

Patients' Characteristics Effecting the Use of a MyChart Patient Portal

Ali Ahmed
Manning School of Business
University of Massachusetts Lowell
Ali_Ahmed@student.uml.edu

Abdullah Wahbeh
Slippery Rock University of Pennsylvania
Abdullah.Wahbeh@sru.edu

Tareq Nasralah
Dakota State University
Tareq.Nasralah@dsu.edu

Cherie B. Noteboom
Dakota State University
Cherie.Noteboom@dsu.edu

Abstract

In this study, we have studied the effects of patients' characteristics on the use of an online patient portal. We have created an explanatory model to illustrate the relationship between the patient-portal use and the patients' demographic and health characteristics. The study is conducted on a large dataset of 1 million patient records, provided by a leading national healthcare provider. Our results indicate, that a unit increase in health problems increases the odds of using the patient portal by 31.1%. Moreover, a single visit to an emergency department decreases the odds of using a patient portal by 7.1%, while a visit to an urgent care center decreases the odds of portal use by 9.2%. We also found that female patients are 58% more likely to use the patient portal as compared to the male patients. The study has practical implications for health care providers, patients and portal developers.

1. Introduction

In the domain of healthcare delivery, patients' access to their health records has the potential to improve their health outcomes [3, 26]. Providing personal health records to the patients establishes a more collaborative relationship between caregivers and patients [9, 23]. To increase this collaboration, healthcare organizations have developed applications which electronically communicate between providers and patients. These applications are called patient portals, which are group of online applications developed to allow patients to securely access their health information with a potential to improve care quality and reduced associated cost [14, 16]. Patient portals have the potential to bring together providers and patients to mediate care outside of

traditional healthcare centers and clinics [6, 12, 24]. Moreover, patient's engagement has been identified as one of the pillars in the healthcare provisions, for reducing the healthcare cost and improving the quality of US healthcare [20]. Even though many hospitals have implemented patient portals, the adoption and use of these portals by patients is still very low [2]. The goal of this research is to gain insight of patients' characteristics, which are significantly affecting the use and adoption of these portals.

In this research, we have used a large dataset to develop a relationship for patients' demographic and health characteristics that are affecting the use of the MyChart patient portal. We have created an explanatory model, to estimate this relationship. Specifically, we have analyzed the effect of patient's age, gender, race, ethnicity, insurance type, health problems, emergency department visits, and urgent care visits, on the use of the patient portal. The aim was to find the magnitude, direction and significance of these factors affecting the use of the patient portal. The patient portal under study is a MyChart patient portal, developed by EPIC Healthcare Software¹. According to EPIC, the company currently holds medical records of 54% of all the patients in the United States and 2.5% of all the patients worldwide [10].

2. Background

Patient portals are an effective healthcare communication technology that benefits both, patients and healthcare providers. The benefits of patient portals for healthcare providers include improved provider-patient communication, decrease in recordkeeping costs, decrease in repeated lab tests, shorter hospital stays, higher patient safety rates, and reduced medical errors [7]. Patient portal is a provider-tethered application that provides patients with online digital access to health-

¹ <https://www.epic.com>

care services and information provided directly by an ambulatory-care [5, 8]. In addition to providing access to personal medical records, patient portals provide patients with virtual care, such as the ability to schedule an electronic visit via the portal, and real-time video visits where patients interact with a healthcare provider instead of traveling to the clinic or hospital [8, 19].

It is important for providers and hospitals to understand the patient characteristics that are significantly affecting the use of patient portal [4, 6]. This understanding can improve the adoption and use of patient portals and also helps in fulfilling the healthcare needs of patients [24]. Understanding the factors affecting the utilization of patient portals is still an underexplored research area. In the literature, studies which evaluated patient characteristics associated with the use of patient portals found that portal users were more likely to be female, middle-aged, with much greater level of illness than non-users [25, 27]. The University of Pittsburgh (Pittsburgh, Pennsylvania) evaluated characteristics of early adopters of patient portals [15]. They have analyzed the patients' characteristics who have utilized the E-visit functionality of a patient portal. The study found that E-visits users were more likely to be female, young, not retired, and in poorer health condition, as indicated by greater numbers of diagnoses and medications [15]. In another study conducted by the Cleveland Clinic, Department of Internal and Family Medicine, found that portal users were more likely to be young, have commercial insurance, and belong to a White race group [28]. Similarly, Osborn et al., (2013), found that portal users are likely to be Caucasian/White, have higher incomes, and have private insurance [24]. The most common portal actions were found to be viewing test results (37%), viewing and responding to clinic messages (29%), and sending medical advice requests (56%) [8]. Another empirical study found that 58% of patient portal users were White, and all other racial/ethnic minority groups had poorer baseline adherence statistic as compared to Whites [19]. Other major factors studied in previous research studies include, diagnosis (symptoms and severity) [13, 17, 18, 21, 22], age [13, 17, 18], limited knowledge / education / health literacy [13, 21], limited computer and internet access [21], socio-economic condition, Medicaid recipients [17], ethnicity[13, 17], attitude, and trust [19].

Our research is different from previous research studies in multiple ways. First, most of the previous studies were conducted on a small dataset and used methodologies such as observational cohort study [18], qualitative semi-structured interviews [21], cross-sectional analysis [17], empirical evaluation [22], or literatures reviews [13]. To the best of our knowledge, none of the previous studies have used a large dataset of over 1 million patient records to empirically measure the

effect of key patient's characteristics on the use and adoption of a patient portal. Second, we are using two new patient's characteristics which may influence the use of patient portal. These are Emergency Department (ED) visits and Urgent Care Center (UCC) visits. Previously these characteristics have been studied in a slightly different manner. The [1, 6, 11] have measured how the patient portal usage increases or decrease the visit to an emergency department or urgent care center. Whereas, we are analyzing this relationship in an inverse manner, i.e. analyzing the effect of Emergency Department (ED) and Urgent Care Center (UCC) visits on the use of the patient portal. We are trying to answer the questions, whether the use of ED or UCC visit increase or decrease the chances of accessing the patient portal. To the best of our knowledge no one has previously explored this relationship in this way while using a large dataset.

3. Data & Methodology

In this study, we have examined the patients' demographic and health characteristics and its effects on the adoption and utilization of a patient portal. The dataset used in this study is a real-world patient dataset, provided by a leading private healthcare system in the nation. It was a limited dataset that was stripped-off protected health information (PHI), reviewed by a privacy board and received the IRB approval. The dataset contained 1,142,691 randomly sampled patient records. Each record contains patient's demographic characteristic, health characteristics, and portal utilization information for the last three years. The demographics variables are age, gender, race, ethnicity and insurance type. The class distribution of all the demographic characteristics are presented in Table 1.

Table 1. Distribution of Demographic Characteristic

Gender		
Male	597,793	52.29%
Female	545,235	47.70%
	1,143,028	100%
Age		
0-14	228,247	19.97%
15-29	230,998	20.21%
30-44	208,275	18.22%
45-59	202,386	17.71%
60-74	173,784	15.20%
75+	99,338	8.69%
	1,143,028	100%
Race		
White	1,003,080	87.76%
Black or African American	28,677	2.51%
American Indian/Alaska Native	49,026	4.29%

Asian	13,296	1.16%
Native Hawaiian/Pacific Islander	1,792	0.16%
Others	47,157	4.13%
	1,143,028	100%
Ethnic Group		
Not Hispanic or Latino	1,071,283	93.72%
Hispanic or Latino	35,390	3.10%
Others	36,355	3.18%
	1,143,028	100%
Insurance Company		
Medicare	199,286	17.43%
Medicaid	141,947	12.42%
BCBS (Blue Cross Blue Shield)	401,965	35.17%
Other Private Insurance	399,830	34.98%
	1,143,028	100%

The patient health characteristics include the variables for the number of health problems a patient has, the number of times a patient has visited an emergency department in the last three years and the number of times a patient has visited an urgent care center in the last three years. The Table 2 provides descriptive statistics for all these health characteristics.

Table 2. Descriptive Statistics of Health Characteristics

Number of Health Problems	
Mean	0.59
Standard Deviation	1.40
Minimum	0.0
Maximum	29.0
Number of Emergency Department Visits (ED visits)	
Mean	0.523
Standard Deviation	1.2
Minimum	0.0
Maximum	167
Number of Urgent Care Visits (UCC Visits)	
Mean	0.687
Standard Deviation	1.89
Minimum	0.0
Maximum	68.0

The portal utilization information is represented by a categorical variable with two classes; Accessed = 1; representing if a patient has accessed the portal in the last three years and Accessed = 0; representing otherwise. Table 3 provides the class distribution of the variable Portal Accessed.

Table 3. Portal Access Distribution

Patient Portal Accessed		
Accessed = 0	833,383	72.91%
Accessed = 1	309,645	27.08%
	1,143,028	100%

To analyze the factors effecting the use and adoption of the patient portal, we perform a multivariate logistic regression analysis as it is suitable for the binary dependent variable. The dependent variable in our regression model is whether a patient has accessed the portal in last three years or not (i.e. Portal Accessed). The following equation represents our explanatory model with all the categorical and continuous variables.

$$\begin{aligned} \Pr(\text{Accessed} = 1) = G(\text{Constant} \\ + \beta_1 \text{HealthProblems} \\ + \beta_2 \text{EDVisits} + \beta_3 \text{UCCVisits} \\ + \beta_4 \text{Female} + \beta_{5i} \text{Age}_i + \beta_{6j} \text{Race}_j \\ + \beta_{7k} \text{Ethnicity}_k + \beta_{8l} \text{Insurance}_l \\ + \beta_9 \text{HealthProblems} + \varepsilon) \end{aligned}$$

$$\text{where } G(\beta'X) = \frac{e^{\beta'X}}{1 + e^{\beta'X}}$$

and

$i = \text{Age categories } 1 - 5$

$j = \text{Race categories } 1 - 6,$

$k = \text{Ethnicity categories } 1 - 2$

$l = \text{insurance categories } 1 - 3$

4. Results and Discussion

In this study, we have explored the relationship between patient's demographic & health characteristics and patient portal use. Our explanatory model specifically explored the effects of patient's age, gender, race, ethnicity, insurance type, health problems, ED-visits and UCC-visits. The results of our model are shown in Table 4. We found consistently significant (p-value < 0.01) relationship for most of the independent variables.

We have estimated that a one-unit increase in health problems increases the odds of using the patient portal by 31.1%. A single visit to an emergency department decreases the odds of using a patient portal by 7.1%, while a visit to an urgent care center decreases the odds of portal use by 9.2%.

In the terms of demographic characteristics, we have estimated that the odds of using a patient portal by a female user is 58% higher as compared to the odds of a male user. Similarly, some age groups have higher odds

of using the patient portal compared to others. The base age group in the model is the group of 0 – 14. The users of this age group are most likely to be parents of the children who are between age group 0 – 14 and registered in the patient portal. The odds of using the patient portal by the age group of 30 – 44 are the highest as compared to all other age groups, they are almost 10.12 times more likely to use the patient portal compared to the parents who are using on behalf of their children. Moreover, the estimated odds of using the patient portal decreases after the age of 59, while the odds of using a patient portal for the age group of 75 and above is least compared to other age groups. These findings are consistent with the findings of Palen et al. [25] and Ralston et al. [27]. The effect of age group 60-74 was not consistent and found insignificant in the model.

Table 4. Logistic Regression Results

Logistic Regression Model			
Explaining Patient Portal Access. DV: Accessed = 1			
Variables	Coeff.	Std. Err.	Odds Ratio
Constant	-0.0293**	0.212	
Health Characteristics			
Health Problems	0.271***	0.004	1.311
ED Visits	-0.073***	0.003	0.929
UCC Visits	-0.096***	0.007	0.908
Gender			
Female	0.458***	0.062	1.580
Age Groups			
15-29	1.523***	0.310	4.585
30-44	2.315***	0.232	10.12
45-59	0.121**	0.621	1.128
60-74	-0.030-	0.023	0.970
75+	-0.843*	0.426	0.430
Race			
Black or African American	-1.394***	0.026	0.248
American Indian/Alaska Native	-1.782***	0.022	0.168
Asian	-0.485*	0.032	0.615
Native Hawaiian/Pacific Islander	-1.146**	0.103	0.032
Others	-0.473***	0.043	0.623
Ethnic Group			
Hispanic or Latino	-0.718***	0.048	0.487
Others	-0.110	0.022	0.865
Insurance Company			
Medicare	-0.204***	0.010	0.815
Medicaid	-0.403***	0.008	0.668
BCBS	0.106***	0.005	1.111
No. Observations	1,143,028		
Degrees of Freedom	18		
DF Residual	1,143,009		
p > χ^2	< 0.01***		
Pseudo R2	0.099		
Model / Method	Logit / MLE		

Significant Levels: *** p < .01, ** p < .05, * p < .10.

The White race is the base group for the race category. All the other races are estimated to be less

likely to use the patient portal as compared to the White race. The Native Hawaiian & Pacific Islander race patients has the least odds of using the patient portal. They are 96.8% less likely to use the patient portal compared to the White race patients. This is also consistent with previous research studies [15, 25]. Similarly, the odds of using the portal with Hispanics or Latino ethnicity are 0.487 times less compared to Non-Hispanics.

Our model has estimated a negative relationship between portal use and the Medicaid/Medicare insurance type. The patients with the private insurance companies, such as Blue Cross Blue Shield, have a positive relationship with the use of the patient portal. The Medicare patients are 18.5% less likely to use the patient portal compared to a private insurance company. Similarly, the odds of using the patient portal by a patient having Medicaid insurance is about 33% less compared to the odds of patients who have a private or commercial insurance. These findings are also consistent with the finding of [10, 11], who found that private insurance buyers are more likely to use the patient portal. The estimated Pseudo R² for model is 0.09, it is calculated using McFadden's statistics, which uses a ratio of the log likelihood of the intercept model and the log likelihood of the full model. This shows that the fitted model is better than the non-fitted models and explains the variability to some extent.

5. Conclusion

In this research, we have used a large dataset of over 1 million patient records to create an explanatory model. The model has explained the relationship between patient's portal use and their demographic and health characteristics. Specifically, the model has estimated the effect of age, gender race, ethnicity, insurance type, health problems, ED visits, and UCC visits on patient's portal use. Many of the findings were consistent with previous research findings. Such as, the use of patient portal of females, young & middle aged, whites and patients having commercial insurance are more likely to use the patient portal. The two new factors used in this research are the Emergency department (ED) visits and Urgent care centers (UCC) visits. We have found a negative relationship between EDs and UCCs visits and the use of the patient portal.

In this research, we have contributed to the field of healthcare IT in three ways; first, we have used a real-world patient dataset of a large size. Most of the previous studies were conducted on small samples using surveys and other historical datasets. Second, we have confirmed many findings of the previous studies, which were conducted using small empirical studies, qualitative semi-structured interviews, cross-sectional analysis, or literature reviews methodologies. Third, we have used

two new factors, ED visits and UCC visits, effecting the patients' use of patient portals.

There are number of limitations in the paper. First, we have not incorporated any information about patient's illness type. Patients with chronic illnesses may have higher impact on the use of patient portal. Second, the dataset contains unrealistic proportions of the race groups. For example, we have more Native and Asian race people in the dataset as compared to Blacks.

This paper is our first paper using this dataset. In our future studies, we plan to add more factors, such as patient's illness type, family history and geographic location. Future studies can also include, predictive models and machine learning techniques to estimate the predictive accuracy of these factors. We also plan to study the frequency of portal use by the patient, which can be a very interesting research question. This research has set the stage for us as well as for other researchers to use real-world large datasets to explore the adoption of IT in healthcare settings.

6. References

- [1] Ahmed, A., T. Nasralah, Y. Wang, et al., "Impact of E-Visits on Emergency Departments and Urgent Care Centers", 2017.
- [2] Al-Ramahi, M., A. Wahbeh, and C. Noteboome, "Features Related to Patient Portal User Satisfaction: N-Gram-Based Analysis of Users' Feedback", *Proceedings of the 2018 ACM SIGMIS Conference on Computers and People Research*, ACM (2018), 152.
- [3] Al-Ramahi, M.A., J. Liu, and O.F. El-Gayar, "Discovering Design Principles for Health Behavioral Change Support Systems: A Text Mining Approach", *ACM Trans. Manage. Inf. Syst.* 8(2–3), 2017, pp. 5:1–5:24.
- [4] Ammenwerth, E., P. Schnell-Inderst, and A. Hoerbst, "The impact of electronic patient portals on patient care: a systematic review of controlled trials", *Journal of medical Internet research* 14(6), 2012.
- [5] Baird, A., M.F. Furukawa, and T.S. Raghu, "Understanding contingencies associated with the early adoption of customer-facing web portals", *Journal of Management Information Systems* 29(2), 2012, pp. 293–324.
- [6] Emont, S., "Measuring the impact of patient portals", *California Healthcare Foundation*, 2011, pp. 1–20.
- [7] Erdeljac, H.P., M.J. Snider, K. Bartsch, and R. Weiss, "Patient Portals in Pharmacist-run Ambulatory Care Clinics: Is There 'Meaningful Use'?", *Excerpts in Pharmacy Research Journal* 2(1), 2016, pp. 5.
- [8] Gerber, D.E., A.L. Laccetti, B. Chen, et al., "Predictors and intensity of online access to electronic medical records among patients with cancer", *Journal of oncology practice* 10(5), 2014, pp. e307–e312.
- [9] Giardina, T.D., S. Menon, D.E. Parrish, D.F. Sittig, and H. Singh, "Patient access to medical records and healthcare outcomes: A systematic review", *Journal of the American Medical Informatics Association* 21, 2014, 737–741.
- [10] Glaze, J., "Epic Systems draws on literature greats for its next expansion", *Wisconsin State J*, 2015.
- [11] Goldzweig, C.L., G. Orshansky, N.M. Paige, et al., "Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review", *Annals of internal medicine* 159(10), 2013, pp. 677–687.
- [12] Hogan, T.P., K.M. Nazi, T.M. Luger, et al., "Technology-assisted patient access to clinical information: An evaluation framework for blue button", *Journal of Medical Internet Research* 16(3), 2014.
- [13] Irizarry, T., A.D. Dabbs, and C.R. Curran, "Patient portals and patient engagement: a state of the science review", *Journal of medical Internet research* 17(6), 2015.
- [14] Islam, M.N., M. Kabir, J. Sultana, et al., "Autism Sohayika: A Web Portal to Provide Services to Autistic Children", *International Conference on Mobile Web and Intelligent Information Systems*, Springer (2018), 181–192.
- [15] Jung, C., R. Padman, G. Shevchik, and S. Paone, "Who are portal users vs. early e-Visit adopters? A preliminary analysis", *AMIA Annual Symposium Proceedings*, American Medical Informatics Association (2011), 1070.
- [16] Juntunen, K., and R. Halonen, "Self-care Portal as a Trigger for a Work Process Change: A Case from Finland", In *Knowledge and Technologies in Innovative Information Systems*. Springer, 2012, 225–240.
- [17] Ketterer, T., D.W. West, V.P. Sanders, J. Hossain, M.C. Kondo, and I. Sharif, "Correlates of patient portal enrollment and activation in primary care pediatrics", *Academic pediatrics* 13(3), 2013, pp. 264–271.
- [18] Kipping, S., M.I. Stuckey, A. Hernandez, T.

Nguyen, and S. Riahi, “A web-based patient portal for mental health care: benefits evaluation”, *Journal of medical Internet research* 18(11), 2016.

[19] Lyles, C.R., U. Sarkar, D. Schillinger, et al., “Refilling medications through an online patient portal: consistent improvements in adherence across racial/ethnic groups”, *Journal of the American Medical Informatics Association* 23(e1), 2015, pp. e28–e33.

[20] Minniti, M.J., T.R. Blue, D. Freed, and S. Ballen, “Patient-interactive healthcare management, a model for achieving patient experience excellence”, In *Healthcare Information Management Systems*. Springer, 2016, 257–281.

[21] Mishuris, R.G., M. Stewart, G.M. Fix, et al., “Barriers to patient portal access among veterans receiving home-based primary care: a qualitative study”, *Health Expectations* 18(6), 2015, pp. 2296–2305.

[22] Nambisan, P., “Factors that impact Patient Web Portal Readiness (PWPR) among the underserved”, *International journal of medical informatics* 102, 2017, pp. 62–70.

[23] Noteboom, C.B., J. Hafner, and A. Wahbeh, “Characteristics of Complete and Incomplete Physicians’ Unlearning with Electronic Medical Record”, *Journal of the Midwest Association for*

Information Systems| Vol 2017(2), 2017, pp. 57.

[24] Osborn, C.Y., L.S. Mayberry, K.A. Wallston, K.B. Johnson, and T.A. Elasy, “Understanding patient portal use: implications for medication management”, *Journal of medical Internet research* 15(7), 2013.

[25] Palen, T.E., C. Ross, J.D. Powers, and S. Xu, “Association of online patient access to clinicians and medical records with use of clinical services”, *Jama* 308(19), 2012.

[26] Peacock, S., A. Reddy, S.G. Leveille, et al., “Patient portals and personal health information online: perception, access, and use by US adults”, *Journal of the American Medical Informatics Association*, 2016, pp. ocw095.

[27] Ralston, J.D., C.M. Rutter, D. Carrell, J. Hecht, D. Rubanowice, and G.E. Simon, “Patient use of secure electronic messaging within a shared medical record: a cross-sectional study”, *Journal of general internal medicine* 24(3), 2009, pp. 349–355.

[28] Tenforde, M., A. Nowacki, A. Jain, and J. Hickner, “The association between personal health record use and diabetes quality measures”, *Journal of general internal medicine* 27(4), 2012, pp. 420–424.