

Impact of Patient Portal Use on Clinical Outcomes

Full Paper

Tamuchin McCreless
Northern Kentucky University
tam.mccreless@nku.edu

Wael Eid
University of South Dakota
wael.eid@use.edu

Abstract

Patient portals are an important component for engaging patients in their own care. While providers are expected to implement patient portals to adhere to meaningful use guidelines, there has until recently been little research to demonstrate impact of the use of patient portals on patient care. This study leverages data from a regional diabetes clinic which contains record on over 44,000 registered diabetes patients. The data provide evidence that the frequency of use of a patient portal has a positive impact on clinical outcomes of diabetes patients.

Keywords

Electronic health records, patient portals

Introduction

Patient engagement is increasingly being recognized as a crucial component of a patient's care routine (Forbat, Cayless, Knighting, Cornwell, Kearney, 2009; Coulter, 2002; Barello, Graffigna, Vegni, 2012). After leaving a physician's office or hospital, patients are often the only individuals responsible for ensuring that they receive the proper care. The responsibilities placed on patients becomes increasingly burdensome as conditions become more severe or are accompanied by comorbidities. The amount of information and instructions patients must follow to adhere to evidence based practice guidelines is large and complex. Traditionally, a provider's reach into a patient's care would only extend as far as the doors of the facility in which they practice. This reach would occasionally extend into the patient's home through phone calls when patients deemed an issue of high enough priority to warrant contacting a provider. A provider's ability, however, to address all questions or concerns is limited. These time constraints have become greater as providers have had to take on larger volumes of patients to deal with a population that is acquiring chronic conditions at an increasing rate (Vogeli, Shields, Lee, Gibson, Marder, Weiss, Blumenthal, 2007). Technology is being used to aid providers in engaging patients in their own care. Patient portals, specifically, are being used to aid patients in keeping track of medication, appointments, test results, and other items related to the care of a patient (Kruse, Bolton, Freriks, 2015). Federal guidelines for electronic health record systems have set requirements related to the implementation of patient portal modules in existing systems. By 2017, providers are expected to implement APIs to electronic health record systems, allowing for third parties to write apps for mobile devices, increasing options for patients to be engaged in their own care.

While these portals are believed to have an impact on patient care, there have been until recently few studies that have been able to provide evidence of this. This study adds to a growing body of evidence that patient portals have a positive impact on patient outcomes. Specifically, the study show support for frequency of use of patient portals impacting clinical outcomes of registered diabetics being treated in a regional diabetes clinic.

Background and Literature Review

This study contributes to a body of evidence demonstrating the impact of patient portals on clinical outcomes. The impact of patient portal use on various dependent measures has been well explored, especially within the past five years. A literature search discovered 6 systematic reviews of studies that measure the impact of patient portals on some aspect of patient care (Ammenwerth, Schnell-Inderst & Hoerbst, 2011; Ammenwerth, Schnell-Inderst & Hoerbst, 2012; Otte-Trojel, de Bont, Rundall, van de Klundert, 2014; Goldzweig, Orshansky, Paige, Towfigh, Haggstrom, Miake-Lye, Shekelle, 2013; Giardina, Menon, Parrish, Sittig, Singh, 2014; Kruse, Bolton, Freriks, 2015). In comparing findings from these reviews as well as exploring papers related to this area, there were 42 papers discovered that measured the impact of patient portals on some measure of care. There were 14 quantitative papers discovered that measured the impact of patient portals on a non-process based outcome of care. Of these 14, only 6 involved measurement of impact on outcomes associated with diabetes. Most of these studies viewed use of the patient portal as a binary variable. The intent of this study is to go beyond looking at the use of portals as a binary variable and to determine whether the manner in which portals are used has an effect on clinical outcomes. Although there are a number of dimensions regarding the manner in which patients use portals that could be studied in this regard, this study focuses on the frequency with which portals are used and how this impacts patient outcomes. This has been done only in two prior studies (Osborn, Mayberry, Wallston, Johnson, Elasy, 2013; Tenforde, Nowacki, Jain, Hickner, 2012). One of these studies provided support that more frequent users of patient portals had lower HbA1C measures, based on a self-reported measure of frequency of use (Osborn, Mayberry, Wallston, Johnson, Elasy, 2013). The other study provided support for greater change in HbA1C levels for users versus non-users, but found no evidence that greater use (as measured by time on the system) led to better outcomes (Tenforde, Nowacki, Jain, Hickner, 2012). To the author's knowledge, no study has yet been conducted which measures frequency of use as an objective measure and demonstrates that more frequent users have better outcomes, but also experience improvement in outcomes when participating in a care program. That is the finding reported in this study.

Research Questions and Hypotheses

The research question this study addresses is what effect patient portals have on clinical outcomes. Specifically being addressed is the effect that frequency of use of a patient portal has on clinical outcomes. Since the patient portal is designed with the intent of keeping patients engaged in the management of their conditions, and since patients who are more engaged are expected to have better outcomes, it is hypothesized that patients who are more frequent users of patient portals in general have better health outcomes than those who are less frequent users or non-users.

H1: Frequency of use of a patient portal has a positive impact on clinical outcomes.

A care plan for someone with a chronic disease has the intention of improving outcomes that are associated with a given disease condition. Patients are enrolled in a diabetes management program if they have clinical measures that place them into an at-risk category. The goal of such programs is to manage a patient's condition in a way that will reduce the risk of patient experiencing a serious clinical incident. The easiest way to determine whether or not patients are managing conditions effectively is to observe the change in clinical outcomes. Providers of diabetes patients, for example, want to see HbA1C levels of their patients decrease as they participate in a care management program. Patients face clinical inertia when they are participating in a care management program without seeing any movement in their recorded clinical measures. The program is successful if a patient's most recent clinical outcome measure is better than the measure taken at the date that they were enrolled into the program. Patient portals play a key role in this process. The patient portal is designed to ensure that patients are reminded of when to take medications, when to schedule appointments with specialists, as well as data regarding lab results. It is therefore expected that patients who frequently use the patient portal will see a greater improvement in clinical outcomes from the beginning of enrolling in a care program to the end.

H2: Frequency of use of a patient portal has a positive impact on improvement of clinical outcomes.

Method

This study leverages data on patients who were registered diabetics in a diabetes clinic serving a metropolitan area of roughly 2 million people. The patients used for the study were those that enrolled in a diabetes care management program. The program's goal is to keep each patient's diabetes under control, preventing patients from becoming higher risk patients and experiencing an event that could lead to hospitalization. The data were obtained from an Epic electronic health record system serving the hospital with which the diabetes clinic is affiliated. The data were obtained through the Clarity relational database which connects to Epic's Chronicles database. SQL queries were constructed to pull data on patients who were part of the hospital's diabetes registry, and enrolled to participate in the care management program. The timeframe of the data in the study includes a six year period ranging from 2011 to 2016. The data were limited to patients who had been enrolled in the program for only 6 months.

To determine the effects of frequency of use on clinical outcomes, 6 analyses were run using multiple regression with clinical outcomes as the dependent variable, frequency of use of clinical portals as an independent variable among several other covariates which were also used as independent variables. The specific details on which measures were used is described below. To determine if these effects were different in patients of varying levels of acuity, the same analysis was conducted on patients of low HbA1C values (below 8), medium values (between 8 and 9) and high values (above 9).

Clinical Outcomes

There were three different clinical outcomes that were used in this study: HbA1C levels, LDL, and mean arterial blood pressure. These measures are recorded when patients enter the program and are recorded periodically throughout participation in the program. To determine the effect of patient portal use on outcomes in general, the most recent recording after program enrollment of each of these three measures was used. To determine the effect of patient portal use on improvement in clinical outcomes, the difference between the first recorded measure on or after enrollment and the last recorded measure after enrollment.

Frequency of Patient Portal Use

The Epic electronic health record system utilizes a patient portal feature known as MyChart. The system keeps logs related to patient use. For this study, the most recent access to MyChart was recorded for all patients enrolled in the diabetes management program. This most recent access was used as a proxy for frequency of use, as there were no additional data to calculate actual frequency. The use of this measure assumes that the proximity of patients' most recent use of the system will give insight into how often they actually use the system. Patients were categorized based on how recently they last accessed the MyChart system. The categories used in the analysis were: Never accessed MyChart, accessed in the past 3 months, accessed in the past 3 months to 6 months, accessed more than 6 months ago.

Covariates

To account for other differences among patients, several covariates believed to have an effect on clinical outcomes were used in the regression analysis. These include age, gender, amount of time spent in a room with a primary care physician, the number of years since enrollment, whether or not the patient has seen an endocrine specialist, the type of insurance carrier the patient has (commercial or government), and the patient's risk score as calculated by Epic. The age used in the analysis was age at enrollment into the program. The amount of time spent in a room by a primary care physician is a measure that comes from the Epic system and is measured from when a physician logs into the Epic system while seeing a patient until the time when the physician logs out. The measure used here was an average measure over all of the visits a patient had in the clinic from the time of enrollment. The number of years since enrollment was taken from the date of enrollment up to the date that the analysis was conducted. A visit to an endocrine specialist was retrieved from the Epic system using clinical specialty codes of physicians that visited patients during enrollment. Insurance carriers are documented within the Epic system. For the purposes of this study, the only factor used with respect to the carrier is whether or not the carrier was commercial or government. Commercial carriers often have incentives to reduce premiums based on management of

chronic conditions. The risk score calculated by Epic is intended to give an idea of how “at-risk” a patient is based on a number of metrics such as demographic metrics, utilization patterns, and clinical outcomes. The formula to calculate the risk is proprietary and has not been disclosed to the author of this paper.

Results

There were 44,055 patients who had enrolled in the program over the 6 year period from the beginning of 2011 to the end of 2016. Excluding patients who had been enrolled for less than 6 months brought the number of patients to 36,254. Because the study measured the impact of portal use on various outcomes, only patients who had recorded values for these outcomes could be included in the study. This brought the total number of patients included in the study down to the number of observations reported in Tables 1-3. The results of the regression analysis on all patients is shown in Table 1. These results provide support for H1 by showing that patients who have used MyChart more recently have lower HbA1C results than those who do not use MyChart. The magnitude of the effect of MyChart decreases for people who have not accessed the system as recently. Those patients who have accessed the system in the past 3 months have on average an HbA1C final reading that is 0.322 points lower than those that do not use the system. This effect is slightly lower for those who have only used the system as recently as 3-6 months ago, having HbA1C readings that are only 0.303 points lower than non-users. Those that have had their most recent use more than 6 months ago only see a difference of 0.052 compared to non-users. This effect can also be observed for LDL and MAP, with those using the system within the past 3 months showing a significant difference while the difference for those from 3-6 months or greater than 6 months are non-significant.

With respect to H2, this was not supported in the analysis that was run for all patients, as there was no effect of MyChart use on the change in any of the three clinical outcomes from the first to the last reading.

The results for patients with medium level HbA1C values is shown in Table 2. These results provide support for H1 as related to HbA1C and LDL, although there does not appear to be any impact of MyChart use on MAP. There is also support for H2 in this table with respect to the change in HbA1C levels. Those who have used MyChart within the past 3 or from 3-6 months show a significant decrease in beginning and final HbA1C levels compared to non-users. Those who have not used the system in greater than 6 months do not show a significant decrease compared to non-users. There is partial support for H2 with respect to changes in LDL as well. Although patients who have accessed the system in the past 3 months do not show a significant change in LDL compared to non-users, those who have used the system in the past 3-6 months show a significant change compared to non-users, while those who have not used the system in more than 6 months do not show as large of a decrease compared to those in the 3-6 months category. These results are comparable to those for patients with HbA1C levels greater than 9, shown in Table 3, which also provide support for H1 and H2, with respect to HbA1C, LDL, and changes in HbA1C and LDL. These results also show partial support for H2 with respect to changes in MAP. The patients in this group who have used MyChart within the past 3 months show significant changes in MAP, although oddly those in the 3-6 month group show a significant positive increase compared to non-users. The R-squared values for all of these analyses are relatively low, which indicates that there are a number of out variables influencing these outcomes which have not been included in the model.

Dependent variable:

	Last HbA1C	Last LDL	Last MAP	HbA1C Change	LDL Change	MAP Change
Gender (Male)	0.110***	-9.215***	0.794***	-0.037	0.948**	-0.258
Age	-0.029***	-0.415***	-0.070***	0.005***	0.101***	0.005
PCP Time	0.003***	0.085***	0.010**	-0.0002	0.029*	-0.004
Years Enrolled	0.118***	-1.666***	-0.169**	-0.037**	-1.156***	-0.350***
Endocrine Seen	0.335***	-3.931***	-0.871***	-0.440***	0.897*	-0.311
Insurance (Govt)	0.039*	-1.419***	-0.356**	0.051*	0.517	0.095
Risk Score	0.060***	-2.180***	-0.988***	-0.077***	-1.027***	-0.493***
MyChart 0-3M	-0.322***	-3.859***	-0.335**	0.013	0.256	-0.026
MyChart 3-6M	-0.303***	-1.026	-0.429	-0.011	-1.548	0.136
MyChart > 6M	-0.052*	0.581	0.049	0.039	0.641	0.218
Constant	8.441***	121.836***	99.009***	-0.302***	-10.508***	-0.344
Observations	24,215	24,303	24,356	24,191	24,303	24,356
R ²	0.084	0.058	0.027	0.012	0.003	0.002
Adjusted R ²	0.084	0.058	0.027	0.011	0.002	0.002
F Statistic	223.148***	149.336***	67.854***	28.252***	6.643***	4.930***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 1. Regression Results for All Patients

Dependent variable:

	Last HbA1C	Last LDL	Last MAP	HbA1C Change	LDL Change	MAP Change
Gender (Male)	-0.058	-10.992***	0.826**	-0.063	2.272*	-0.533
Age	-0.016***	-0.412***	-0.036**	-0.014***	0.101*	0.018
PCP Time	0.004**	0.100**	0.028**	0.004**	0.013	0.002
Years Enrolled	0.031	-0.016	-0.354	0.021	-0.911	-0.523*
Endocrine Seen	0.006	-5.115***	-1.254***	-0.033	2.388*	-0.012
Insurance (Govt)	0.065	-2.968**	-0.802*	0.056	0.085	-0.042
Risk Score	-0.005	-2.705***	-0.990***	-0.009	-1.681**	-0.415
MyChart 0-3M	-0.349***	-4.223***	-0.455	-0.330***	-0.639	-0.240
MyChart 3-6M	-0.393***	-2.873	-1.117	-0.366***	-5.697*	-0.482
MyChart > 6M	-0.123*	-2.481	-1.215**	-0.108	-1.874	-0.187
Constant	8.692***	119.156***	97.357***	0.186	-9.677**	-1.404
Observations	3,005	2,998	3,005	3,005	2,998	3,005
R ²	0.035	0.068	0.025	0.029	0.005	0.002
Adjusted R ²	0.032	0.065	0.022	0.026	0.002	-0.001
F statistic	10.800***	21.880***	7.723***	9.023***	1.542	0.685

Note: *p<0.1; **p<0.05; ***p<0.01

Table 2. Regression Results for Patients with HbA1C Between 8 and 9

	<i>Dependent variable:</i>					
	Last HbA1C	Last LDL	Last MAP	HbA1C Change	LDL Change	MAP Change
Gender (Male)	-0.174***	-10.287***	1.566***	-0.105	3.688***	0.864**
Age	-0.038***	-0.508***	-0.060***	-0.017***	-0.105*	-0.046**
PCP Time	0.005**	0.057	0.025**	0.003	0.035	0.011
Years Enrolled	0.046	-0.495	0.016	0.027	-0.861	-0.195
Endocrine Seen	-0.134**	-4.906***	-0.802**	-0.246***	0.232	0.041
Insurance (Govt)	0.016	-1.528	-0.449	0.007	3.222**	0.568
Risk Score	0.097***	-2.683***	-0.403**	-0.021	-2.098***	-0.204
MyChart 0-3M	-0.567***	-5.716***	-0.525	-0.372***	-3.438**	-1.049**
MyChart 3-6M	-0.621***	-0.316	0.835	-0.458**	-6.497*	2.026*
MyChart > 6M	-0.028	-1.365	0.315	0.042	0.334	0.304
Constant	10.527***	130.130***	97.026***	-1.212***	-4.340	-0.436
Observations	3,940	3,927	3,940	3,940	3,927	3,940
R ²	0.072	0.061	0.019	0.020	0.009	0.006
Adjusted R ²	0.070	0.058	0.016	0.017	0.006	0.004
F statistic	30.677***	25.277***	7.569***	7.935***	3.403***	2.449***

Note: *p<0.1; **p<0.05; ***p<0.01

Table 3. Regression Results for Patients with HbA1C > 9

Discussion

The purpose of this study is to demonstrate the frequency of use of a patient portal system can have an impact on clinical outcomes. While prior studies have shown an effect of patient portals on some outcomes, none have explored the frequency of use itself as a variable. The study provides support for the impact that frequency of use has on both measured outcomes as well as change in outcomes from the beginning of participation in a diabetes management program to the most recent measurement of a given outcome. The study has important implications for healthcare providers, payers and patients. The implications for providers and patients are perhaps straightforward. For providers, implementing and encouraging patients to use a patient portal system could aid them in moving patients towards better results. For patients, signing up for and using these systems on a regular basis should lead to better results.

The results of the study may have the most significant implication for payers. While moving patients towards better outcomes is in the interest of all parties, payers are put in the position of providing incentives to patients to engage in the management of conditions. The incentives can involve lower premiums for those who receive annual exams, higher copays for specialist visits, and discounts for using providers who belong to the payer network. Payers also provide incentives for patients who complete online risk assessments. It is reasonable to believe that payers may in the future provide incentives to patients who use portals. To do this, payers would need information to inform the structure of the incentive. For example, is creating a portal account a sufficient action to warrant an incentive to a patient? Should patients be required to log into a portal system at a particular frequency to receive incentives? If so, how often. This study provides insight that may aid payers in making such decisions. Payers could construct incentives based on existing patient attributes. For example, patients with a goal of controlling HbA1C levels may only need to be encouraged to use the portal every 3-6 months, since more frequent use does not seem to provide a much larger benefit.

Limitations

The findings of this study do have limitations. The chief limitation is that the study is not a randomized controlled trial. The patients who use the MyChart system, and those who choose to use it more frequently are self selected. This makes it difficult to demonstrate a causal relationship between MyChart use and outcomes. That is, patients may be using the system because they are more conscientious or have other attributes which make them better managers of their condition, and it is these same attributes that leads them to use the MyChart system more frequently.

The measurement of MyChart use is also a limitation in this study. The data were gathered for a clinician to optimize diabetes care, and thus less focus was placed on the use of patient portals. Thereby, the only attribute available for analysis was the last access to the MyChart system. While this was used as a proxy for frequency of use, it is not a true measure of frequency of use. This could have some effect on the results.

Future Research

In addition to future research projects which could be carried out to address the limitations described above, there are also other aspects of patient portal appropriation that may affect the impact of portal use on patient outcomes. Aside from frequency of use, it would be interesting to see which components of patient portals are having the largest impact on outcomes. Why are patients benefitting from use of the system? Is it that they are receiving alerts and provider messages? Is it the convenience of being able to set up an appointment online? Is it the ease of access to results? Further, understanding provider attributes or patient attributes that could affect the manner in which patient portals are used and how this use impacts outcomes would also be of interest.

REFERENCES

- Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2011). "Patient empowerment by electronic health records: first results of a systematic review on the benefit of patient portals," *Stud Health Technol Inform*, 165, pp. 63-67.
- Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2012). "The impact of electronic patient portals on patient care: a systematic review of controlled trials," *Journal of medical Internet research*, (14:6), e162.
- Barello, S., Graffigna, G., & Vegni, E. (2012). "Patient engagement as an emerging challenge for healthcare services: mapping the literature," *Nursing research and practice*, 2012.
- Coulter, A., Stationery Office HMSO Great Britain, & Nuffield Trust for Research and Policy Studies in Health Services. (2002). *The autonomous patient: ending paternalism in medical care* pp. 106-21. London: TSO.
- Earnest MA, Ross SE, Wittevrongel L, Moore LA, Lin CT. (2004) "Use of a patient-accessible electronic medical record in a practice for congestive heart failure: patient and physician experiences," *J Am Med Inform Assoc* (11:5), pp. 410-417
- Forbat, L., Cayless, S., Knighting, K., Cornwell, J., & Kearney, N. (2009). "Engaging patients in health care: an empirical study of the role of engagement on attitudes and action," *Patient education and counseling*, (74:1), pp. 84-90.
- Giardina, T. D., Menon, S., Parrish, D. E., Sittig, D. F., & Singh, H. (2014). "Patient access to medical records and healthcare outcomes: a systematic review," *Journal of the American Medical Informatics Association*, (21:4), pp. 737-741.
- Goldzweig, C. L., Orshansky, G., Paige, N. M., Towfigh, A. A., Haggstrom, D. A., Miake-Lye, I., ... & Shekelle, P. G. (2013). "Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review," *Annals of internal medicine*, (159:10), pp. 677-687.
- Grant RW, Wald JS, Schnipper JL, Gandhi TK, Poon EG, Orav EJ, et al. (2008) "Practice-linked online personal health records for type 2 diabetes mellitus: a randomized controlled trial," *Arch Intern Med*, (168:16), pp. 1776-1782

- Kruse, C. S., Bolton, K., & Freriks, G. (2015). "The effect of patient portals on quality outcomes and its implications to meaningful use: a systematic review," *Journal of medical Internet research*, (17:2), e44.
- Osborn, C. Y., Mayberry, L. S., Wallston, K. A., Johnson, K. B., & Elasy, T. A. (2013). "Understanding patient portal use: implications for medication management," *Journal of medical Internet research*, (15:7), e133.
- Otte-Trojel, T., de Bont, A., Rundall, T. G., & van de Klundert, J. (2014). "How outcomes are achieved through patient portals: a realist review," *Journal of the American Medical Informatics Association*, (21:4), pp. 751-757.
- Ross SE, Moore LA, Earnest MA, Wittevrongel L, Lin CT. (2004) "Providing a web-based online medical record with electronic communication capabilities to patients with congestive heart failure: randomized trial," *J Med Internet Res* (6:2), e12
- Tenforde, M., Nowacki, A., Jain, A., & Hickner, J. (2012) "The association between personal health record use and diabetes quality measures," *Journal of general internal medicine*, (27:4), pp. 420-424.
- Vogeli, C., Shields, A. E., Lee, T. A., Gibson, T. B., Marder, W. D., Weiss, K. B., & Blumenthal, D. (2007). "Multiple chronic conditions: prevalence, health consequences, and implications for quality, care management, and costs," *Journal of general internal medicine*, (22:3), pp. 391-395.