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Association of Online Patient Access to Clinicians and Medical Records With Use of Clinical Services

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Context Prior studies suggest that providing patients with online access to health records and e-mail communication with physicians may substitute for traditional health care services.

Objective To assess health care utilization by both users and nonusers of online access to health records before and after initiation of MyHealthManager (MHM), a patient online access system.

Design, Setting, and Participants Retrospective cohort study of the use of health care services by members (≥18 years old) who were continuously enrolled for at least 24 months during the study period March 2005 through June 2010 in Kaiser Permanente Colorado, a group model, integrated health care delivery system. Propensity scores (using age, sex, utilization frequencies, and chronic illnesses) were used for cohort matching. Unadjusted utilization rates were calculated for both MHM users and nonusers and were the basis for difference-of-differences analyses. We also used generalized estimating equations to compare the adjusted rates of utilization of health care services before and after online access.

Main Outcome Measures Rates of office visits, telephone encounters, after-hours clinic visits, emergency department encounters, and hospitalizations between members with and without online access.

Results Comparing the unadjusted rates for use of clinical services before and after the index date between the matched cohorts, there was a significant increase in the per-member rates of office visits (0.7 per member per year; 95% CI, 0.6-0.7; $P<.001$) and telephone encounters (0.3 per member per year; 95% CI, 0.2-0.3; $P<.001$). There was also a significant increase in per-1000-member rates of after-hours clinic visits (18.7 per 1000 members per year; 95% CI, 12.8-24.3; $P<.001$), emergency department encounters (11.2 per 1000 members per year; 95% CI, 2.6-19.7; $P=.01$), and hospitalizations (19.9 per 1000 members per year; 95% CI, 14.6-25.3; $P<.001$) for MHM users vs nonusers.

Conclusion Having online access to medical records and clinicians was associated with increased use of clinical services compared with group members who did not have online access.

JAMA. 2012;308(19):2012-2019 www.jama.com

USING HEALTH INFORMATION technology to foster efficient health care delivery is an important component of health care reform. Previous studies indicate that patients desire online access to their medical records and e-mail communication with their clinicians.[1-6] The Institute of Medicine report *Crossing the Quality Chasm: A New Health System for the 21st Century* posited electronic patient-physician messaging as a promising technology to improve the quality and efficiency of health care.[7] Several studies support this contention.[8-10] Some reports estimate that 25% to 70% of all visits to physicians do not require face-to-face appointments.[11-13] Therefore, online consultations may substitute for traditional health care visits.[14-16]

Prior studies examining the association of online messaging with use of other health care services report conflicting results. Some show no change while others reveal reduced use of office visits or telephone calls.[17-21] Some commentators[20,22-25] suggest that providing patients online access to their medical records may reduce the need for face-to-face contact. The presumption is if patients could look up health information such as their test results, request prescription refills, schedule appointments, and send secure e-mail to clinicians, then their use of clinical in-person and telephone calls may decrease.

Previously, studies within Kaiser Permanente demonstrated that patients with access to online messaging had

For editorial comment see p 2034.

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fewer annual office visits than patients without online access, but this lower rate of visits was more than offset by an increased rate of telephone contacts.[26,27] Many previous studies involved small numbers of patients and were conducted early in the implementation of patient online access. Now that online access to health records is better established within Kaiser Permanente, we investigated the association between patient online access and use of clinical services. Because several previous studies suggest that online access may replace a patient's need for face-to-face health care services,[11-13] we hypothesized that members who had online access to their medical records, including the ability to communicate with clinicians online, would decrease their use of in-person clinical services.

METHODS

The study was conducted at Kaiser Permanente Colorado (KPCO), a group model, integrated health care delivery system that provides health care for a diverse population of more than 500 000 members in the Denver-Boulder-Longmont metropolitan area. Since 2004, KPCO has used a fully integrated electronic medical record (EMR) product (KP HealthConnect; Epic Systems) for health care documentation. This system includes appointment scheduling, clinical progress notes, orders (laboratory, radiology, medications, and referrals), telephone and e-mail encounters, and test result review. Clinicians are expected to use the system to document all clinical encounters. In May 2006, KP HealthConnect added an online feature, MyHealthManager (MHM). This feature allows members to obtain secure online access to their health records, including test results, immunization records, active medications, medical problem list, and care plans. In addition, members can use MHM to schedule or cancel nonurgent appointments, request medication refills, and send and receive secure messages to and from clinicians. The primary goal of the MHM system is to provide members access to all of these functions so they have the opportunity to review and manage their own health information.

Each KPCO member receives information from multiple sources about how to register for the service. Any members 13 years of age and older with internet access and their own e-mail accounts can register to use the system. Members receive information about the system and invitations to register in their membership materials, via notices posted in Kaiser clinics, at clinic check-in, through periodic member mailings, and in quarterly newsletters. Members of KPCO may visit the Kaiser website to register for MHM. Once they are registered, they obtain their own unique user ID and password, which allows secure MHM access via any computer with internet access. Members can send secure e-mails to clinicians through the MHM system. When MHM messages are sent by clinicians, members receive notifications in their personal e-mail accounts prompting them to log in to MHM to retrieve their messages in a secure manner.

Study Design

We conducted a retrospective cohort study with matched controls after obtaining approval from the KPCO institutional review board, which included a waiver of informed consent. The study period was March 2005 through June 2010. For inclusion in the study, KPCO members were required to be 18 years or older and continuously enrolled in the health plan for at least 24 months during the study period. We collected administrative data for health care utilization documented in the EMR for 1 year prior to and after the index date. We defined the index date for MHM users as the date they activated their online access. In addition, MHM users were required to have maintained an active access status for at least 12 months and used at least 1 MHM feature. For MHM nonusers, we determined the length of time each member was enrolled in the health plan during the study period. We then used the median date of each member's length of enrollment as the index date.

Because members were more likely to receive information about registering for MHM during a clinic visit, there is an increase in use of clinical services surrounding the MHM activation date. To minimize this effect, we excluded from analysis the use of clinical services for a 30-day period before and after the index dates for both MHM users and nonusers. We collected information from the EMR and administrative databases on patient age, sex, visit frequencies, and race/ethnicity. (Race/ethnicity was self-reported by members from an extensive list of options and consolidated into the following categories: white, Hispanic, black, other, or unknown.) We also collected patient-specific diagnoses data from the clinical database. We specifically looked for the presence of diagnoses such as asthma (codes 493.xx and 493.20 from the *International Classification of Diseases, Ninth Revision* [*ICD-9*]), diabetes mellitus (*ICD-9* codes 250.xx), coronary artery disease (*ICD-9* codes 414.xx), and congestive heart failure (*ICD-9* codes 414.8, 425.4, 425.5, and 428.xx). Numbers of office visits, telephone encounters, after-hours clinic visits, emergency department visits, and hospitalizations were collected from the administrative and EMR databases.

Statistical Methods

Descriptive statistics were calculated and tested using χ^2 tests for categorical variables and *t* tests for age. Because this was an observational study and the patient characteristics of MHM users and nonusers were dissimilar, we first calculated propensity scores by estimating the probability of MHM activation for each member using logistic regression for all study participants with age, sex, race, number of chronic illnesses, and baseline office visit rate category. One-to-one matching of MHM users to nonusers was performed using propensity scores within a range of ± 0.05 within index year and baseline

office visit category.[28] The baseline visit categories consisted of 0, 1 to 2, 3 to 5, and 6 or more office visits in the year preceding the index date. Using the matched cohorts, we calculated health care utilization rates for office visits, telephone calls, after-hours clinic visits, emergency department visits, and inpatient hospitalizations in the year prior to and after the index date. We reported office visit and telephone call rates on an individual basis (per member per year). However, because the individual rates for after-hours clinic visits, emergency department visits, and hospitalizations were very small, we reported these as rates per 1000 members per year to present the rates as whole numbers for clarity. We graphed office visit utilization over time using the matched cohorts. Difference-of-differences analyses were completed to test the change in 12-month utilization rates between the matched MHM and nonuser groups and specified matched subgroups based on age and 4 disease categories.

In addition, we used generalized estimating equations (GEEs)[29,30] for correlated count data to model and compare all utilization rates in terms of visit rate ratios between the time periods before and after online registration for the matched cohorts and specified subgroups based on age and 4 disease categories. All statistical analyses were performed using SAS version 9.2 (SAS Institute) with 2-sided statistical tests at a .05 significance level.

RESULTS

Member use of online access steadily increased from about 25% at the end of 2007 to 53.8% by June 2009 (n = 375 620). More than 45% of members with MHM access used at least 1 MHM function. We identified 87 206 members with online access and 71 663 members without access who were 18 years or older and continually enrolled in the health plan for at least 24 months during the study period. We used propensity scoring to match MHM users to nonusers. The

Table 1. Characteristics of Matched and Unmatched MyHealthManager Users and Nonusers[a]

	Unmatched, No. (%)			Matched, No. (%)		
	MHM Users (n = 87 206)	Nonusers (n = 71 663)	*P* Value	MHM Users (n = 44 321)	Nonusers (n = 44 321)	*P* Value
Age categories, y						
<20	1759 (2.0)	3471 (4.8)	<.001	945 (2.1)	952 (2.2)	.93
20-39	21 822 (25.0)	32 896 (45.9)		17 295 (39.0)	17 385 (39.2)	
40-59	38 963 (44.7)	27 556 (38.5)		19 666 (44.4)	19 584 (44.2)	
≥60	24 662 (28.3)	7740 (10.8)		6415 (14.5)	6400 (14.4)	
Age, mean (SD), y	50.5 (15.8)	40.8 (14.5)	<.001	44.9 (14.5)	43.7 (14.7)	<.001
Sex						
Female	51 349 (58.9)	32 916 (45.9)	<.001	23 772 (53.6)	23 307 (52.6)	.002
Male	35 857 (41.1)	38 747 (54.1)		20 549 (46.4)	21 014 (47.4)	
Race/ethnicity						
White	61 067 (70.0)	24 552 (34.3)	<.001	22 580 (50.9)	22 717 (51.3)	.92
Hispanic	5835 (6.7)	7766 (10.8)		5084 (11.5)	5056 (11.4)	
Black	2065 (2.4)	2548 (3.6)		1714 (3.9)	1719 (3.4)	
Other	2532 (2.9)	2131 (3.0)		1775 (4.0)	1763 (4.0)	
Unknown	15 707 (18.0)	34 666 (48.4)		13 168 (29.7)	13 066 (29.5)	
No. of chronic illnesses						
0	67 724 (77.7)	64 814 (90.4)	<.001	37 905 (85.5)	38 011 (85.8)	.38
1	16 207 (18.6)	6117 (8.5)		5739 (12.9)	5592 (12.6)	
2	2731 (3.1)	625 (0.9)		585 (1.3)	611 (1.4)	
3	509 (0.6)	100 (0.1)		88 (0.2)	100 (0.2)	
4	35 (0.04)	7 (0.01)		4 (0.01)	7 (0.02)	
Chronic illness						
Asthma	9001 (10.3)	3503 (4.9)	<.001	3203 (7.2)	3151 (7.1)	.50
Diabetes mellitus	8241 (9.5)	2933 (4.1)	<.001	2804 (6.3)	2764 (6.2)	.58
Coronary artery disease	4162 (4.8)	777 (1.1)	<.001	744 (1.7)	762 (1.7)	.64
Congestive heart failure	1932 (2.2)	482 (0.7)	<.001	438 (1.0)	465 (1.1)	.37
Office visits at baseline						
0	14 882 (17.1)	31 615 (44.1)	<.001	11 414 (25.7)	11 414 (25.7)	>.99
1-2	29 068 (33.3)	21 709 (30.3)		16 394 (37.0)	16 394 (37.0)	
3-5	24 383 (28.0)	11 768 (16.4)		10 402 (23.5)	10 402 (23.5)	
≥6	18 873 (21.6)	6571 (9.2)		6111 (13.8)	6111 (13.8)	

Abbreviation: MHM, MyHealthManager.
[a] Propensity scores (±0.05) within MHM activation year and baseline office visit categories were used to match MHM user and nonuser study participants.

refined cohorts each contained 44 321 matched members. Individuals who enrolled in MHM were slightly older (*t* test, $P<.001$) and more likely to be female (χ^2, $P=.002$) than nonusers (TABLE 1).

In the year following activation of MHM access, the MHM cohort had increased rates of office visits per mem-

Table 2. Annual Rates of Health Care Utilizations in the Matched Cohorts at Baseline and After the Index Date[a]

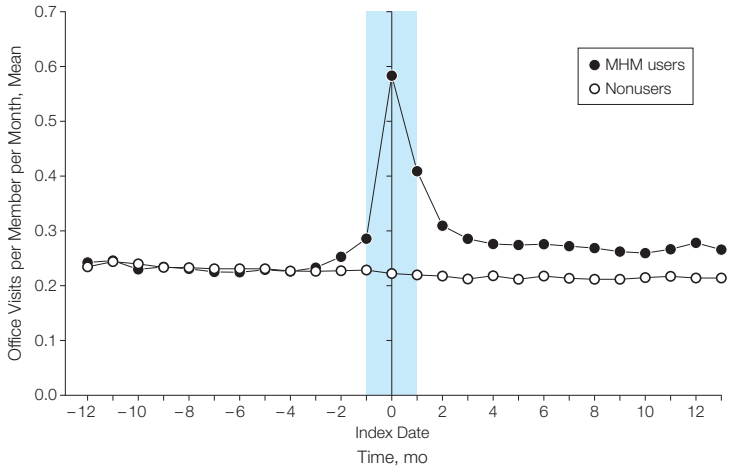
	Mean per Member per Year (95% CI)		Mean per 1000 Members per Year (95% CI)		
Matched Data	Office Visits	Calls	After-Hours Clinic Visits	ED Visits	Inpatient Hospitalizations
Matched cohorts (n = 44 321)					
MHM pre	2.7 (2.7-2.8)	3.9 (3.8-3.9)	85.6 (82.3-88.8)	138.3 (133.7-142.9)	52.3 (49.8-54.8)
MHM post	3.2 (3.2-3.2)	4.2 (4.1-4.3)	96.8 (93.4-100.1)	147.4 (142.5-152.4)	72.3 (69.3-75.3)
Nonuser pre	2.7 (2.6-2.7)	3.7 (3.7-3.8)	84.2 (81.2-87.3)	183.3 (177.8-188.7)	65.9 (62.9-69.1)
Nonuser post	2.5 (2.4-2.5)	3.8 (3.7-3.8)	76.9 (73.9-79.9)	181.2 (175.4-187.1)	66.0 (62.8-69.3)
Difference of differences (*P* value)[b]	0.7 (<.001)	0.3 (<.001)	18.7 (<.001)	11.2 (.01)	19.9 (<.001)
Age <50 y (n = 28 829)					
MHM pre	2.6 (2.5-2.6)	3.6 (3.5-3.6)	94.5 (90.3-98.6)	140.4 (134.4-146.4)	45.6 (42.8-48.4)
MHM post	2.9 (2.9-3.0)	3.8 (3.7-3.8)	101.2 (96.9-105.5)	144.0 (137.9-150.0)	68.2 (64.7-71.6)
Nonuser pre	2.5 (2.5-2.5)	3.3 (3.3-3.4)	88.7 (84.8-92.6)	178.7 (171.9-185.5)	58.1 (54.8-61.4)
Nonuser post	2.2 (2.2-2.3)	3.2 (3.2-3.3)	79.3 (75.6-82.9)	176.1 (169.1-183.1)	52.6 (49.5-55.8)
Difference of differences (*P* value)[b]	0.7 (<.001)	0.3 (<.001)	16.2 (<.001)	6.3 (.23)	28.0 (<.001)
Age ≥50 y (n = 15 120)					
MHM pre	3.0 (2.9-3.1)	4.4 (4.3-4.5)	67.8 (63.1-72.5)	130.9 (123.8-137.9)	62.8 (57.6-67.9)
MHM post	3.6 (3.5-3.6)	4.9 (4.8-5.0)	93.5 (87.9-99.0)	147.4 (139.9-154.9)	81.2 (75.4-86.9)
Nonuser pre	2.9 (2.9-3.0)	4.5 (4.4-4.7)	72.5 (67.7-77.3)	184.7 (175.4-194.0)	84.1 (77.5-90.7)
Nonuser post	2.9 (2.9-2.9)	4.9 (4.4-5.0)	72.2 (66.8-77.5)	185.4 (176.1-194.7)	91.9 (84.7-99.2)
Difference of differences (*P* value)[b]	0.6 (<.001)	0.2 (.04)	25.9 (<.001)	15.9 (.03)	10.6 (.06)
No chronic illness (n = 37 764)					
MHM pre	2.5 (2.4-2.5)	3.4 (3.3-3.4)	79.1 (75.9-82.4)	123.6 (118.9-128.2)	45.6 (43.1-48.1)
MHM post	2.9 (2.9-3.0)	3.6 (3.6-3.7)	89.3 (85.7-92.9)	130.6 (125.6-135.6)	62.4 (59.5-65.2)
Nonuser pre	2.4 (2.4-2.5)	3.2 (3.1-3.2)	77.4 (74.3-80.6)	162.6 (157.1-168.1)	55.1 (52.1-57.9)
Nonuser post	2.2 (2.2-2.2)	3.2 (3.1-3.2)	68.5 (66.4-72.5)	159.2 (153.4-164.9)	54.2 (51.3-57.1)
Difference of differences (*P* value)[b]	0.7 (<.001)	0.3 (<.001)	18.1 (<.001)	10.5 (.02)	17.6 (<.001)
Asthma (n = 2821)					
MHM pre	3.7 (3.6-3.9)	5.3 (5.1-5.6)	144.6 (126.5-162.8)	219.8 (195.9-243.7)	56.4 (46.2-66.5)
MHM post	4.3 (4.1-4.4)	5.5 (5.2-5.7)	155.9 (137.7-174.2)	193.5 (170.8-216.3)	95.7 (82.4-108.9)
Nonuser pre	3.6 (3.5-3.8)	5.1 (4.8-5.3)	137.2 (121.8-152.5)	238.9 (215.6-262.3)	76.6 (63.2-89.9)
Nonuser post	3.3 (3.2-3.5)	5.0 (4.8-5.3)	130.4 (115.1-145.8)	248.8 (225.5-272.2)	72.3 (59.5-85.2)
Difference of differences (*P* value)[b]	0.8 (<.001)	0.2 (.27)	18.1 (.22)	–36.2 (.06)	43.6 (<.001)
Diabetes mellitus (n = 2147)					
MHM pre	4.1 (3.9-4.2)	7.3 (6.9-7.7)	103.4 (87.9-118.8)	196.1 (172.2-219.9)	93.6 (76.7-110.6)
MHM post	4.6 (4.4-4.8)	8.1 (7.8-8.5)	133.7 (116.3-151.0)	212.9 (187.9-237.8)	108.1 (90.3-125.8)
Nonuser pre	3.9 (3.7-4.1)	7.0 (6.7-7.4)	93.6 (79.5-107.7)	277.6 (245.7-309.5)	95.0 (76.7-113.3)
Nonuser post	3.9 (3.7-4.0)	8.0 (7.6-8.4)	91.8 (76.6-106.9)	262.7 (234.1-291.3)	122.5 (102.3-142.7)
Difference of differences (*P* value)[b]	0.6 (<.001)	–0.2 (.52)	32.1 (.04)	31.2 (.21)	–13.0 (.45)
Coronary artery disease (n = 354)					
MHM pre	3.7 (3.3-4.1)	6.1 (5.4-6.8)	96.0 (64.2-127.9)	180.8 (125.0-236.5)	161.0 (116.6-205.5)
MHM post	4.3 (3.9-4.7)	7.1 (6.3-7.9)	144.1 (101.8-186.3)	245.8 (185.9-305.6)	158.2 (108.1-208.3)
Nonuser pre	3.7 (3.3-4.1)	7.3 (6.4-8.1)	87.6 (54.9-120.1)	288.1 (215.9-360.4)	234.5 (172.1-296.7)
Nonuser post	3.7 (3.3-4.2)	7.8 (6.6-8.9)	90.4 (56.5-124.3)	302.3 (215.9-388.6)	172.3 (118.2-226.4)
Difference of differences (*P* value)[b]	0.5 (.09)	0.5 (.53)	45.2 (.17)	50.8 (.34)	59.3 (.25)
Congestive heart failure (n = 140)					
MHM pre	5.9 (5.1-6.7)	8.9 (7.4-10.5)	100.0 (38.9-161.1)	278.6 (184.4-372.7)	264.3 (149.8-378.7)
MHM post	6.4 (5.5-7.3)	10.8 (8.9-12.7)	142.8 (71.8-213.9)	492.9 (342.2-643.5)	357.1 (219.6-494.7)
Nonuser pre	5.5 (4.8-6.3)	11.5 (9.5-13.5)	92.9 (40.2-145.5)	442.9 (293.8-591.9)	342.9 (221.3-464.4)
Nonuser post	5.1 (4.3-5.9)	9.9 (8.3-11.7)	114.3 (53.9-174.7)	414.3 (216.9-611.7)	328.6 (197.9-459.2)
Difference of differences (*P* value)[b]	0.9 (.10)	3.4 (.01)	21.4 (.69)	242.8 (.06)	107.1 (.35)

Abbreviations: ED, emergency department; MHM, MyHealthManager.

[a] No. is reported as MHM user and nonuser matched pair. "Pre" refers to the baseline rate, the rate for the 12 months prior to the index date. "Post" refers to the rate for the 12 months after the index date. Data from 30 days before and 30 days after the index date are excluded from the analysis. Rates for office visits and calls are reported per individual; other categories are reported per 1000 members to present the rates as whole numbers for clarity.

[b] MHM user (post – pre) minus nonuser (post – pre).

Figure. Matched Cohort Mean Office Visits per Month



Each data point represents mean office visits from the preceding 30 days. The tinted area indicates a 30-day period on either side of the index date. Data from this 60-day period were excluded from the rate calculations reported in Table 2 and the generalized estimating equations analysis reported in Table 3.

ber per year (3.2; 95% CI, 3.2-3.2 vs 2.7; 95% CI, 2.7-2.8; rate difference, 0.5; 95% CI, 0.4-0.5; $P<.001$) and telephone encounters (4.2; 95% CI, 4.1-4.3 vs 3.9; 95% CI, 3.8-3.9; rate difference, 0.3; 95% CI, 0.3-0.4; $P<.001$), compared with utilization rates in the year prior to MHM activation (TABLE 2). Over the same time period, MHM nonusers showed a decrease of 0.2 office visits per member per year (2.5; 95% CI, 2.4-2.5 vs 2.7; 95% CI, 2.6-2.7; $P<.001$) and an increase of 0.1 telephone encounters per member per year (3.8; 95% CI, 3.7-3.8 vs 3.7; 95% CI, 3.7-3.8; $P=.03$) compared with the period before the index date.

When we compared the use of clinical services before and after the index date between MHM users and nonusers, we saw a significant increase in the per-member rates of office visits (0.7 per member per year; 95% CI, 0.6-0.7; $P<.001$) and telephone encounters (0.3 per member per year; 95% CI, 0.2-0.3; $P<.001$). There was also a significant increase in per-1000-member rates of after-hours clinic visits (18.7 per 1000 members per year; 95% CI, 12.8-24.3; $P<.001$), emergency department encounters (11.2 per 1000 members per year; 95% CI, 2.6-19.7; $P=.01$), and hospitalizations (19.9 per 1000 members per year; 95% CI, 14.6-25.3; $P<.001$) for MHM users compared with nonusers. This utilization pattern was seen for members both younger and older than 50 years.

Members with a diagnosis of asthma who were MHM users had significantly increased rates of office visits (4.3 per member per year; 95% CI, 4.1-4.4 vs 3.7 per member per year; 95% CI, 3.6-3.9; $P<.001$) compared with their pre-MHM usage period; rates of hospitalization also increased (95.7 per 1000 members per year; 95% CI, 82.4-108.9 vs 56.4 per 1000 members per year; 95% CI, 46.2-66.5; $P<.001$) compared with the pre-MHM usage period and compared with nonusers (43.6 per 1000 members per year; 95% CI, 23.2-64.0; $P<.001$). Those members with a diagnosis of diabetes who were MHM users had significantly increased rates of office visits (4.6 per member per year; 95% CI, 4.4-4.8 vs 4.1 per member per year; 95% CI, 3.9-4.2; $P<.001$) compared with their pre-MHM usage period and compared with nonusers (0.6 per member per year; 95% CI, 0.4-0.8; $P<.001$). In addition, members with diabetes had increased rates of after-hours clinic visits compared with nonusers (32.1 per 1000 members per year; 95% CI, 2.1-62.2; $P=.04$). We observed that members with congestive heart failure who were MHM users had increased rates of telephone encounters compared with nonusers (3.4 per member per year, 95% CI, 0.7-6.1; $P=.01$). Among members with coronary artery disease, we did not see a difference in utilization of services between users and nonusers of the MHM.

A time-series graph for the matched cohorts demonstrates the spike in office visits surrounding the time of MHM activation (FIGURE). Users clearly sustained a higher rate of office visits after their MHM activation compared with their baseline rate and with the rate of nonusers. Similar time-series results were seen for use of other clinical services.

We used GEE modeling to adjust for age, sex, baseline rates of office visits, and specific chronic illnesses. We then compared utilization of clinical services between MHM users and nonusers. The GEE modeling results yielded similar results to those reported earlier in this section. We found the rate ratio for MHM users was 1.16 (95% CI, 1.15-1.18; $P<.001$) for office visits, 1.08 (95% CI, 1.07-1.09; $P<.001$) for telephone encounters, 1.13 (95% CI, 1.08-1.18; $P<.001$) for after-hours clinic visits, 1.07 (95% CI, 1.02-1.11; $P<.001$) for emergency department visits, and 1.38 (95% CI, 1.30-1.47; $P<.001$) for hospitalizations when compared with their pre-MHM access rate for these services (TABLE 3). In contrast, nonusers exhibited rate ratios of 0.92 (95% CI, 0.91-0.93; $P<.001$) for office visits, a small increase in telephone encounters (1.02; 95% CI, 1.00-1.03; $P=.03$), 0.91 (95% CI, 0.87-0.96; $P<.001$) for after-hours clinic visits, and no change in emergency department visits (0.99; 95% CI, 0.95-1.02) or for hospitalizations (1.00; 95% CI, 0.94-1.06) when compared with their rates before the index date. When we compared the rate differences between MHM users and nonusers for these clinical services, the differences were all significant ($P\leq.01$) (Table 3).

The rate differences for members with chronic illnesses demonstrated more variability. Significant changes

were seen for members with asthma, where MHM users had a rate ratio of 1.15 (95% CI, 1.10-1.19; $P<.001$) compared with nonusers, who had a rate ratio of 0.92 (95% CI, 0.89-0.96; $P<.001$) for office visits after their respective index dates. The comparison of MHM users with nonusers with asthma showed significant differences in rates of MHM users for office visits ($P<.001$), emergency department visits ($P=.05$), and hospitalizations ($P<.001$).

MHM users with diabetes demonstrated significant differences in rate ratios for office visits (1.13; 95% CI, 1.08-1.17; $P<.001$), telephone encounters (1.11; 95% CI, 1.06-1.16; $P<.001$), and after-hours clinic visits (1.29; 95% CI, 1.07-1.56; $P=.01$). Nonusers with diabetes showed differences in rate ratios for telephone encounters (1.14; 95% CI, 1.09-1.19; $P<.001$) and hospitalizations (1.29; 95% CI, 1.02-1.62; $P=.03$). Only the increase in the office visit rate ratio for MHM users with diabetes was significantly different compared with nonusers ($P<.001$).

MHM users with coronary artery disease had significant differences in rate ratios for office visits (1.16; 95% CI, 1.04-1.29; $P=.006$) and telephone encounters (1.16; 95% CI, 1.03-1.31; $P=.01$) compared with their pre-MHM rate, but none of the comparisons with nonusers reached statistical significance.

MHM users with congestive heart failure had a rate ratio increase for emergency department visits (1.77; 95% CI, 1.20-2.60; $P=.04$) compared with their pre-MHM rate. Users and nonusers of MHM with congestive heart failure had significant rate ratio differences in telephone encounters ($P=.01$) and emergency department visits ($P=.03$).

COMMENT

In this study, we found that patients with online access to their medical records,

Table 3. Generalized Estimating Equations Modeling of Matched Data Comparing MHM Users and Nonusers[a]

Matched Data[b]	IRR (95% CI) Before and After the Index Date[c]				
	Office Visits	Calls	After-Hours Clinic Visits	ED Visits	Inpatient Hospitalizations
Matched cohorts (n = 44 321)					
MHM users	1.16 (1.15-1.18)	1.08 (1.07-1.09)	1.13 (1.08-1.18)	1.07 (1.02-1.11)	1.38 (1.30-1.47)
Nonusers	0.92 (0.91-0.93)	1.02 (1.00-1.03)	0.91 (0.87-0.96)	0.99 (0.95-1.02)	1.00 (0.94-1.06)
P value, MHM users vs nonusers	<.001	<.001	<.001	.01	<.001
Age <50 y (n = 28 829)					
MHM users	1.16 (1.14-1.18)	1.05 (1.04-1.07)	1.07 (1.01-1.13)	1.03 (0.98-1.08)	1.49 (1.38-1.61)
Nonusers	0.90 (0.89-0.92)	0.96 (0.95-0.98)	0.89 (0.84-0.95)	0.98 (0.94-1.03)	0.91 (0.84-0.98)
P value, MHM users vs nonusers	<.001	<.001	<.001	.22	<.001
Age ≥50 y (n = 15 120)					
MHM users	1.18 (1.16-1.21)	1.12 (1.09-1.15)	1.38 (1.26-1.49)	1.13 (1.05-1.20)	1.29 (1.17-1.43)
Nonusers	0.97 (0.95-0.98)	1.08 (1.06-1.10)	0.99 (0.91-1.09)	1.00 (0.94-1.07)	1.09 (0.99-1.21)
P value, MHM users vs nonusers	<.001	.03	<.001	.01	.02
No chronic illness (n = 37 764)					
MHM users	1.18 (1.17-1.19)	1.08 (1.06-1.09)	1.13 (1.07-1.19)	1.06 (1.01-1.11)	1.37 (1.28-1.46)
Nonusers	0.91 (0.89-0.92)	0.99 (0.97-1.01)	0.89 (0.85-0.95)	0.98 (0.94-1.02)	0.98 (0.92-1.06)
P value, MHM users vs nonusers	<.001	.01	<.001	.01	<.001
Asthma (n = 2821)					
MHM users	1.15 (1.10-1.19)	1.03 (0.98-1.07)	1.08 (0.93-1.25)	0.88 (0.77-1.00)	1.69 (1.38-2.08)
Nonusers	0.92 (0.89-0.96)	0.99 (0.95-1.03)	0.95 (0.82-1.09)	1.04 (0.93-1.16)	0.94 (0.77-1.15)
P value, MHM users vs nonusers	<.001	.30	.23	.05	<.001
Diabetes mellitus (n = 2147)					
MHM users	1.13 (1.08-1.17)	1.11 (1.06-1.16)	1.29 (1.07-1.56)	1.06 (0.93-1.26)	1.15 (0.92-1.45)
Nonusers	0.98 (0.93-1.02)	1.14 (1.09-1.19)	0.98 (0.79-1.22)	0.94 (0.82-1.09)	1.29 (1.02-1.62)
P value, MHM users vs nonusers	<.001	.46	.06	.19	.51
Coronary artery disease (n = 354)					
MHM users	1.16 (1.04-1.29)	1.16 (1.03-1.31)	1.50 (0.99-2.25)	1.36 (0.98-1.88)	0.98 (0.65-1.47)
Nonusers	1.01 (0.89-1.15)	1.07 (0.93-1.23)	1.03 (0.63-1.70)	1.05 (0.78-1.14)	0.73 (0.49-1.09)
P value, MHM users vs nonusers	.12	.39	.26	.24	.32
Congestive heart failure (n = 140)					
MHM users	1.09 (0.93-1.26)	1.21 (1.00-1.46)	1.43 (0.64-3.17)	1.77 (1.20-2.60)	1.35 (0.81-2.25)
Nonusers	0.92 (0.81-1.05)	0.87 (0.74-1.01)	1.23 (0.61-2.48)	0.94 (0.62-1.42)	0.96 (0.58-1.58)
P value, MHM users vs nonusers	.11	.01	.78	.03	.34

Abbreviations: ED, emergency department; IRR, incidence rate ratio; MHM, MyHealthManager.
[a] Sample interpretation: in the first matched data set for rates of office visits, the MHM users' IRR of office visits after and before MHM activation is 1.16. The nonuser group demonstrates a rate ratio of 0.92 of office visits after and before the index date.
[b] No. is reported as MHM user and nonuser matched pair. Propensity scores (±0.05) within MHM activation year and baseline office visit categories were used to match MHM user and nonuser study participants.
[c] Data from 30 days before and 30 days after the index date are excluded from the analysis.

including secure e-mail communication with clinicians, had a subsequent increase in use of most in-person and telephone clinical services, which is contrary to our expectations and the results of some prior studies.[26,27] In the year following activation, members with such access had increased rates of office visits, telephone encounters, and acute care services compared with a matched cohort of members without online access. These findings were consistent in both younger and older individuals and for those without chronic health conditions. We found more variability in rates of utilization by MHM users with chronic illnesses. This finding is in contrast to a previous study of MHM users[31] but consistent with the finding for patients with chronic illnesses using telemonitoring services.[32]

There are several possible explanations for these findings. Coile[33] stated that patients need "better, faster, cheaper" processes of care for diagnosing, treating, and monitoring their health. Online access to care may have led to an increase in use of in-person services because of additional health concerns identified through online access. Members might have activated their online access in anticipation of health needs. Members who are already more likely to use services may selectively sign up for online access and then use this technology to gain even more frequent access rather than view it as a substitute for contact with the health care system.

There are several limitations to our study. The results we observed may pertain only to highly integrated systems possessing EMRs with online patient portals. We did not have access to data about the types and frequency of the online services used by MHM users. Therefore, we did not have data to compare utilization rates by type of online service accessed. In addition, we did not assess the reasons why patients made contact with the health care system. The reasons are generally recorded in free text; as a generic code, such as "advice"; or not coded at all. In future studies, manual record reviews or natural language processing may be used to glean additional information regarding the reasons patients access clinical services. Patients who did not use MHM appeared to have lower utilization rates for both office and telephone encounters, even when matched for specific chronic conditions. Members who made more clinic visits also received more opportunities to hear about and sign up for online access. Nonusers may also have had less access to the internet because of their socioeconomic status.[34,35] Because KPCO does not collect information from members about socioeconomic status or internet access, we could not evaluate these possibilities.

Other unmeasured influences may have affected members' decisions to sign up for online access to their health records. Members who signed up for online access may have greater health concerns that influence health care contact rates. Kaiser Permanente offers patient self-management tools (both online and written materials) and personal chronic disease management programs. Both MHM users and nonusers have access to all disease management programs, patient self-management systems, and clinicians in the Kaiser Permanente system. Some of these services are available online to anyone, even individuals who are not members of a KPCO health plan. To access more personalized online services, MHM access is required. Members who do not use MHM can access these clinicians and services in traditional ways, by telephone or by in-person clinical encounters. In this study, we did not compare usage patterns for these services between MHM users and nonusers.

Finally, any large study may identify statistically significant differences that are not clinically relevant. However, the magnitude of differences in utilization that we identified appears to be clinically significant. For example, in a health system with 100 000 adult members with online access, if the rate of office visits increases by 0.5 visits per member per year, concomitant with an increase in telephone encounters by 0.3 per member per year, over the course of a year clinicians and the health system would need to provide 50 000 more clinic visits and respond to 30 000 more telephone calls. If this also holds true for a small group practice, a primary care physician with 1000 adult patients who have online access would need to provide for almost 10 more clinic visits per week and over 5.5 more telephone calls per week.

Further research is needed to evaluate why patients seek and subsequently use online access and whether online access affects health outcomes beyond utilization. Comparing clinical outcomes between online users and nonusers may prove beneficial in tailoring services to member needs. Further evaluation of the cost and benefits of online access to health care services, virtual visits (such as e-mail communication between patients and clinicians), and clinical decision making is also needed.

Overall, our findings suggest that the relationship between online access and utilization is more complex than the simple substitution of online for in-person care suggested by earlier studies.[26,27] If these findings are evident in other systems, health care delivery planners and administrators will need to consider how to allocate resources to deal with increased use of clinical services. As online applications become more widespread, health care delivery systems will need to develop methodologies that effectively integrate health information technologies with in-person care.

Author Contributions: Dr Palen had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Palen, Ross, Xu.
Acquisition of data: Palen, Ross, Powers.
Analysis and interpretation of data: Palen, Ross, Powers, Xu.
Drafting of the manuscript: Palen, Ross.
Critical revision of the manuscript for important intellectual content: Palen, Ross, Powers, Xu.
Statistical analysis: Palen, Ross, Powers, Xu.
Obtained funding: Palen.
Administrative, technical, or material support: Palen.
Study supervision: Palen, Xu.
Conflict of Interest Disclosures: All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Dr Palen is em-

ployed by the Colorado Permanente Medical Group. Ms Ross, Mr Powers, and Dr Xu are all employees of the Kaiser Permanente Health Plan of Colorado. No other disclosures were reported.

Funding/Support: This study was supported by the Kaiser Permanente Colorado Regional Initiative Committee Fund.

Role of the Sponsor: The funding source had no role in the design and conduct of the study; in the collection, analysis, and interpretation of the data; or in the preparation, review, or approval of the manuscript.

Online-Only Material: The Author Video Interview is available at http://www.jama.com.

Additional Contributions: We thank John F. Steiner, MD, and Cristy Geno-Rasmusson, MPH, for their thoughtful review of the manuscript and helpful comments. We also thank Barbara McCray, AA, for her editorial review. All are employees of the Institute for Health Research department of Kaiser Permanente Health Plan of Colorado and as employees did not receive any added compensation for their work on the manuscript.

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