Mobile Device Applications for Electronic Patient Portals in Oncology

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PURPOSE Mobile devices provide individuals with rapid and frequent access to electronic patient portals. We investigated how oncology patients use this technology to review test results and communicate with providers.

PATIENTS AND METHODS We performed a retrospective study of patients enrolled in the MyChart electronic health portal associated with the Epic electronic medical record at the Harold C. Simmons Comprehensive Cancer Center from 2012 to 2017. We recorded type of portal access according to year and patient characteristics. Associations among patient characteristics and types of portal access were tested using Mann-Whitney *U* test, χ^2 test, and linear Gaussian regression models.

RESULTS Since the availability of a mobile device application in 2012, 2,524 patients with cancer accessed MyChart from a mobile device at least once, which accounted for 291,526 mobile log-ins. The number of patients with MyChart mobile application log-ins increased from 4% in 2012 to 13% in 2017 ($P = .004$). Among these patients, the median proportion of log-ins that occurred through mobile device use increased from 22% to 72% during this time period ($P < .001$). Mobile access occurred more frequently among younger ($P < .001$), black ($P = .002$), and Hispanic ($P = .004$) patients. Since 2012, total portal log-in frequency increased approximately 110% among patients who used the mobile application compared with 25% among those who did not use the mobile application ($P < .001$).

CONCLUSION Mobile access to electronic health portals has increased patient portal use, particularly among traditionally underserved populations. How this widely and immediately available technology affects patient expectations and experiences warrants additional study.

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INTRODUCTION

Electronic patient portals provide individuals access to their personal health information through secure Internet connections. Designed to enhance transparency and increase patient satisfaction, electronic portals allow patients to review laboratory and imaging results, contact providers and clinic staff with medical questions and updates, schedule future appointments, and request medication refills. Patients with cancer have long advocated for the use of online tools to access their electronic health record.¹ Among oncology patient populations, rates and intensity of portal use have increased markedly in recent years.² Despite this increased uptake, under-represented groups, including nonwhite, Hispanic, and non-English-speaking patients, have had lower rates of and interest in portal use, which raises concerns about a growing digital divide.^{3,4}

Although enthusiasm for patient access to medical records remains high,⁵⁻⁸ both behavioral^{9,10} and more

social^{11,12} drivers of perceived usefulness and ease of use underlie patient intention to use patient portal technology. Alignment among ease of access, patient needs and expectations, caregivers, and provider teams is a critical component of clinical quality.^{13,14} Several key legislative actions have sought to promote¹⁵ and standardize health information portability,¹⁶ technological access,¹⁷ and individual access and interoperability.¹⁸

When portal technology first emerged, Internet access generally required use of a desktop or laptop computer. More recently, the advent of mobile devices has enabled immediate and continuous access to the Internet from almost anywhere. Over the past 5 years, the proportion of American adults who own a smartphone with Internet capabilities has increased from 25% to 75%.¹⁹ Daily smartphone use now averages 5 hours a day.²⁰ These devices also have expanded Internet connectivity to populations that did not previously have routine broadband access, most notably adults with annual household incomes less than \$30,000.^{19,21}

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Accepted on November 11, 2018 and published at ascopubs.org/journal/cci on February 25, 2019; DOI <https://doi.org/10.1200/CCI.18.00094>

CONTEXT

Key objective: How has the availability of mobile device applications affected the use of electronic patient portals in oncology practice?

Knowledge generated: Over the past 5 years, an increasing proportion of patients with cancer have been using mobile applications to access electronic patient portals and with increasing frequency. Compared with the overall population of patient portal users, these individuals tend to be younger and more likely from under-represented minority groups.

Relevance: Mobile application access may lead to a decrease the digital divide that has characterized Web-based patient portal access. Because of the ease of use, the availability of mobile access may result in a substantial increase in overall volume of portal activity, which has implications for oncology practice staffing and workflows. How this widely and immediately available technology affects patient expectations and experiences warrants additional study. Ensuring that this technology continues to meet patient needs and preferences while remaining manageable for oncology practices will be key.

Mobile application access to patient portals has been studied in primary care settings.^{22,23} However, the impact of mobile technology on patient portal use has not been described in oncology populations. We therefore studied use patterns in a regional National Cancer Institute (NCI)–designated comprehensive cancer center that serves a diverse patient population.

PATIENTS AND METHODS

Data Source and Extraction

MyChart is a secure, online portal for patients to access health information within the Epic electronic medical record used throughout the University of Texas Southwestern Medical Center. It became available through some clinical departments as early as 2005 and was implemented in the Harold C. Simmons Cancer Center in 2007. Since then, all patients at the Simmons Cancer Center have been offered MyChart access at the time of registration. Until 2015, patients who expressed interest received an e-mail with a unique activation code. Starting in 2015, interested patients could enroll onsite at the time of their initial appointment. In addition, patients are provided a telephone number for technical assistance with enrollment and access to MyChart. MyChart access through a mobile device application first became available in 2012.

This study was approved by the Simmons Cancer Center protocol review and monitoring committee and the University of Texas Southwestern institutional review board (STU 012017-024). By working with two information resources analysts (J.C., D.X.), our team identified all MyChart log-in records from January 1, 2007, to May 12, 2017, among the cohort of patients with cancer we have reported in prior publications.³ Patients' demographic and portal content data were extracted from the institutional Epic Clarity tables.

Statistical Analysis

Patients were classified into two categories according to whether their MyChart accounts had at least one mobile

application log-in after mobile access became available in 2012. Of note, we defined application access strictly according to modality rather than to device. That is, if patients used a portable device, such as a smartphone, to access MyChart through the Web browser, it was not considered a mobile application log-in. The association between patient category (one or more mobile log-ins v no mobile log-ins) and various patient demographics were evaluated by either Mann-Whitney *U* test or χ^2 test. Missing demographic and other data were not used in our analysis; no imputation was performed. To quantify MyChart user preference for log-in platform, we focused on the following two end points: individual patient's mobile log-in proportion in each year and individual patient total log-in frequency from all platforms in each year. We applied both univariable and multivariable linear regression to model the association between patients' mobile log-in proportion and their demographic characteristics. By using (nonlinear) multivariable regression and adjusting for time/log-in year effect, we compared total log-ins among eventual mobile application users and never users of the mobile application. All statistical tests were performed using functions from the stats package in R version 3.4.2.

RESULTS

A total of 18,081 patients logged into MyChart during the study period through either the Web site or the mobile application. During this interval, a substantial increase was observed in the overall use of MyChart at our cancer center. In 2012, 7,010 patients had MyChart accounts (322,524 total log-ins) compared with 13,181 accounts (747,010 total log-ins) in 2016. Of this cohort, 2,524 patients (14%) accessed the patient portal through the mobile application at least once since it became available in 2012. [Table 1](#) lists the characteristics of patients who did and did not use mobile MyChart access. In the overall population, median age was 64 years, 51% were female, and 77% were white. Patients who used the mobile MyChart application were

TABLE 1. Demographic Characteristics of Patients Who Used and Did Not Use the Mobile Portal Application

Characteristic	Mobile Log-In Patients, No. (%)	Web Log-In Patients, No. (%)	P*
No. of patients	2,524	15,557	
Sex			.104
Female	1,312 (52.0)	7,811 (50.2)	
Male	1,212 (48.0)	7,744 (49.8)	
Unknown	0 (0)	2 (0.0)	
Age, years			< .001
Median (IQR)	59 (47-69)	64 (55-72)	
Race			< .001
White	1,993 (79.0)	11,944 (76.8)	
Black	223 (8.8)	1,360 (8.7)	
Asian	94 (3.7)	550 (3.5)	
Other	95 (3.8)	560 (3.6)	
Unknown	119 (4.7)	1,143 (7.4)	
Ethnicity			< .001
Hispanic	178 (7.1)	863 (5.6)	
Non-Hispanic	2,255 (89.3)	13,573 (87.3)	
Unknown	91 (3.6)	1,121 (7.2)	
Language			.009
English	2,471 (97.9)	15,232 (97.9)	
Spanish	31 (1.2)	136 (0.9)	
Other	22 (0.0)	136 (0.9)	
Unknown	0 (0)	53 (0.3)	

Abbreviation: IQR, interquartile range.

*Mann-Whitney *U* and Wilcoxon tests used to test age. All other characteristics are tested using χ^2 test.

younger than those who did not (median age, 59 v64 years; $P < .001$).

Both the overall volume of MyChart use and the proportion conducted through the mobile application increased over time. In 2016, 1,647 patients (13% of the 13,181 with at least one MyChart log-in in 2016) logged in through the mobile application, an increase from 251

(4%) in 2012. Mobile application log-ins represented approximately 2% of MyChart access in 2012, which increased to 15% in 2017 ($P < .001$; Fig 1). During this period, mobile application users increasingly used mobile MyChart access. In 2012, mobile access accounted for 22% of their log-ins, which increased to 71% in 2017 (Fig 2).

FIG 1. Annual patient portal log-ins by access type (Web portal or mobile application), 2012 to 2016.

FIG 2. Proportion of log-ins that occurred through the mobile application among mobile application users.

Although the proportion of log-ins from mobile devices increased over time across populations, the tendency to use this option varied according to patient age, race, and ethnicity. [Figure 3](#) shows the proportion of log-ins through the mobile application among mobile application users. In 2017, among patients who accessed MyChart from the mobile application at least once, those younger than age 40 years used the application for more than 90% of log-ins, whereas those older than age 60 years used the mobile application for approximately 65% of log-ins. Small patient numbers may account for the substantial year-by-year fluctuations seen in those older than age 80 years, which comprised only 14 to 61 individuals, depending on the year. Black and Hispanic patients who used mobile MyChart access did so for approximately 80% of log-ins compared with 70% of log-ins for white and non-Hispanic patients. Univariable and multivariable analyses of the proportion of mobile application yearly log-ins are listed in [Table 2](#).

To determine how the availability of mobile MyChart access influenced patient behavior, we examined pre- and post-mobile application log-in frequency for patients ([Fig 4](#)). In the premobile application period (before 2012), patients who went on to become mobile application users averaged six more log-ins per year than Web-only users (20 v 14; $P = .11$). Before 2012, the rate of increase in number of annual log-ins was 3.5 per year for eventual mobile application users compared with 2.0 for Web-only users ($P < .001$). From 2012 onward, the rate of increase accelerated to 4.8 log-ins per year for mobile application users compared with no increase for Web-only users ($P < .001$). From 2012 onward, annual log-ins for mobile application users was 52 versus 22 for Web-only users ($P < .001$). By 2017, mobile users averaged three times the log-ins of nonmobile users, an absolute difference of almost 40 log-ins annually ($P = .006$).

DISCUSSION

In the current study, we examined pre- and postmobile application portal behaviors in a diverse oncology population.

In this analysis of more than 18,000 patients, we observed a steady increase in uptake in mobile application use, which accounted for approximately 15% of portal log-ins by 2017. Of note, the availability of mobile access to the patient portal seemed to have had the greatest impact on historically underserved populations, with black, Hispanic, and Spanish-speaking patients using mobile access with greater frequency. This trend may mark an early lessening of the digital divide in health care. Previous studies showed that these populations were less likely than non-Hispanic whites to use patient portals.^{3,24,25} This observation echoes earlier research demonstrating that black and Hispanic individuals are more likely to be smartphone-only Internet users because of reduced access to computers.²¹ The pattern also reiterates portal use patterns among primary care populations in which mobile-ready patient health records disproportionately reach ethnic minorities and patients with lower socioeconomic status.^{22,23}

We also observed clear differences according to patient age, with younger patients more likely to use mobile access and to use it for a greater proportion of portal log-ins. These findings are consistent with broader patterns of smartphone use. In 2018, approximately 45% of adults ages 65 years and older owned a smartphone compared with more than 75% of younger adults.⁴ These differences have been attributed to lack of resources, interest, or knowledge to adopt smartphones among elderly individuals.⁸ Although most older adults have interest in using patient portals, earlier studies have suggested that health care organizations might consider tailored strategies to meet their needs, including addressing the role of informal caregivers in the process and integrating portal information into telephone conversations and face-to-face contact with providers.²⁶

The availability of mobile access to patient portals appears to have accelerated the steady increase in portal use. Earlier studies of portal technology noted clear increases in log-in volumes, which reflected growth in both user numbers and intensity of use.²⁷ Although Web-only users demonstrated a 25% increase in log-in activity after 2012, log-in activity more than doubled for mobile application users during the same period. Although eventual mobile application users had increased portal use compared with nonusers before 2012, the difference was minimal, and the rate of increase before 2012 was similar between groups. The implications of this heightened use on providers and clinic staff may be considerable. Even before mobile access, some individual nurses were handling hundreds of incoming portal messages per month.² Given ongoing pressures for clinical facilities to see more patients and complete ever more complex documentation in less time, how they also will incorporate the nonreimbursed activities of portal management remains uncertain.

In oncology populations, electronic portal technology may carry particular considerations. For instance, given the severity and acuity of the underlying malignancy, symptoms

FIG 3. Proportion of portal log-ins through the mobile application among mobile application users categorized by (A) age, (B) race, (C) ethnicity, and (D) primary language.

conveyed through portals may represent medical urgencies. Test results (radiology results, in particular) viewed through portals may represent significant and distressful changes in clinical status, such as disease progression. In addition, prior studies have suggested that the frequency and volume of portal use in oncology populations may exceed that of primary care and other specialty populations.²⁷⁻²⁹ Mobile applications may further heighten these issues. Because mobile application-based messaging to medical providers could have a similar feel to social texting, it seems possible that mobile application users might expect a particularly short turnaround. Separately, depending on device settings, mobile access to patient portals could mean real-time notification and viewing of incoming test results. If those results convey distressing

content, such as evidence of disease progression, the setting in which they are viewed would be critical. Indeed, although many patients seem comfortable with portal-delivered results, the majority still prefer in-person or telephone communication.³⁰ Furthermore, in a single-center survey conducted at Stanford University, approximately one half of oncologists reported that sharing digital radiology and pathology records negatively affected communication with patients.³¹

This study has a number of limitations. The single-center setting of an NCI-designated comprehensive cancer may not necessarily represent broader oncology populations. In particular, individuals who receive care at NCI-designated cancer centers tend to have different socioeconomic status, education levels, and clinical outcomes than the

TABLE 2. Regression Analysis of Individual Patient Mobile Log-In Proportion

Factor	Univariable Linear Regression		Multivariable Linear Regression	
	Effect Size	P	Effect Size	P
Log-in year	0.06	< .001	0.06	< .001
Sex				
Male v female	−0.04	.003	−0.009	.52
Age				
> 64 v ≤ 64 years	−0.13	< .001	−0.13	< .001
Race				
White v black	−0.08	.002	−0.07	.01
Ethnicity				
Non-Hispanic v Hispanic	−0.08	.004	−0.05	.17
Language				
Spanish v English	0.23	.009	0.40	< .001

broader population, which could influence patient portal activity.^{32,33} The current analysis does not provide details beyond portal log-ins, such as which portal activities (eg, viewing of test results v messaging) patients engaged in or how long sessions lasted, both of which merit investigation in future studies. We also did not determine the setting in which portal access occurred. Small patient numbers for certain demographic groups (eg, age younger than 40 years and older than 80 years) may limit the generalizability of findings in these populations. In addition, race and ethnicity data were missing in up to 7% of patients, and rates of missing data differed between the Web-only and mobile application groups likely because the Web-only group presumably includes patients registered earlier in time when demographic data may not have been captured as frequently. Finally, our analysis was based on use of the

mobile MyChart application, not the type of device used. If patients accessed MyChart through the Web browser on a smartphone or other portable device, it was not recorded as a mobile log-in.

In conclusion, in parallel with the marked growth in smartphone use overall, mobile access to patient portals in this single-center study has increased substantially since its emergence earlier this decade. This technology has expanded use by younger and nonwhite patients who may have had less frequent Internet access before mobile devices. Mobile portal access also seems to be driving additional growth in the already increasing intensity of portal use. Ensuring that this technology continues to meet patient needs and preferences while remaining manageable for oncology practices will be key.

FIG 4. Median number of annual log-ins by eventual mobile application users and Web-only users before (2007 to 2011) and after (2012 to 2016) the availability of the MyChart mobile application.

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PRIOR PRESENTATION

Presented at the ASCO Quality Care Symposium, Phoenix, AZ, September 28-29, 2018.

SUPPORT

Supported by a National Cancer Institute Midcareer Investigator Award in Patient-Oriented Research (K24CA201543-01; D.E.G.), a National Institute of Diabetes and Digestive and Kidney Diseases Short-Term Institutional Research Training Grant (5T35DK66141-10; K.P.), and the National Center for Advancing Translational Sciences University of Texas Southwestern Center for Translational Medicine (U54RFATR12006). Biostatistical support provided by the Biostatistics Shared Resource at the Harold C. Simmons Comprehensive Cancer Center, University of

Texas Southwestern Medical Center, which is supported in part by National Cancer Institute Cancer Center Support Grant 1P30CA142543-01 and by the Cancer Prevention and Research Institute of Texas (RP150596).

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

The following represents disclosure information provided by authors of this manuscript. All relationships are considered compensated.

Relationships are self-held unless noted. I = Immediate Family Member, Inst = My Institution. Relationships may not relate to the subject matter of this manuscript. For more information about ASCO's conflict of interest policy, please refer to www.asco.org/rwc or ascopubs.org/jco/site/inf.

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Stock and Other Ownership Interests: Gilead Sciences

Consulting or Advisory Role: Samsung Bioepis, Bristol-Myers Squibb

Speakers' Bureau: Bristol-Myers Squibb

Research Funding: Immunogen (Inst), ArQule (Inst), ImClone Systems (Inst), BerGenBio (Inst), Karyopharm Therapeutics (Inst)

Patents, Royalties, Other Intellectual Property: Royalties from Oxford University Press for two books, royalties from Decision Support in Medicine from the Clinical Decision Support–Oncology online program

Travel, Accommodations, Expenses: Eli Lilly, ArQule, Bristol-Myers Squibb

No other potential conflicts of interest were reported.

ACKNOWLEDGMENT

We thank Helen Mayo, MLS, for assistance with literature searches and Dru Gray for assistance with manuscript preparation.

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