log-ons (categorized into quartiles of use), and number of outpatient visits (total count), all gathered from the EHR, from the 12 months prior to the baseline. We adjusted for baseline patient portal log-ons, rather than the length of time each patient had been a portal user or their total lifetime portal use, because we hypothesized that recent portal use was most likely to influence patients' subsequent online refill function use.

Analytic Approach

For unadjusted analyses, we first examined whether the racial/ethnic make-up of the portal user sample differed from that of the Diabetes Registry overall, using a chi-square goodness-of-fit test. We then examined racial/ethnic differences in: 1) online refill function use and 2) baseline statin adherence among portal users, using chi-squared and *t*-tests. Lastly, we evaluated the pre-post changes in adherence by refill function and race/ethnicity subgroups using paired *t*-tests.

For adjusted analyses, we used a difference-in-differences framework[31] to estimate changes in statin adherence for those initiating: 1) exclusive and 2) occasional online refill function use, after subtracting the background changes in adherence observed among the reference group. We calculated these adjusted differences using modified least-squares regression models.[32,33] The difference-in-difference estimator of the refill function effect was then compared across racial/ethnic groups (using an interaction term in the fully adjusted model) to evaluate whether the impact of using the refill function on medication adherence differed significantly by race/ethnicity.

This study was approved by the Institutional Review Board of Kaiser Permanente Northern California's Division of Research.

RESULTS

The demographics of the study sample are presented in Table 1. Subjects were, on average, 63 years old and had an average of 6.7 chronic medication prescriptions and 11.4 outpatient visits in the previous year. The distribution of race/ethnicity was 58% White, 10% Asian, 9% Latino, 9% Filipino, 7% Black, and 9% Mixed/Other/Unknown, with a much larger proportion of Whites compared with the overall racial/ethnic make-up of the Diabetes Registry ($P < .001$). Refill function users tended to be younger, to utilize a higher number of chronic medications than those not refilling their medications online, and to have a higher number of total kp.org log-ons at baseline.

Table 1: Sample Characteristics at Baseline

Mean (SD) or column percentage	Total	Portal users: refill function use categories			
		Reference group	Exposure groups		
	$n = 17\ 760$	No use	Occasional refill function use	Exclusive refill function use	P-value
		(n = 9055)	(n = 5418)	(n = 3287)	
Demographics					
Age (SD)	62.7 (11.3)	64.6 (11.0)	60.1 (11.3)	61.9 (10.8)	<.001
Female	46	46	48	43	<.001
Portal Use					
Use of kp.org features					
Secure messaging	78	71	85	86	<.001
Appointments	54	37	70	72	<.001
Lab view	86	79	93	94	<.001
Log-ons to kp.org					
<4	23	40	7	4	<.001
4–14	25	30	24	15	
15–33	26	19	32	34	
≥34	26	11	36	48	
Health status					
Number of chronic medications used	6.7 (3.1)	6.6 (3.1)	6.7 (3.1)	6.8 (3.0)	.02
Number of outpatient visits	11.4 (12.2)	11.5 (12.0)	11.5 (13.1)	10.9 (11.2)	.08

SD, standard deviation.

Blacks were significantly less likely to be exclusive refill function users compared with Whites (Table 2), but there were no other significant differences in refill function use by race/ethnicity. At baseline, the average percentage of time a patient was without a supply of statins was 12.9%. Whites had the lowest percentage time without a supply of statins (11.8%), with all other racial/ethnic groups having worse baseline adherence (Blacks = 15.7%, Asians = 13.1%, Filipinos = 13.4%, Latinos = 15.7%, and Other = 14.2%; all $P < .01$).

We first examined unadjusted changes in adherence over the study period (Figure 1). There were no significant changes in medication adherence among the reference group (n = 9055). Among *occasional* refill function users (n = 5418), all racial/ethnic groups had a decrease in percentage time without a supply of statins, but this change was statistically significant for Whites only (from 14.2% to 12.6%, $P < .01$). However, among *exclusive* online refill function users (n = 3287), there were statistically significant absolute decreases in percentage of time without a supply of statins for Whites (a 3.2% decrease), Asians (a 5.1% decrease), Filipinos (a 3.9% decrease), Latinos (a 5.6% decrease), and Mixed/Other/Unknown (a 3.0% decrease). The 3.7% absolute decrease in time without a supply of statins for Blacks (n = 148) did not reach statistical significance, possibly due to insufficient statistical power.

Adjustment for potential confounding and temporal changes over time among the reference group did not substantively change the patterns in the difference-in-differences models (Table 3). There was a significant absolute decrease in time without a supply of statins for
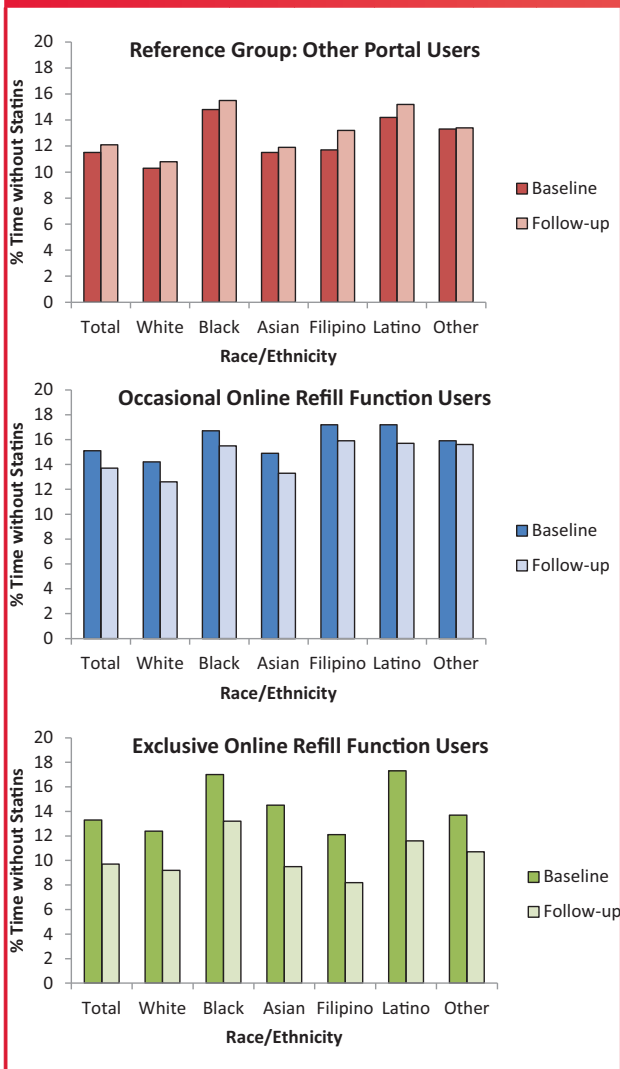
Table 2: Baseline Adherence and Refill Function Use, by Race/Ethnicity

Race/Ethnicity	Time without stains at baseline (%)	Online refill function use		
		Portal user, but not refill function user	Occasional refill function user	Exclusive refill function user
		n (%)	n (%)	n (%)
White	11.8	5218 (51)	3022 (29)	2035 (20)
Black	15.7	675 (54)	425 (34)	148 (12)*
Latino	15.7	778 (49)	539 (34)	260 (16)
Asian	13.1	935 (51)	547 (35)	366 (20)
Filipino	13.4	615 (54)	341 (30)	185 (16)
Other	14.2	834 (50)	544 (33)	293 (18)

*$P < 0.05$.

exclusive refill function users among all racial/ethnic groups, except Other/Mixed/Unknown, with absolute percentage decreases in time without a supply of statins ranging from 3.2% for Whites to 6.1% for Latinos. The improvements were statistically similar across

Figure 1: Changes in statin adherence by refill function use and race/ethnicity.

Table 3: Adjusted Difference-in-Difference Changes in Statin Adherence, by Race/Ethnicity

Race/ Ethnicity	Occasional users of refill function, compared with other portal users	Exclusive users of refill function compared with other portal users
	Risk difference (95% CI)	Risk difference (95% CI)
White	−1.7 (−2.6 to −0.1)*	−3.2 (−4.3 to −2.2)*
Black	−1.4 (−3.7 to 0.9)	−3.8 (−7.3 to −0.4)*
Latino	−2.1 (−4.3 to 0.01)	−6.1 (−8.8 to −3.4)*
Asian	−1.7 (−3.7 to 0.4)	−5.0 (−7.3 to −2.6)*
Filipino	−2.5 (−5.0 to 0.1)	−4.9 (−8.0 to −1.7)*
Other	0.02 (−2.1 to 2.1)	−2.6 (−5.1 to 0.02)

CI, confidence interval.
Interaction term for race * refill function use: $P = .53$. Models controlled for baseline adherence, age, gender, total number of medications at baseline, outpatient utilization visits at baseline, and total number of kp.org log-ons at baseline. *$P < 0.05$.

racial/ethnic groups (*P*-value for interaction $P = 0.53$). Similar to unadjusted findings, the only significant improvement among occasional refill function users was seen among Whites, with a 1.7% decrease in percentage of time without a supply of statins.

All patterns of statistical significance were virtually identical when we used the standard dichotomization for adherent vs non-adherent (<20% vs ≥20% time without sufficient medication supply; data not shown).

DISCUSSION

Our study was the first to demonstrate that initiation of refilling medications online was associated with significantly improved medication adherence across diverse racial/ethnic groups in an integrated healthcare system. The most highly engaged online refill function users experienced significant improvement in statin adherence regardless of their race/ethnicity. Our study was a well-controlled examination of diabetes patients' behavior when using a new online patient portal feature for their healthcare management, and we were able to not only estimate pre-post changes in medication adherence over time but also compare these trends with those of a reference group. Overall, our

findings support the notion that, once patients are engaged in patient portal use, patient portals may encourage or improve key health behaviors, such as medication adherence. This finding is particularly promising, because patient portals are becoming more prevalent in the United States.

Our data also indicated lower overall patient portal registration and online refill use among racial/ethnic minority groups. This is consistent with previous evidence (both within and external to the Kaiser Permanente system) that racial/ethnic minorities are significantly less likely to register for online patient portal use or to actively use any portal feature compared with Whites.[7–11] Our work therefore suggests that the inverse care law appears to be operating with respect to initial uptake/use of patient portals, but perhaps not with respect to differential effectiveness among ongoing users.[34] This may speak to the fact that, while there are usability or accessibility challenges for patients registering for the portal, features like online refilling do not present major additional barriers to use once a patient registers. Furthermore, because exclusive refill function users within each racial/ethnic group had similar improvements in medication adherence over time, refilling medications online likely did not reduce extant racial/ethnic disparities in medication adherence – although we did not have the statistical power to examine this aspect in depth.

Our findings could potentially be interpreted in light of a change in patient activation or health status not measured explicitly in this study. There is previous evidence that recent increases in comorbidity are linked to the initiation of patient portal use among older adults,[35] suggesting that a new health need could influence online refill function use as well. If there changes in patients' health or activation drove improved medication adherence in our study, our findings may imply that the availability of the online refill function was a tool to enable health behavior change among patients who were ready to act (rather than a causal agent itself). Future studies that can explicitly measure changes in patient activation over time would be particularly informative to tease out the causal links between portal use and health outcomes.

RESEARCH AND APPLICATIONS

We recognize several limitations of this study. First, we only examined patient portal use within one integrated healthcare delivery system, and, therefore, our findings may not be generalizable to other populations. However, the Kaiser Permanente Northern California sample is racially/ethnically and socioeconomically diverse[17] and representative of individuals in the entire geographic region.[36] This healthcare system is also well past the early adoption phase of their patient portal (portal access has been available to patients for over a decade), which suggests that these findings may anticipate other health systems' future experiences after launching their portal websites. Second, we examined the relationship between only one portal feature and one health behavior (initiation of online refill function use and medication adherence, for a single medication). We recognize that focusing on statin adherence may not represent adherence for other medications, but we felt it was important to isolate a specific pathway between the type of portal use and a relevant health outcome. Future research will need to examine other relationships between demographics, like age and gender, with refill function use, as well as whether and how our findings extend to other portal functions and health behaviors.

CONCLUSION

From a clinical and health policy perspective, the role of patient portals will increase in the coming years. Not only will healthcare organizations be implementing these technology systems and encouraging patients to use them in order to meet MU criteria, but portals represent a primary platform for future EHR-integrated tools to engage patients and families in care, by, for instance, importing data from devices and sensors into the medical record. Our findings demonstrate that providing tools for healthcare management (such as online prescription refilling) can improve self-care management. It was reassuring to observe in our data that online prescription refilling benefited all race/ethnic groups. However, the racial/ethnic differences in baseline adherence, as well as portal and refill function use, highlight the need to understand a multitude of approaches to encourage positive health behaviors across diverse groups. To support medication adherence overall, we need to better match patients' needs and capabilities to refill services, even for those patients already using online patient portals.

CONTRIBUTORS

C.R.L. conceptualized the study and contributed to protocol design, data acquisition, data analysis, and drafting of the manuscript. U.S., D.S., J.D.R., J.Y.A., R.N., and A.J.K. guided the study conceptualization, data acquisition, and data analyses, and edited and approved the manuscript. All authors have fulfilled the criteria for authorship established by the International Committee of Medical Journal Editors and approved the submission of the manuscript.

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None.

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AUTHOR AFFILIATIONS

[1]University of California San Francisco, Department of Medicine, Division of General Internal Medicine, San Francisco General Hospital, San Francisco, CA, USA

[2]University of California San Francisco, Center for Vulnerable Populations, San Francisco, CA, USA

[3]Kaiser Permanente Northern California, Division of Research, Oakland, CA, USA

[4]Group Health Research Institute, Seattle, WA, USA

[5]Kaiser Permanente, National Market Research, Oakland, CA, USA

RESEARCH AND APPLICATIONS