

# Relationships Between Patient Portal Activation and Patient Satisfaction Scores Among CG-CAHPS and HCAHPS Respondents

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Patient satisfaction has become an important measure as the need for health care to be more patient centered has been increasingly emphasized. Identified as a key element of care quality by the Institute of Medicine,<sup>1</sup> patient-centered care encourages providers to include patients as partners, engaging and empowering patients to actively participate in their health care.<sup>2</sup> With the shift to this focus on patient-centered care, patient experience has become an important aspect of health care quality, in which patient satisfaction with their care is used as one measure of the patient experience.<sup>3</sup>

To improve patient satisfaction, health care providers are increasingly focused on increasing the patient-centeredness of care, and patient-centered health information technologies such as patient portals are one such tool that may be beneficial. Patient portals are offered as websites or mobile applications and are tethered to a patient's electronic health record (EHR) to provide patients with access to their personal health information and a means to manage their health care and communicate with their health care providers. Through these functions, patient portals satisfy CMS' Promoting Interoperability Program (formerly the Meaningful Use program) requirements to improve quality of care by supporting health information exchange between health care providers and their patients.<sup>4,5</sup>

Although they were first implemented in the outpatient setting, patient portals are now increasingly implemented in the inpatient setting, with functions tailored to support patients during hospitalization. Outpatient and inpatient portals together have the potential to benefit patients across care settings. Multiple benefits of patient portals have been reported in previous studies, including improved patient knowledge about their health conditions, increased patient engagement, and enhanced patient-provider communication,<sup>6-8</sup> but the impact of patient portals on patient satisfaction is not well understood.

Our study aimed to address this gap in knowledge by exploring how outpatient and inpatient portals might be associated with patient satisfaction, as measured by Clinician and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) and Hospital CAHPS (HCAHPS) survey responses. The CG-CAHPS

## ABSTRACT

**OBJECTIVES:** Patient portals are health information technology tools that offer patients access to their personal health information and a means to communicate with health care providers, but little is known about their impact on patient satisfaction. Identifying factors that increase patient satisfaction may improve patient care and can protect health care providers from financial penalties. Our study sought to investigate how patient portals are associated with patient satisfaction in both inpatient and outpatient settings.

**STUDY DESIGN:** Retrospective, pooled cross-sectional study.

**METHODS:** Data from the Clinician and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) and Hospital CAHPS (HCAHPS) patient satisfaction surveys were linked to inpatient and outpatient portal account status at a large academic medical center. Using fractional logistic regression, we investigated the relationship between patient satisfaction survey scores and patient portal activation.

**RESULTS:** Patients with an activated outpatient portal account reported higher patient satisfaction across a subset of the CG-CAHPS dimensions, and patients with an activated inpatient portal account reported higher patient satisfaction across a subset of the HCAHPS dimensions, compared with patients without the respective portal accounts.

**CONCLUSIONS:** Our study suggests the potential for patient portals to enhance patient satisfaction, especially in areas such as care coordination and care transitions. In both inpatient and outpatient settings, portal use may improve the patient-centeredness of care. Our findings indicate important considerations for both health care organizations and their patients to promote patient portal use as a means of improving patient satisfaction, especially in the context of potential impacts on reimbursement and reputation.

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## TAKEAWAY POINTS

This study sought to investigate how patient portals in both inpatient and outpatient settings are associated with patient satisfaction as measured by Clinician and Group Consumer Assessment of Healthcare Providers and Systems (CG-CAHPS) and Hospital CAHPS (HCAHPS) surveys.

- ▶ Patients with an activated outpatient portal account reported higher patient satisfaction in 2 dimensions of the CG-CAHPS survey (communication with their doctor and care coordination), and patients with an activated inpatient portal account reported higher patient satisfaction in 3 dimensions of the HCAHPS survey (communication with their nurse, care transition, and discharge), compared with patients without respective portal accounts.
- ▶ The highest marginal gains in patient satisfaction scores for patients with an activated portal account were for care coordination for the outpatient portal and care transition for the inpatient portal.
- ▶ Future work should evaluate the impact of patient portal functions and their use as mediating factors of the effect of patient portals on patient experience.

survey<sup>9</sup> and the HCAHPS survey<sup>10</sup> were developed by the Agency for Healthcare Research and Quality<sup>11</sup> and CMS<sup>12</sup> to collect standardized perspectives of patient satisfaction based on patients' outpatient and inpatient experiences, respectively. These surveys assess patient satisfaction across several dimensions of the patient experience, such as communication with doctors, nurses, and staff; care coordination and care transitions; access to and responsiveness of care; and facility conditions.

Understanding the association between patient portal use and patient satisfaction, as measured by the CG-CAHPS and HCAHPS surveys, has important implications for the delivery of managed care. First, patient satisfaction measures are interpreted to reflect the quality of care received by the patient because they are based on patients' perceived needs and expectations.<sup>13-15</sup> In addition, public reporting of patient satisfaction scores by CMS provides comparable data among health care providers that can affect their reputation and influence patient recruitment and retention.<sup>16</sup> Furthermore, patient satisfaction is included as a factor in performance assessments that affect reimbursement payments from CMS.<sup>17</sup> Understanding whether and how patient portals are associated with patient satisfaction can help direct health care organizations to use these tools in ways that positively affect patient experience.

## METHODS

## Study Setting

This study was conducted at The Ohio State University Wexner Medical Center, a large Midwestern academic medical center (AMC) that includes 6 hospitals and 53 ambulatory care locations. At this AMC, outpatients are offered electronic access to their health care information through an outpatient portal, MyChart (MC; Epic Systems). Inpatients at this AMC are offered Android tablets during their hospital stay; through these tablets, patients have access to an inpatient portal, MyChart Bedside (MCB; Epic Systems).

MC includes functions that allow patients to access their personal health information (eg, medical history, test results), view and schedule appointments, and message their providers. MCB includes

functions that are tailored to the hospital setting; these functions allow patients to access their personal health information (eg, test results, vital signs), view an anticipated schedule for their medications and/or procedures, view educational materials, view names and pictures of their care team members, order meals, send requests, and message their care team (see [eAppendix A](#) for a full list of portal functions [eAppendices available at [ajmc.com](#)]).

## Data and Study Sample

Retrospective data were obtained for patient encounters from our AMC's Information Warehouse (IW) in accordance with the Honest

Broker protocol; this protocol is recognized by The Ohio State University's Institutional Review Board (IRB) as a means to use deidentified data without requiring formal IRB approval. Data were obtained for patient encounters between January 2019 and January 2020 for patients aged between 18 and 110 years. Our study sample consisted of 50,314 outpatient encounters and 7783 inpatient encounters (ie, hospital stays). Our study sample was focused on encounters that have CG-CAHPS or HCAHPS responses from our AMC's patient population.

## MC and MCB Account Activation

Using Epic System's EHR log files for MC and MCB, we identified variables that captured patient activation of their portal accounts. We defined patients with an activated MC or activated MCB account as those patients who registered their portal account online with an activation code provided by the medical center and successfully logged into the portal system at least once (see [eAppendix A](#) for additional details about MC and MCB activation). Among all patients during our study period, approximately 53% had activated MC accounts and 46% had activated MCB accounts.

## Patient Satisfaction Surveys: CG-CAHPS and HCAHPS

The IW provided us with the CG-CAHPS and HCAHPS survey scores for the patient encounters of our study population with and without activated MC and MCB accounts during the study period. CG-CAHPS and HCAHPS scores were collected on a rolling basis at the AMC and were aggregated for our study time period. Of note, both the CG-CAHPS and HCAHPS surveys have inclusion and exclusion criteria that are described in great detail in the literature.<sup>18,19</sup>

The CG-CAHPS and HCAHPS surveys contained questions that were aggregated into composite measures related to 4 and 9 dimensions of patient care, respectively. Each survey also collected 2 global measures that assessed the rating and recommendation of either the provider or the hospital (see [eAppendix B](#) for a complete list of survey measures and dimensions). The measures for pain management in the hospital were excluded because scores for this measure were not available from the AMC during the study

period because of an institutional decision to not collect this information. During our study period, CG-CAHPS and HCAHPS response rates at the AMC among all patients were approximately 14% and 19%, respectively.

We used top-box scores for each patient satisfaction dimension as the dependent variables for our study. The top-box score for each individual question was calculated as the fraction of respondents who selected the most positive response. Top-box scores within each dimension were aggregated by summing the top-box scores for all questions associated with that dimension and dividing by the total number of questions answered for that specific dimension. This resulted in the top-box proportion for each dimension, which was used as the dependent variable for the fractional logistic regression model. For example, a top-box proportion for Doctor Communication of 0.90 is constructed based on 2700 responses of “always” of a possible 3000 responses to any of the questions under this dimension.

### Data Analysis

To develop our analytic data set, we merged data from multiple data sources using a unique identifier variable for patient encounters. Using this identifier, we linked patient demographic/clinical information, patient satisfaction scores, and activated MC/MCB account status for patients by encounter. We subsequently split our analytic data into 2 separate sets, one for the MC and CG-CAHPS analysis and the other for the MCB and HCAHPS analysis. Our first data set contained 50,314 eligible patient encounters with CG-CAHPS scores for 1 or more dimensions. Of these encounters, we had 36,798 (73.1%) encounters with activated MC accounts. Our second data set contained 7783 eligible patient encounters with HCAHPS scores, with 3729 (47.9%) of those encounters with activated MCB accounts. For both of our analytical data sets, only CG-CAHPS and HCAHPS responses that were reported after portal activation were retained.

We used patient demographic and clinical characteristics as covariates to obtain adjusted estimates from our empirical models. These covariates, including race, age, patient self-reported health status, health insurance status, gender, and survey mode, were obtained from the CG-CAHPS or HCAHPS survey or the EHR (see [eAppendix C](#) for additional details about the selection of covariates used in our empirical model). We also included a covariate that indicated multiple survey responses because respondents answering multiple surveys may have systematic differences in how they responded to the surveys compared with 1-time respondents.

Our study analysis included univariate and multivariate approaches. For the latter, we used fractional logistic regression model estimations on our separate data sets (see [eAppendix C](#) for more information about this analytic approach). Our analysis was at the patient encounter level and included patients with multiple encounters; hence, we estimated robust standard errors that clustered and accounted for the unique variance by patients. All statistical analyses, including our univariate tests (analysis of variance for continuous variables and  $\chi^2$  for categorical and binary variables), were performed using

Stata 15 software (StataCorp LLC). For our multivariate analysis, we corrected for multiplicity by performing Bonferroni corrections to maintain a family-wise error rate (FWER) of 0.05. We indicate results that have *P* values below the adjusted  $\alpha$  levels for each analytical set.

## RESULTS

[Table 1](#) and [Table 2](#) provide descriptive statistics about demographic and clinical characteristics for the patient encounters in our CG-CAHPS and HCAHPS data sets. Patients with activated MC and activated MCB accounts were most often White, 65 years or older, and female and had good self-reported health status and commercial insurance. Between patients with activated patient portal accounts (MC or MCB) and their counterparts with no activated patient portal accounts, there were significant differences by all the demographic and clinical characteristic variables used in our analysis. Notably, for both data sets, the groups without activated portal accounts had much older patients and more patients on Medicare than the respective groups with activated portal accounts. Survey mode and multiple survey response differed significantly across groups within each data set. We compared our analytical samples with the overall outpatient and inpatient encounters at our AMC by race, age, gender, and health insurance status. There were statistically significant differences based on these factors for both analytical samples, with the exception of gender in the inpatient sample. Both the inpatient and outpatient samples were more likely to have White, older, and Medicare-covered patient encounters; the outpatient sample was also likely to have more male patient encounters (results available on request).

[Table 3](#) reports the unadjusted and adjusted odds ratios for (1) the estimation of activated MC account status (reference: no MC account) on the 6 CG-CAHPS top-box dimensions and (2) the estimation of activated MCB account status (reference: no MCB account) on the 10 HCAHPS top-box dimensions. We also report the marginal effects for our adjusted models, which can be interpreted as the percentage change in the dependent variable (at the mean) associated with the switch from no patient portal to activated patient portal status.

With respect to the results in panel A, the odds of higher top-box proportions for doctor communication were 1.24-fold higher among patients with activated MC accounts compared with those without activated MC accounts. This was a 1.33% higher proportion of top-box scores for doctor communication associated with activated MC accounts. Similarly, the odds of higher top-box proportions for care coordination were 1.20-fold higher among patients with activated MC accounts compared with those without activated MC accounts. This was a 4.22% higher proportion of top-box scores for care coordination associated with activated MC accounts.

Panel B in [Table 3](#) shows that patients with an activated MCB account had significantly higher odds of reporting higher top-box proportions for the HCAHPS dimensions, including nurse communication, care transition, and discharge. Notable relationships

**TABLE 1.** Descriptive Statistics on CG-CAHPS Respondents and MC Account Status

	Total (N = 50,314)	No MC account (n = 13,516)	Activated MC account (n = 36,798)	P
Patient satisfaction dimension, mean (SD) of top-box proportions				
CG-CAHPS Doctor Communication	0.93 (0.19)	0.93 (0.19)	0.94 (0.19)	<.001
CG-CAHPS Access to Care	0.87 (0.26)	0.88 (0.25)	0.87 (0.26)	.002
CG-CAHPS Office Staff	0.95 (0.19)	0.95 (0.19)	0.95 (0.20)	.51
CG-CAHPS Care Coordination	0.77 (0.28)	0.74 (0.30)	0.78 (0.27)	<.001
CG-CAHPS Recommend (global)	0.92 (0.27)	0.93 (0.26)	0.92 (0.27)	.032
CG-CAHPS Provider Rating (global)	0.88 (0.33)	0.88 (0.33)	0.88 (0.33)	.82
Race, n (%)				
Other	2120 (4%)	518 (4%)	1602 (4%)	<.001
White	43,645 (87%)	11,073 (82%)	32,572 (89%)	
African American/Black	4243 (8%)	1822 (13%)	2421 (7%)	
Unknown	306 (1%)	103 (1%)	203 (1%)	
Age in years, n (%)				
18-30	2898 (6%)	429 (3%)	2469 (7%)	<.001
31-45	6242 (12%)	726 (5%)	5516 (15%)	
46-64	17,270 (34%)	3955 (29%)	13,315 (36%)	
≥65	23,904 (48%)	8406 (62%)	15,498 (42%)	
Self-reported health status, n (%)				
Excellent	5679 (11%)	1252 (9%)	4427 (12%)	<.001
Very good	16,364 (33%)	3471 (26%)	12,893 (35%)	
Good	18,079 (36%)	5029 (37%)	13,050 (35%)	
Fair	8077 (16%)	2859 (21%)	5218 (14%)	
Poor	1536 (3%)	628 (5%)	908 (2%)	
Unknown	579 (1%)	277 (2%)	302 (1%)	
Health insurance status, n (%)				
Commercial	19,884 (40%)	2654 (20%)	17,230 (47%)	<.001
Medicaid	3275 (7%)	1271 (9%)	2004 (5%)	
Medicare	22,095 (44%)	7913 (59%)	14,182 (39%)	
Self-pay	582 (1%)	250 (2%)	332 (1%)	
Other	1056 (2%)	483 (4%)	573 (2%)	
Unknown	3422 (7%)	945 (7%)	2477 (7%)	
Gender, n (%)				
Female	29,455 (59%)	7261 (54%)	22,194 (60%)	<.001
Male	20,859 (41%)	6255 (46%)	14,604 (40%)	
Survey mode, n (%)				
Internet	20,489 (41%)	1809 (13%)	18,680 (51%)	<.001
Paper	29,825 (59%)	11,707 (87%)	18,118 (49%)	
Respondent to multiple surveys, n (%)	18,781 (37%)	3372 (25%)	15,409 (42%)	<.001

CG-CAHPS, Clinician and Group Consumer Assessment of Healthcare Providers and Systems; MC, MyChart.

included care transition (7.24% higher). The other outcomes (ie, nurse communication and discharge) had higher proportions of top-box scores that ranged from 2.16% to 3.94%.

We reran our analysis for all the outcomes related to MC and MCB account status for encounters with only the most recent CG-CAHPS

or HCAHPS scores (ie, without controlling for multiple responses). Our results were consistent for all but 1 outcome; the HCAHPS Discharge dimension was no longer significant at the FWER adjusted  $\alpha$ . We discuss our findings based on our original models.

## DISCUSSION

Our study found that patients with an active patient portal account had higher odds of reporting top-box scores on many dimensions of the CG-CAHPS or HCAHPS survey. Patients with an activated outpatient portal account had significantly higher odds of reporting top-box responses to dimensions of the CG-CAHPS survey regarding communication with their doctor and care coordination compared with patients without an activated outpatient portal account. Patients with an activated inpatient portal account had significantly higher odds of top-box responses to dimensions of the HCAHPS survey regarding nurse communication, care transitions, and discharge compared with patients without an activated inpatient portal account.

In many ways, functions of patient portals may be associated with different dimensions of the CG-CAHPS and HCAHPS surveys, as suggested by the findings of our study. For instance, patient portals support patient-provider communication through secure messaging in both inpatient and outpatient settings. In addition, patient portals can assist with the processes of care coordination, care transitions, and discharge from the hospital by providing access to personal health information and educational materials. Notably, the highest marginal gains in top-box scores in our study were for care coordination (4.22%) for the outpatient portal and care transition (7.24%) for the inpatient portal. By facilitating patient and provider communication regarding medications and test results, as well as providing patients tools to help them understand and manage their health conditions, patient portals may be able to support these dimensions of

patient experience, as suggested by the association between these dimensions of patient satisfaction and patient portal use.

Interestingly, the dimensions of patient satisfaction that were not positively associated with activated patient portal status were those that were unlikely to be related to patient portal use. For example,

activated outpatient patient portal status was not correlated with increased satisfaction with office staff, with whom the patients would not be expected to interact through the portal. Furthermore, portal status was not associated with increased satisfaction with access to care. Although the portal does offer a means to schedule appointments, the questions in this domain ask about phoning the provider's office and the promptness of receiving appointments or care, which are extraneous to patient portal use. For activated inpatient portal accounts, there was no correlation with dimensions related to the hospital facility (ie, cleanliness and quietness of the hospital environment) or with responsiveness of care (eg, receiving help with the call button or getting to the restroom), neither of which were related to portal use.

Additional support for the role of patient portals comes from analyses showing that patient satisfaction was correlated with the provisioning of tablet computers in the hospital environment. As inpatient portals are commonly offered to patients through hospital-provided tablet computers, tablet access may influence patient satisfaction. However, prior work has shown that tablet access alone was not associated with higher scores on nurse communication or care transitions,<sup>20</sup> suggesting that functions of the portal beyond tablet access may have contributed to the associations of these dimensions with patient satisfaction.

As patient satisfaction measures are increasingly being incorporated in studies of patient portal use, few studies have utilized CG-CAHPS or HCAHPS surveys as a generalizable approach to measure the correlation between patient portals and patient satisfaction. Previous studies have primarily utilized a subset of CAHPS questions, and to our knowledge, their results have been both limited and variable.<sup>21-24</sup> For example, in one study that used only CAHPS survey questions related to communication, higher self-reported outpatient portal use was correlated with high patient satisfaction and the belief that the portal improved communication.<sup>22</sup> In another study, use of an outpatient portal in the inpatient environment was found to have minimal association with satisfaction when evaluated with partial responses to the HCAHPS survey questions regarding self-management, medications, and overall hospital rating.<sup>23</sup>

**TABLE 2.** Descriptive Statistics on HCAHPS Respondents and MCB Account Status

	Total (N = 7783)	No MCB account (n = 4054)	Activated MCB account (n = 3729)	P
Patient satisfaction dimensions, mean (SD) of top-box proportions				
HCAHPS Nurse Communication	0.83 (0.31)	0.81 (0.32)	0.84 (0.30)	<.001
HCAHPS Doctor Communication	0.83 (0.31)	0.82 (0.32)	0.85 (0.30)	<.001
HCAHPS Care Transition	0.59 (0.41)	0.55 (0.42)	0.62 (0.41)	<.001
HCAHPS Communicating Medications	0.65 (0.39)	0.64 (0.40)	0.67 (0.38)	.003
HCAHPS Responsiveness	0.67 (0.43)	0.66 (0.44)	0.69 (0.43)	.001
HCAHPS Discharge	0.91 (0.23)	0.89 (0.25)	0.92 (0.21)	<.001
HCAHPS Cleanliness	0.75 (0.44)	0.75 (0.43)	0.74 (0.44)	.720
HCAHPS Quietness	0.62 (0.49)	0.60 (0.49)	0.63 (0.48)	.005
HCAHPS Hospital Rating (global)	0.78 (0.41)	0.78 (0.41)	0.78 (0.41)	.980
HCAHPS Recommend (global)	0.81 (0.39)	0.80 (0.40)	0.82 (0.38)	.026
Race, n (%)				
Other	253 (3%)	118 (3%)	135 (4%)	<.001
White	6740 (87%)	3433 (85%)	3307 (89%)	
African American/Black	744 (10%)	479 (12%)	265 (7%)	
Unknown	46 (1%)	24 (1%)	22 (1%)	
Age in years, n (%)				
18-30	433 (6%)	92 (2%)	341 (9%)	<.001
31-45	861 (11%)	196 (5%)	665 (18%)	
46-64	2601 (33%)	1270 (31%)	1331 (36%)	
≥ 65	3888 (50%)	2496 (62%)	1392 (37%)	
Self-reported health status, n (%)				
Excellent	809 (10%)	287 (7%)	522 (14%)	<.001
Very good	1846 (24%)	833 (21%)	1013 (27%)	
Good	2718 (35%)	1495 (37%)	1223 (33%)	
Fair	1721 (22%)	1024 (25%)	697 (19%)	
Poor	459 (6%)	265 (7%)	194 (5%)	
Unknown	230 (3%)	150 (4%)	80 (2%)	
Health insurance status, n (%)				
Commercial	2726 (35%)	949 (23%)	1777 (48%)	<.001
Medicaid	734 (9%)	372 (9%)	362 (10%)	
Medicare	3997 (51%)	2531 (62%)	1466 (39%)	
Self-pay	83 (1%)	53 (1%)	30 (1%)	
Other	232 (3%)	141 (3%)	91 (2%)	
Unknown	11 (0%)	8 (0%)	3 (0%)	
Gender, n (%)				
Female	4148 (53%)	1928 (48%)	2220 (60%)	<.001
Male	3635 (47%)	2126 (52%)	1509 (40%)	
Survey mode, n (%)				
Internet	171 (2%)	61 (2%)	110 (3%)	<.001
Paper	7612 (98%)	3993 (98%)	3619 (97%)	
Respondent to multiple surveys, n (%)	3098 (40%)	1568 (39%)	1530 (41%)	.034

HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems; MCB, MyChart Bedside.

**TABLE 3.** Unadjusted and Adjusted Logistic Regression Results by Patient Satisfaction Dimensions for Activated MC and Activated MCB Account Status<sup>a</sup>

Dimension	Unadjusted OR	95% CI	Adjusted OR	Adjusted 95% CI	FWER adjusted 95% CI	Marginal effect (%)
<b>A. CG-CAHPS and activated MC account</b>						
CG-CAHPS Doctor Communication <sup>a</sup> (n=42,812)	1.16	1.09-1.24	1.24	1.15-1.34	1.12-1.38	1.33
CG-CAHPS Access to Care (n=42,795)	0.92	0.88-0.97	0.96	0.91-1.02	0.89-1.04	-0.45
CG-CAHPS Office Staff (n=42,692)	0.97	0.88-1.07	1.06	0.95-1.18	0.92-1.23	0.03
CG-CAHPS Care Coordination <sup>b</sup> (n=42,680)	1.27	1.23-1.32	1.20	1.15-1.25	1.13-1.26	4.22
CG-CAHPS Recommend (global) (n=42,322)	0.91	0.84-0.99	0.99	0.90-1.10	0.87-1.14	-0.40
CG-CAHPS Provider Rating (global) (n=42,620)	1.01	0.94-1.08	1.06	0.98-1.14	0.95-1.17	0.62
<b>B. HCAHPS and activated MCB account</b>						
HCAHPS Nurse Communication <sup>c</sup> (n=7766)	1.26	1.14-1.39	1.27	1.14-1.41	1.09-1.48	3.94
HCAHPS Doctor Communication (n=7759)	1.20	1.08-1.33	1.17	1.05-1.30	1.00-1.37	2.44
HCAHPS Care Transition <sup>c</sup> (n=7729)	1.32	1.23-1.43	1.19	1.10-1.30	1.06-1.34	7.24
HCAHPS Communicating Medications (n=5031)	1.16	1.05-1.27	1.15	1.04-1.27	0.99-1.33	4.75
HCAHPS Responsiveness (n=7237)	1.16	1.06-1.28	1.13	1.02-1.25	0.98-1.31	4.05
HCAHPS Discharge <sup>c</sup> (n=7336)	1.37	1.20-1.56	1.28	1.11-1.47	1.05-1.56	2.16
HCAHPS Cleanliness (n=7693)	2.94	2.79-3.10	0.98	0.88-1.11	0.84-1.16	-0.03
HCAHPS Quietness (n=7642)	1.14	1.04-1.26	1.07	0.97-1.18	0.92-1.23	2.50
HCAHPS Hospital Rating (global) (n=7699)	1.00	0.90-1.11	1.13	1.00-1.27	0.95-1.34	2.53
HCAHPS Recommend (global) (n=7668)	1.14	1.01-1.28	1.16	1.02-1.32	0.97-1.39	2.65

CG-CAHPS, Clinician and Group Consumer Assessment of Healthcare Providers and Systems; FWER, family-wise error rate; HCAHPS, Hospital Consumer Assessment of Healthcare Providers and Systems; MC, MyChart; MCB, MyChart Bedside; OR, odds ratio.

<sup>a</sup>Estimates based on fractional logistic regression models with robust standard errors clustered by patients; marginal effects at means (d[lnY]/dx) from adjusted model only. Adjusted models control for patient demographic and clinical characteristics as covariates. These covariates are race, age, patient self-reported health status, health insurance status, gender, and survey mode.

<sup>b</sup>Bonferroni corrected  $P < .008$  for  $\alpha$  of 0.05 [99.2].

<sup>c</sup>Bonferroni corrected  $P < .005$  for  $\alpha$  of 0.05 [99.5].

Our study contributes to the existing literature by analyzing all CG-CAHPS and HCAHPS survey dimensions, which, as comprehensive measures, have consequences for health care organizations due to their impact on perceived quality of care, patient recruitment and retention, and reimbursement. Our analyses provide insight into how patient portals may positively affect patients' experiences, both in ambulatory and hospital care settings. Future research should explore the causality of patient portal use on patient satisfaction scores, as well as identify the mediating factors of patient portals and their use on patient experience.

**Limitations**

Our study has several limitations. First, our primary study predictors focused on activated patient portal accounts and did not measure overall portal use or use of specific portal functions. Future extensions of this work should incorporate use measures to enable evaluation of their correlation with dimensions of satisfaction. Second, our study was focused on patients of a single hospital system, which limits our ability to generalize across organizations. Third, the functions offered on the portals at our AMC may vary from those offered at other medical centers. Although portal platforms used by other hospital systems may also be different, the wide implementation

of Epic Systems' portal platforms across US hospitals, as well as the similarity of functions among different portal platforms, supports the generalizability of our results. Fourth, our samples of encounters with and without activated portal accounts differ by notable demographic characteristics. Although we control for these differences in our adjusted model and follow standard risk adjustment procedures for estimating patient satisfaction scores, we acknowledge that there may be unobserved factors that cannot be included in our models. Finally, the potential exists for a simultaneity effect, in which patients who decided to open a portal account are those who are highly satisfied with the provider or hospital, and this could result in an upward bias in our findings. Our study, however, took measures in study design and our analytical models to mitigate this potential effect, giving us confidence in the findings that we report.

**CONCLUSIONS**

Patient portals are a promising tool that can promote patient-centered care by enabling patients to participate in their health care. Our study provides preliminary evidence that patient portal use is correlated with patients' positive perceptions of their care

experiences. Given the importance of patient satisfaction scores in the context of reimbursement and reputation, our results encourage further research to understand how health care providers and institutions can consider the opportunity to promote patient portal use as a means of improving patient satisfaction. ■

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## REFERENCES

- Institute of Medicine. *Crossing the Quality Chasm: A New Health System for the 21st Century*. The National Academies Press; 2001.
- Davis K, Schoenbaum SC, Audet AM. A 2020 vision of patient-centered primary care. *J Gen Intern Med*. 2005;20(10):953-957. doi:10.1111/j.1525-1497.2005.0178.x
- Cleary PD. Evolving concepts of patient-centered care and the assessment of patient care experiences: optimism and opposition. *J Health Polit Policy Law*. 2016;41(4):675-696. doi:10.1215/03616878-3620881
- Blumenthal D, Tavenner M. The "Meaningful Use" regulation for electronic health records. *N Engl J Med*. 2010;363(6):501-504. doi:10.1056/NEJMp1006114
- Ahern DK, Woods SS, Lightowler MC, Finley SW, Houston TK. Promise of and potential for patient-facing technologies to enable Meaningful Use. *Am J Prev Med*. 2011;40(5 suppl 2):S162-S172. doi:10.1016/j.amepre.2011.01.005
- Han HR, Gleason KT, Sun CA, et al. Using patient portals to improve patient outcomes: systematic review. *JMIR Hum Factors*. 2019;6(4):e15038. doi:10.2196/15038
- Kruse CS, Bolton K, Freriks G. The effect of patient portals on quality outcomes and its implications to Meaningful Use: a systematic review. *J Med Internet Res*. 2015;17(2):e44. doi:10.2196/jmir.3171
- Dendere R, Slade C, Burton-Jones A, Sullivan C, Staib A, Janda M. Patient portals facilitating engagement with inpatient electronic medical records: a systematic review. *J Med Internet Res*. 2019;21(4):e12779. doi:10.2196/12779
- CAHPS Clinician & Group Survey. Agency for Healthcare Research and Quality. Updated August 2021. Accessed April 20, 2020. <https://www.ahrq.gov/cahps/surveys-guidance/cg/index.html>
- About the survey. Hospital Consumer Assessment of Healthcare Providers and Systems. Accessed April 20, 2020. <https://hcahpsonline.org/#AboutTheSurvey>
- The CAHPS program. Agency for Healthcare Research and Quality. Updated October 2018. Accessed April 20, 2020. <https://www.ahrq.gov/cahps/about-cahps/cahps-program/index.html>
- Patient satisfaction surveys. *NEJM Catalyst*. January 2018. Accessed April 20, 2020. <https://catalyst.nejm.org/doi/full/10.1056/CAT.18.0288>
- Tsai TC, Orav EJ, Jha AK. Patient satisfaction and quality of surgical care in US hospitals. *Ann Surg*. 2015;261(1):2-8. doi:10.1097/SLA.0000000000000765
- Jha AK, Orav EJ, Zheng J, Epstein AM. Patients' perception of hospital care in the United States. *N Engl J Med*. 2008;359(18):1921-1931. doi:10.1056/NEJMsa0804116
- Kupfer JM, Bond EU. Patient satisfaction and patient-centered care: necessary but not equal. *JAMA*. 2012;308(2):139-140. doi:10.1001/jama.2012.7381
- Giordano LA, Elliott MN, Goldstein E, Lehrman WG, Spencer PA. Development, implementation, and public reporting of the HCAHPS survey. *Med Care Res Rev*. 2009;67(1):27-37. doi:10.1177/1077558709341065
- HCAHPS fact sheet. CMS. October 2019. Accessed April 20, 2020. [https://hcahpsonline.org/globalassets/hcahps/facts/hcahps\\_fact\\_sheet\\_october\\_2019.pdf](https://hcahpsonline.org/globalassets/hcahps/facts/hcahps_fact_sheet_october_2019.pdf)
- Elliott MN, Lehrman WG, Goldstein E, Hambarsoomian K, Beckett MK, Giordano LA. Do hospitals rank differently on HCAHPS for different patient subgroups? *Med Care Res Rev*. 2009;67(1):56-73. doi:10.1177/1077558709339066
- Elliott MN, Zaslavsky AM, Goldstein E, et al. Effects of survey mode, patient mix, and nonresponse on CAHPS hospital survey scores. *Health Serv Res*. 2009;44(2, pt 1):501-518. doi:10.1111/j.1475-6773.2008.00914.x
- Vink S, Fareed N, MacEwan SR, McAlearney AS. An exploration of the association between inpatient access to tablets and patient satisfaction with hospital care. *Perspect Health Inf Manag*. 2019;16(Fall):11.
- Nagykaldi Z, Aspy CB, Chou A, Mold JW. Impact of a wellness portal on the delivery of patient-centered preventive care. *J Am Board Fam Med*. 2012;25(2):158-167. doi:10.3122/jabfm.2012.02.110130
- Neuner J, Fedders M, Caravella M, Bradford L, Schapira M. Meaningful Use and the patient portal: patient enrollment, use, and satisfaction with patient portals at a later-adopting center. *Am J Med Qual*. 2015;30(2):105-113. doi:10.1177/1062860614523488
- Aljabri D, Dumitrascu A, Burton MC, et al. Patient portal adoption and use by hospitalized cancer patients: a retrospective study of its impact on adverse events, utilization, and patient satisfaction. *BMC Med Inform Decis Mak*. 2018;18(1):70. doi:10.1186/s12911-018-0644-4
- Sorondo B, Allen A, Fathima S, Bayleran J, Sabbagh I. Patient portal as a tool for enhancing patient experience and improving quality of care in primary care practices. *EGEMS (Wash DC)*. 2017;4(1):1262. doi:10.13063/2327-9214.1262

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## **eAppendix A. MC and MCB activation and functions**

To activate a MC account, patients are provided information during or after their visit on how to activate and use the outpatient portal. Activation can be completed during a patient's office visit, after their visit via a link e-mailed to the patient, or can be completed by the patient themselves by providing demographic information that links them to a medical record number in the AMC system. For hospitalized patients, patients who were over age 13, English speaking, not incarcerated, and physically and cognitively capable of managing the technology were eligible to receive an Android tablet equipped with the MCB application. After a patient agreed to use the tablet during their hospital stay, a care team member initialized the tablet to activate the patient's MCB account.

MC includes six functions: 1) Messaging (send/receive messages to/from health care providers, request prescription refills, complete an e-visit); 2) Visits (view past and upcoming visits, complete e-check in for upcoming appointments, schedule appointments online with current or new providers, and schedule after hours care or let emergency department know you are on your way); 3) My Record (view medical history, test results, summaries of care); 4) Medical Tools (view symptom checker, share medical records with other providers, participate in research studies); 5) Resources (view patient education, frequently asked questions, grant proxy access); and 6) Billing (pay your bill online or get an estimate of the cost for a procedure).

MCB includes 13 functions: 1) Tutorial (view video about how to use MCB); 2) Happening Soon (view anticipated schedule of medications and procedures); 3) To Learn (view patient education materials); 4) Taking Care of Me (view description and pictures of care team members); 5) Messages (send/receive messages to/from care team members); 6) My Health (view laboratory results and vitals); 7) Order My Meal (order food); 8) I Would Like (send requests); 9) Notes (make personal notes and view progress notes shared by the physician); 10) MyChart (create or access a MC account); 11) Home Screen (view a list of current problems and medications with links to educational content); 12) Questionnaires (view answers related to demographics, symptoms, and more); and 13) Sign Forms (sign consent forms electronically).

## **eAppendix B. CG-CAHPS and HCAHPS Survey Questions Attributed to Relevant Patient Satisfaction Measures**

Note: Top-box responses are bold and underlined. Slight modifications have been made to some questions in this survey in order to fit with AMC goals and targets for care delivery.

### CG-CAHPS Survey Questions Attributed to Relevant Patient Satisfaction Measures

#### *Doctor Communication*

During your most recent visit, did this provider explain things in a way that was easy to understand? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, did this provider give you easy to understand instructions about taking care of these health problems or concerns? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, did this provider listen carefully to you? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, did this provider seem to know the important information about your medical history? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, did this provider show respect for what you had to say? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, did this provider spend enough time with you? [Scale: **Yes, definitely**; Yes, somewhat; No]

#### *Access to Care*

During this visit, did you see this provider within 15 minutes of your appointment time? [Scale: **Yes**, No]

In the last 3 months, when you phoned this provider's office after regular office hours, how often did you get an answer to your medical question as soon as you needed? [Scale: Never, Sometimes, Usually, **Always**]

In the last 3 months, when you phoned this provider's office during regular office hours, how often did you get an answer to your medical question that same day? [Scale: Never, Sometimes, Usually, **Always**]

When you made this appointment for a check-up or routine care, did you get this appointment as soon as you thought you needed? [Scale: Never, Sometimes, Usually, **Always**]

When you made this appointment for care you needed right away, did you get this appointment as soon as you thought you needed? [Scale: Never, Sometimes, Usually, **Always**]

### *Office Staff*

During your most recent visit, did clerks and receptionists at this provider's office treat you with courtesy and respect? [Scale: **Yes, definitely**; Yes, somewhat; No]

During your most recent visit, were clerks and receptionists at this provider's office as helpful as you thought they should be? [Scale: **Yes, definitely**; Yes, somewhat; No]

### *Care Coordination*

During this visit, did this provider have your medical records? [Scale: **Yes**; No]

In the last 3 months, how often did you and anyone on your health care team talk about all the prescription medicines you were taking? [Scale: Never, Sometimes, Usually, **Always**]

In the last 3 months, when this provider ordered a blood test, x-ray, or other test for you, how often did someone from this provider's office follow-up to give you the results? [Scale: Never, Sometimes, Usually, **Always**]

### *Provider Rating*

Using any number from 0 to 10, where 0 is the worst provider possible and 10 is the best provider possible, what number would you use to rate this provider? [Scale: 0 (Worst provider possible), 1, 2, 3, 4, 5, 6, 7, 8, **9**, **10** (Best provider possible)]

### *Recommend*

Would you recommend this provider's office to your family and friends? [Scale: **Yes, definitely**; Yes, somewhat; No]

## HCAHPS Survey Questions Attributed to Relevant Patient Satisfaction Measures

### *Nurse Communication*

During this hospital stay, how often did nurses explain things in a way you could understand? [Scale: Never, Sometimes, Usually, **Always**]

During this hospital stay, how often did nurses listen carefully to you? [Scale: Never, Sometimes, Usually, **Always**]

During this hospital stay, how often did nurses treat you with courtesy and respect? [Scale: Never, Sometimes, Usually, **Always**]

#### *Doctor Communication*

During this hospital stay, how often did doctors explain things in a way you could understand? [Scale: Never, Sometimes, Usually, **Always**]

During this hospital stay, how often did doctors listen carefully to you? [Scale: Never, Sometimes, Usually, **Always**]

During this hospital stay, how often did doctors treat you with courtesy and respect? [Scale: Never, Sometimes, Usually, **Always**]

#### *Care Transition*

During this hospital stay, staff took my preferences and those of my family or caregiver into account in deciding what my health care needs would be when I left. [Scale: Strongly disagree, Disagree, Agree, **Strongly Agree**]

When I left the hospital, I clearly understood the purpose for taking each of my medications. [Scale: Strongly disagree, Disagree, Agree, **Strongly Agree**, I was not given any medication when I left the hospital]

When I left the hospital, I had a good understanding of the things I was responsible for in managing my health. [Scale: Strongly disagree, Disagree, Agree, **Strongly Agree**]

#### *Communicating Medications*

Before giving you any new medicine, how often did hospital staff describe possible side effects in a way you could understand? [Scale: Never, Sometimes, Usually, **Always**]

Before giving you any new medicine, how often did hospital staff tell you what the medicine was for? [Scale: Never, Sometimes, Usually, **Always**]

#### *Responsiveness*

During this hospital stay, after you pressed the call button, how often did you get help as soon as you wanted it? [Scale: Never, Sometimes, Usually, **Always**, I never pressed the call button]

How often did you get help in getting to the bathroom or in using a bedpan as soon as you wanted? [Scale: Never, Sometimes, Usually, **Always**]

### *Discharge*

During your hospital stay, did hospital staff talk with you about whether you would have the help you needed when you left the hospital? [Scale: **Yes**, No]

During your hospital stay, did you get information in writing about what symptoms or health problems to look out for after you left the hospital? [Scale: **Yes**, No]

### *Cleanliness*

During this hospital stay, how often were your room and bathroom kept clean? [Scale: Never, Sometimes, Usually, **Always**]

### *Quietness*

During this hospital stay, how often was the area around your room quiet at night? [Scale: Never, Sometimes, Usually, **Always**]

### *Hospital Rating*

Using any number from 0 to 10, where 0 is the worst hospital possible and 10 is the best hospital possible, what number would you use to rate this hospital? [Scale: 0 (Worst hospital possible), 1, 2, 3, 4, 5, 6, 7, 8, **9**, **10** (Best hospital possible)]

### *Recommend*

Would you recommend this hospital to your friends and family? [Scale: Definitely no, Probably no, Probably yes, **Definitely yes**]

## eAppendix C. Analytic Approach

Fractional logistic regression can be used for the estimation of our dependent variables that have proportional values in the unit interval (i.e.,  $y_j \in [0,1]$ ) and can take the values of 0 or 1, which could result in a missing value in standard logistic regression.<sup>1-3</sup> The log-likelihood function for the fractional logistic regression model is of the form:

$$\ln L = \sum_{j=1}^N y_j \ln\{G(x'j\beta)\} + (1 - y_j) \ln\{1 - G(x'j\beta)\}$$

Where  $G(x'j\beta)$  follows the logit functional form:

$$\exp(x'j\beta) / \{1 + \exp(x'j\beta)\}$$

$N$  is the sample size,  $y_j$  represents one of the CG-CAHPS or HCAHPS top-box proportion variables,  $\ln L$  is a quasi-maximum likelihood estimation function, and  $x'j$  is the vector containing the main predictor, the activated MC account or activated MCB status, and the demographic and clinical characteristic variables for each patient encounter  $j$ .

The covariates for our empirical models were selected based on a literature review of other patient satisfaction studies that have used the CG-CAHPS and HCAHPS scores for similar analyses, and are also based on technical recommendations provided by national agencies involved in the development, administration, and use of the surveys.<sup>4,5</sup> Generally, patient encounters with the characteristics we identified may be associated with systematic differences in patient satisfaction scores and activated MC/MCB status.<sup>6-11</sup>

## References

1. Papke LE, Wooldridge JM. Econometric methods for fractional response variables with an application to 401(k) plan participation rates. *J Appl Econom.* 1996;11(6):619-632.
2. Papke LE, Wooldridge JM. Panel data methods for fractional response variables with an application to test pass rates. *J Econom.* 2008;145(1):121-133.

3. Wooldridge JM. *Econometric analysis of cross section and panel data* 2nd ed. Cambridge, MA: MIT Press, 2010.
4. Agency for Healthcare Research and Quality. Instructions for analyzing data from CAHPS surveys: Using the CAHPS analysis program version 4.1. <https://www.ahrq.gov/sites/default/files/wysiwyg/cahps/surveys-guidance/helpful-resources/analysis/2015-instructions-for-analyzing-data.pdf>. Published 2017. Accessed April 20, 2020.
5. Robert Wood Johnson Foundation. Aggregating and analyzing CAHPS clinician and group survey results: A decision guide. [http://forces4quality.org/af4q/download-document/7148/Resource-13-001\\_aggregating\\_and\\_analyzing\\_cahps\\_decision\\_guide\\_-\\_final.pdf](http://forces4quality.org/af4q/download-document/7148/Resource-13-001_aggregating_and_analyzing_cahps_decision_guide_-_final.pdf). Published 2014. Accessed April 20, 2020.
6. Elliott MN, Zaslavsky AM, Goldstein E, et al. Effects of survey mode, patient mix, and nonresponse on CAHPS hospital survey scores. *Health Serv Res*. 2009;44(2 Pt 1):501-518.
7. Elliott MN, Lehrman WG, Beckett MK, et al. Gender differences in patients' perceptions of inpatient care. *Health Serv Res*. 2012;47(4):1482-1501.
8. Goldstein E, Elliott MN, Lehrman WG, Hambarsoomian K, Giordano LA. Racial/ethnic differences in patients' perceptions of inpatient care using the HCAHPS survey. *Med Care Res Rev*. 2009;67(1):74-92.
9. Walker DM, Hefner JL, Fareed N, Huerta TR, McAlearney AS. Exploring the digital divide: Age and race disparities in use of an inpatient portal. *Telemed J E Health*. 2020;26(5):603-613.
10. Lee G, Park JY, Shin S-Y, et al. Which users should be the focus of mobile personal health records? Analysis of user characteristics influencing usage of a tethered mobile personal health record. *Telemed J E Health*. 2016;22(5):419-428.
11. Graetz I, Gordon N, Fung V, Hamity C, Reed ME. The digital divide and patient portals: Internet access explained differences in patient portal use for secure messaging by age, race, and income. *Med Care*. 2016;54(8):772-779.