Short Communication

Impact of a switch to immediate release on the patient viewing of diagnostic test results in an online portal at an academic medical center

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ABSTRACT

Patient portals allow patients to access their personal health information. The 21st Century Cures Act in the United States sought to eliminate 'information blocking', requiring timely release upon request of electronic health information including diagnostic test results. Some health systems, including the one in the present study, chose a systematic switch to immediate release of all or nearly all diagnostic test results to patient portals as part of compliance with the Cures Act. Our primary objective was to study changes in the time to view test results by patients before and after implementation of Cures Act-related changes. This retrospective pre-post study included data from two 10-month time periods before and after implementation of Cures Act-related changes at an academic medical center. The study included all patients (adult and pediatric) with diagnostic testing (laboratory and imaging) performed in the outpatient, inpatient, or emergency department settings. Between February 9, 2020 and December 9, 2021, there was a total of 3 809 397 diagnostic tests from 204 605 unique patients (3 320 423 tests for adult patients; 488 974 for pediatric patients). Overall, 56.5% (115 627) of patients were female, 84.1% (172 048) white, and 96.5% (197 517) preferred English as primary language. The odds of viewing test results within 1 and 30 days after portal release increased monthly throughout both time periods before and after the Cures Act for all patients. The rate of increase was significantly higher after implementation only in the subgroup of tests belonging to adult patients with active MyChart accounts. Immediate release shifted a higher proportion of result/report release to weekends (3.2% pre-Cures vs 15.3% post-Cures), although patient viewing patterns by day of week and time of day were similar before and after immediate release changes. The switch to immediate release of diagnostic test results to the patient portal resulted in a higher fraction of results viewed within 1 day across outpatient, inpatient, and emergency department settings.

Introduction

Online patient portals allow patient access to information and data in their electronic health record (EHR), including clinical notes, pharmacy/medication information, and diagnostic test results.[1–5] Patient portals also typically allow for communication between patients/families and the clinical team. Patients and providers generally agree that access to such information is important and necessary.[6] In the United States, prior to the 21st Century Cures Act, many institutions suppressed or delayed release of diagnostic test results, allowing time for providers to review results prior to patients; while such a delay potentially allows time for provider interpretation and communication, there is also a potential for 'information blocking' where patients do not have timely access to diagnostic results.[7]

As of April 5, 2021, the Cures Act requires that health systems respond to patients' request for electronic health information without delay.[8] In theory, the Cures Act could be accommodated by a system that releases electronic health information quickly upon patient request but then has another schedule for release of electronic health information not requested.[9,10] In practice, some health systems, including the one in the present study, have chosen to accommodate the rule by timely release of all or nearly all electronic health information relevant to the Cures Act into patient portals whether requested by patients or not. This complies with the Cures Act and may be logistically easier given EHR functionality in some health systems.[11]

A switch to immediate release has a number of potential benefits for patient and family engagement in healthcare, including the inpatient and

emergency care settings.[12–14] However, this approach has not been met with universal acceptance.[9,15–17] Concerns have been raised that immediate release may negatively affect patient well-being from potential misinterpretation of results and/or receiving sensitive test results from an online record alert rather than a conversation with a provider. Studies of changes in patient anxiety have shown mixed results.[6,18,19] In addition to the timing of release of test results to the portal, an important factor is how patients are notified that new information is available. For example, text or email messages will generally alert patients faster than having to log into the patient portal without any prior notification message and may cause more anxiety.[19] Another feared unintended consequence is increased clinician workload responding to patient electronic or phone messages on questions that previously would have been addressed during planned phone conversations or in a face-to-face interaction with a provider, a phenomenon observed at an academic medical center in a several month period after switch to immediate release.[20]

No studies to our knowledge have looked at whether the time for patients to view test results after release to the online portal has changed since implementation of immediate result release. The objective of our current study was to compare the time it took for the patient to view diagnostic test results after release to the patient portal before and after implementation of Cures Act-related changes at our institution in early 2021. Secondary goals were to examine impact of immediate release on day of week and time of day patterns for result release and review.

Materials and methods

Setting and patient portal design

The study was conducted at the University of Iowa Hospitals and Clinics, an 860 bed tertiary/quaternary care academic medical center. The medical center includes inpatient, emergency department, and outpatient services at a central campus location. Inpatient and outpatient pediatric services are available at the 190-bed affiliated children's hospital, also located at the central medical center campus. Affiliated adult and pediatric clinics are also located throughout the state. The EHR for the medical center has been Epic (Epic systems, Inc., Madison, WI, USA) since 2009. The institution adopted the tethered patient portal (Epic MyChart) in 2010.[21] Prior to February 9, 2021, release of diagnostic test results (including laboratory results along with pathology and imaging reports) at our institution to MyChart could occur by either auto-release or manual release (more detailed description is in the Supplemental Text).[21,22]

For pediatric patients at our institution, parents/legal guardians have full access to their child's MyChart account through 11 years old. Pediatric patients can create their own MyChart account once they turn 12. At ages 12 and 13, both parents/guardians and child can access the child's MyChart account. Once the child turns 14, parents/guardians have more limited access that does not include clinical notes and diagnostic test results but does include some functionality such as child immunization records.

To comply with the 21st Century Cures Act, our institution made a number of changes to MyChart release affecting diagnostic test results and provider notes. On February 9, 2021, the institution decided to switch to immediate release to MyChart for all diagnostic tests excluding anatomic pathology, genetic testing, microbiology cultures, and radiology. On March 9, 2021, all remaining diagnostic test results/reports (including anatomic pathology, genetic testing, microbiology cultures, and imaging) moved to immediate release with very limited exceptions including positive human immunodeficiency virus (HIV) screening results (using an antigen/antibody screen) and a small number of genetic tests for neurodegenerative disorders including Huntington's disease (more detailed description of the rationale for these choices is in the Supplemental Text).

Study design and data retrieval

The data in this study was collected as part of a retrospective study approved by the University of Iowa Institutional Review Board (protocol #

202112257) covering the timeframe from February 9, 2020 to December 9, 2021. Data for the study was retrieved using Epic Reporting Workbench,[21] allowing for retrieval of past diagnostic test results. Data was retrieved for all orders of 267 laboratory tests for which a specimen was collected during the retrospective analysis period. These account for an estimated 97.0% of all laboratory tests performed in the pathology laboratories, with 91.7% of tests previously in a one business day delay release category for MyChart and the remaining 8.3% in a 4 business day release category with a few exceptions such as HIV screening and Huntington's Disease gene testing described above (see Supplemental Text for more details). Data was also retrieved for 82 order codes associated with different radiology imaging studies including 28 X-ray (estimated 98.1% of all X-ray studies performed), 23 computed tomography (CT) (estimated 97.9% of CT studies), 26 magnetic resonance imaging (MRI) (estimated 97.4% of MRI studies), and 6 nuclear imaging studies (estimated 98.0% of total nuclear studies) that were performed during the retrospective analysis time. Point of care laboratory and radiology testing was excluded from analysis. The number of laboratory and imaging codes analyzed provided a manageable number for analysis from a very large number of active codes for laboratory tests (approximately 2300 including infrequently ordered send-out tests for rare allergens and genetic syndromes) and imaging studies (approximately 1300) in the EHR, with many codes very rarely ordered.

For each laboratory or imaging order, the following data elements were retrieved: order description, patient location from which order was placed (emergency department, inpatient, or outpatient), age of patient at diagnostic test, legal sex, date/time of specimen collection or imaging study, date/time of result/report release to the EHR, whether patient or proxy had an active MyChart account, date/time of release of result/report to MyChart, date/time of patient or proxy reviewing the result/report, primary insurance for the patient (private or public/uninsured), preferred language (English or other), and self-declared race in the EHR (White or non-White). Adult patients were considered as 18 years or older; pediatric patients were considered as less than 18 years old (note some patients have data before and after turning 18 years old and were counted in both categories).

Statistical analysis

Two corresponding 10-month periods (specimen collection or imaging study performed between February 9, 2020 and December 9, 2020 or February 9, 2021 and December 9, 2021) were compared with respect to viewing of results in MyChart within 1 day (24 h) or within 30 days of release of the result to MyChart. The rationale for establishing these 2 time periods were to represent baseline (pre-Cures Act changes) and post-Cures Act changes. We excluded 2 months from the statistical analysis (December 10, 2020–February 8, 2021), as this timeframe saw extensive education and marketing related to the upcoming changes that may have impacted viewing. However, we included this interim 2-month timeframe in all the figures that depict changes over time.

In all analyses, we excluded 49 879 tests of 8101 patients due to unknown or conflicting demographic information. Among patients with active MyChart accounts, generalized estimating equations (GEE) were used to model the probability of whether a test result/report was viewed over time. Estimates were obtained for 2 timeframes, viewing within 1 day and within 30 days from portal release. The GEE was clustered on patient such that the correlation between the viewing of any 2 tests from the same patient was assumed to be constant. To account for any potential trend over time in patient results review, time (in months) was included as a covariate. An indicator variable to denote the time after February 2021 was also included to capture the impact of the Cures Act on the trend. This approach allowed us to analyze changes in the trend of patients results viewing before and after the implementation of the Cures Act. Additionally, patients' demographics and test characteristics were included as covariates. Since access to MyChart accounts differs by age, analyses were stratified by 4 age categories (<12 years, 12 to <14 years, and 14 to <18 years, and 18 years and older). Models were fitted using SAS® v9.4 (SAS Institute, Cary, NC).

Table 1

Characteristics of $n = 204\,605$ unique patients (with and without active MyChart accounts) whose diagnostic tests were taken between February 9, 2020 and December 9, 2021.

	Mean ± SD or n (%)
Age at first test	44.3 ± 23.6
Sex	
Male	88 978 (43.5)
Female	115 627 (56.5)
Race	
African-American	13 203 (6.5)
Asian	5501 (2.7)
Hispanic/Latino	8539 (4.2)
Multi-racial	4634 (2.3)
Native American	680 (0.3)
White	172 048 (84.1)
Language	
English	197 517 (96.5)
Not English	7088 (3.5)
Active MyChart account during retrospective period	
Yes	144 457 (70.6)
No	60 148 (29.4)

Results

Patient demographics and characteristics

In the retrospective timeframe from February 9, 2020 to December 9, 2021, there were a total of 3 809 397 total diagnostic tests from 204 605 unique patients, out of which 3 320 423 tests belonged to adult patients and 488 974 belonged to pediatric patients. Table 1 shows the summary statistics of the 204 605 unique patients in the overall cohort with and without MyChart accounts. The majority (70.6%) had an active MyChart account at some point between February 9, 2020 and December 9, 2021.

Table 2 displays the summary statistics of the 3 320 423 total diagnostic test results/reports (laboratory and imaging) from 173 030 unique adult patients (aged 18 years or older) with and without MyChart accounts. Of the diagnostic tests, 256 672 (7.7%) were imaging studies and 3 063 751 (92.3%) were laboratory tests. There were 488 974 total diagnostic test (laboratory and imaging) results from 32 349 unique patients aged less than 18 years old with and without MyChart accounts. Similar to adults, the majority of the diagnostic tests were laboratory tests (89.4%) compared to imaging studies (10.6%) (See Table 2). Summaries of diagnostic test ordering during the pre- and post-Cures Act implementation time periods for

Table 3

Characteristics of tests belonging to adult patients with active MyChart accounts during the 2 parallel 10-month periods.[a]

Test of adult patients	Feb-Dec 2020	Feb-Dec 2021
$n =$	850 544	1 036 151
Order type (n (%))		
Imaging	62 625 (7.4)	77 624 (7.5)
Lab	787 919 (92.6)	958 527 (92.5)
Location (n (%))		
Emergency department	90 436 (10.6)	104 809 (10.1)
Inpatient	313 806 (36.9)	372 607 (36.0)
Outpatient	446 302 (52.5)	558 735 (53.9)
Payment source (n (%))		
Private	418 678 (49.2)	443 502 (42.8)
Public/uninsured	431 866 (50.8)	592 649 (57.2)
View category (n (%))		
<1 day	187 849 (22.1)	324 812 (31.3)
1–3 days	58 989 (6.9)	87 542 (8.4)
4–7 days	36 285 (4.3)	46 412 (4.5)
8–30 days	51 833 (6.1)	71 273 (6.9)
Not viewed within 30 days	515 588 (60.6)	506 112 (48.8)

[a] Parallel time periods were February 9, 2020–December 9, 2020 (pre-Cures Act-related changes) and February 9, 2021–December 9, 2021 (post-Cures Act-related changes).

Table 4

Characteristics of tests belonging to pediatric patients with active MyChart accounts during the 2 parallel 10-month periods.[a]

Test of pediatric patients	Feb–Dec 2020	Feb–Dec 2021
$n =$	119 890	128 915
Order type (n (%))		
Imaging	12 197 (10.2)	13 326 (10.3)
Lab	107 693 (89.8)	115 589 (89.7)
Location (n (%))		
Emergency department	5410 (4.5)	6704 (5.2)
Inpatient	78 614 (65.6)	77 933 (60.5)
Outpatient	35 866 (29.9)	44 278 (34.3)
Payment source (n (%))		
Private	73 462 (61.3)	71 987 (55.8)
Public/uninsured	46 428 (38.7)	56 928 (44.2)
View category (n (%))		
<1 day	18 406 (15.4)	43 035 (33.4)
1–3 days	4786 (4.0)	7830 (6.1)
4–7 days	3072 (2.6)	4295 (3.3)
8–30 days	4526 (3.8)	7365 (5.7)
Not viewed within 30 days	89 100 (74.3)	66 390 (51.5)

[a] Parallel time periods were February 9, 2020–December 9, 2020 (pre-Cures Act-related changes) and February 9, 2021–December 9, 2021 (post-Cures Act-related changes).
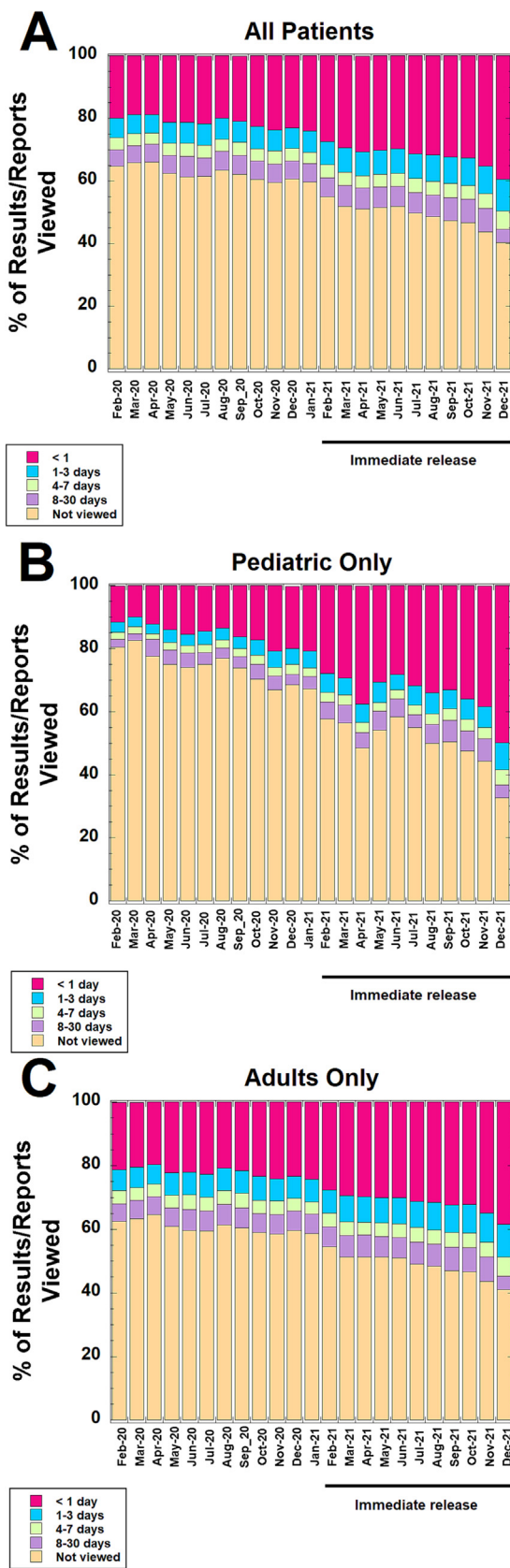
Table 2

Characteristics of diagnostic tests of patients with and without active MyChart accounts between February 9, 2020 and December 9, 2021.

	All tests	Test of adult patients		Test of pediatric patients	
		All adults	With MyChart only[a]	All pediatric	With MyChart only
$n =$	3 809 397	3 320 423	2 064 774	488 974	273 552
Order type (n (%))					
Imaging	308 572 (8.1)	256 672 (7.7)	153 370 (7.4)	51 900 (10.6)	27 991 (10.2)
Lab	3 500 825 (91.9)	3 063 751 (92.3)	1 911 404 (92.6)	437 074 (89.4)	245 561 (89.8)
Location type (n (%))					
ED	411 632 (10.8)	388 798 (11.7)	215 758 (10.4)	22 834 (4.7)	13 256 (4.8)
Inpatient	1 903 043 (50.0)	1 563 133 (47.1)	752 533 (36.4)	339 910 (69.5)	172 178 (62.9)
Outpatient	1 494 722 (39.2)	1 368 492 (41.2)	1 096 483 (53.1)	126 230 (25.8)	88 118 (32.2)
Payment source (n (%))					
Private	1 463 720 (38.4)	1 231 291 (37.1)	948 645 (45.9)	232 429 (47.5)	161 510 (59.0)
Public/uninsured	2 345 677 (61.6)	2 089 132 (62.9)	1 116 129 (54.1)	256 545 (52.5)	112 042 (41.0)
View category (n (%))					
<1	621 395 (16.3)	555 131 (16.7)	555 131 (26.9)	66 264 (13.6)	66 264 (24.2)
1–3 days	172 550 (4.5)	158 642 (4.8)	158 642 (7.7)	13 908 (2.8)	13 908 (5.1)
4–7 days	97 642 (2.6)	89 592 (2.7)	89 592 (4.3)	8050 (1.6)	8050 (2.9)
8–30 days	146 489 (3.8)	133 673 (4.0)	133 673 (6.5)	12 816 (2.6)	12 816 (4.7)
Not viewed	2 771 321 (72.7)	2 383 385 (71.8)	1 127 736 (54.6)	387 936 (79.3)	172 514 (63.1)

[a] Abbreviations: ED, emergency department.

Fig. 1. Time for patients with active MyChart accounts to view diagnostic test results/reports after release to MyChart for (A) all patients, (B) pediatric (<18 years old) patients only, and (C) adult (18 years and older) only. The time categories are <1 day (<24 h), 1–3 days, 4–7 days, 8–30 days, and not viewed. The analysis excludes patients who did not have an active MyChart account at the time of diagnostic testing.
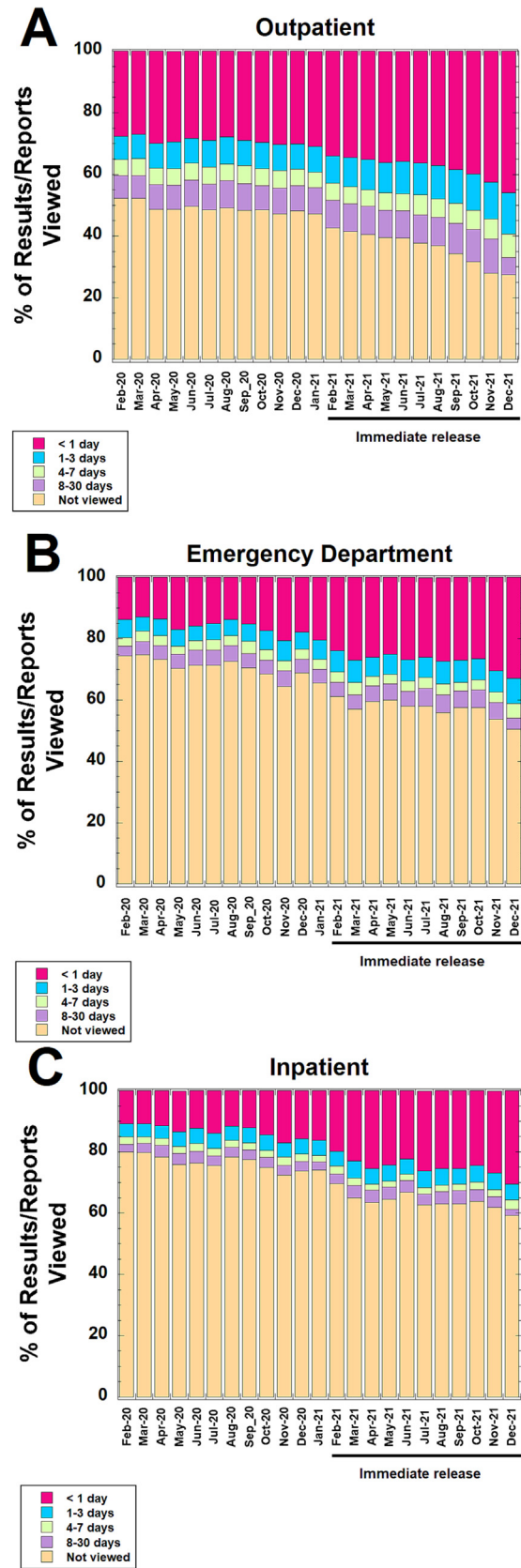
Fig. 2. Time for patients with active MyChart accounts to view diagnostic test results/reports after release to MyChart for diagnostic tests that were obtained in (A) outpatient, (B) emergency department, or (C) inpatient locations. Subcategories of the same as in Fig. 1.

the adult and pediatric populations with active MyChart accounts are provided in Table 3 and Table 4, respectively.

Viewing test results and reports by patient or proxy within 1 and 30 days

Diagnostic tests of adult patients with active MyChart accounts

Fig. 1 shows changes in viewing of diagnostic test results/reports in MyChart by all patients (Fig. 1A), pediatric patients (Fig. 1B), and adult patients (Fig. 1C) who had active MyChart accounts. At a broad level, by December 2021, overall viewing of diagnostic tests within 30 days increased to over 50% across all patients and in the subsets of pediatric and adult patients (Fig. 1). Viewing was highest for diagnostic testing ordered in the outpatient setting compared to that ordered in the inpatient or emergency department settings (Fig. 2.)

For tests belonging to adult patients, the most notable change is an increase in results viewed within 1 day (24 h) (Fig. 1, Table 3, Table 5). The odds of viewing test results within 1 day increased by 3.9% for every month between February and December 2020 and 4.5% for every month between February and December 2021. Similarly, the odds of tests being viewed within 30 days increased by 4.3% for every month between February and December 2020 and 5.2% for every month between February and December 2021. The changes in the rate of increase of the odds over time after February 2021 were significant in both models predicting viewing within 1 and 30 days. Factors associated with increased odds of viewing test results/reports included white race, female sex, private insurance (compared to public insurance or uninsured), testing performed in outpatient setting (compared to inpatient or emergency department), and English as preferred language. Compared to tests of the youngest age group (18–24 years old), tests of patients aged between 25 and 44 on average had higher odds of being viewed in MyChart.

Diagnostic tests of pediatric patients with active MyChart accounts

Overall, for the diagnostic tests of pediatric patients with active MyChart accounts, patterns were similar to the data of the adult population (Fig. 1B and C, Table 4). The general trends were also similar between the 3 pediatric age groups (<12, 12 to <14, and 14 to <18 years old) analyzed, although the multiplicative change in the odds ratio of time after February 2021 were not significant in any of the age subgroups (Tables 6–8). Factors associated with increased odds of viewing test results/reports within 1 and

30 days in the pediatric patients included preferred language of English (for the subgroups 12 years and older), testing performed in outpatient setting, and white race (subgroup 14 to <18 years old) (Tables 6–8).

Analysis including patients without an active MyChart accounts

We also examined data that included the subset of patients who did not have an active MyChart account at the time of testing and thus could not view diagnostic test results/reports for that reason. In general, the percentage of test results associated with a patient with an inactive MyChart account stayed relatively constant at around 40%, with a slight decrease for adult patients after the immediate release changes (Supplemental Fig. 1). The highest percentage of results associated with inactive MyChart accounts occurred in the inpatient and emergency department settings (approximately 50% of total) as compared to outpatient setting (approximately 20% of total) (Supplemental Fig. 2).

Timing of diagnostic test result/report release

Day of week

We also examined how the changes related to the Cures Act impacted the patterns of the day of the week that diagnostic test results were released to and viewed in MyChart (Fig. 3). In terms of result release to MyChart, a notable trend was that Tuesday was the most common day that test results were released to MyChart pre-Cures Act (Fig. 3A). This mainly reflects Tuesday being the day of auto-release for results finalized on Friday, Saturday, or Sunday (assuming no holidays) if in the one business day auto-release category (see Supplemental Text for more details).

After the switches to immediate release (post-Cures Act), patterns of release for all diagnostic testing, imaging, and anatomic pathology evened out across weekdays, with a notable increase in results released on weekends for all diagnostic testing and imaging (Fig. 3A and C). Interestingly, the patterns of result viewing in MyChart were similar pre- and post-Cures Act for all categories of testing, with similar rates of weekend viewing before and after Cures Act changes (Fig. 3B, D, and F).

Time of day

We also examined how the changes related to the Cures Act impacted the patterns of the time of day that diagnostic test results were released to and viewed in MyChart (Supplemental Fig. 3). In terms of result release

Table 5

Results of GEE predicting 2 viewing outcomes (viewed within 1 day and 30 days) of tests belonging to adult patients with active MyChart accounts.[a,b]

Predictors	Tests viewed within 1 day		Tests viewed within 30 days	
	Odds ratio	95% CI[b]	Odds ratio	95% CI
Time (month)	1.039	(1.034, 1.044)	1.043	(1.038, 1.048)
Multiplicative change in odds ratio of time after Feb 2021	1.006	(1.003, 1.01)	1.009	(1.006, 1.012)
Age				
18–24 (reference)	–	–	–	–
25–34	1.158	(1.105, 1.213)	1.217	(1.147, 1.292)
35–44	1.089	(1.036, 1.144)	1.173	(1.099, 1.251)
45–50	0.870	(0.83, 0.911)	0.996	(0.935, 1.061)
55–64	0.749	(0.716, 0.784)	0.878	(0.826, 0.933)
65–74	0.749	(0.713, 0.786)	0.869	(0.816, 0.926)
74 +	0.663	(0.626, 0.703)	0.730	(0.679, 0.785)
Sex – Male vs Female	0.910	(0.891, 0.929)	0.826	(0.809, 0.843)
Race – White vs Non-White	1.247	(1.209, 1.286)	1.228	(1.19, 1.268)
Language – English vs Not English	1.431	(1.318, 1.554)	1.422	(1.313, 1.54)
Payment source – Public/uninsured vs Private	0.912	(0.882, 0.943)	0.946	(0.909, 0.984)
Location type				
Outpatient (reference)	–	–	–	–
Emergency department	0.775	(0.753, 0.797)	0.588	(0.573, 0.604)
Inpatient	0.747	(0.726, 0.770)	0.565	(0.549, 0.582)
Order type				
Lab (reference)	–	–	–	–
Imaging	0.859	(0.845, 0.873)	1.042	(1.027, 1.057)

[a] Abbreviations: CI, confidence interval; GEE, generalized estimating equation.
[b] Models assumed the slope of time (month) changed after February 2021.

Table 6

Results of GEE predicting 2 viewing outcomes (viewed within 1 day and 30 days) of tests belonging to pediatric patients <12 years old with active MyChart accounts.[a,b]

Predictors	Tests viewed within 1 day		Tests viewed within 30 days	
	Odds ratio	95% CI[b]	Odds ratio	95% CI
Time (month)	1.084	(1.042, 1.126)	1.097	(1.060, 1.134)
Multiplicative change in odds ratio of time after Feb 2021	1.019	(0.990, 1.049)	1.014	(0.988, 1.041)
Age	1.019	(1.007, 1.032)	1.016	(1.004, 1.029)
Sex – Male vs Female	1.003	(0.885, 1.138)	1.016	(0.921, 1.120)
Race – White vs Non-White	1.200	(0.999, 1.441)	1.250	(1.079, 1.448)
Language – English vs Not English	1.132	(0.848, 1.501)	1.310	(0.999, 1.716)
Payment source – Public/uninsured vs Private	0.790	(0.687, 0.908)	0.857	(0.730, 1.007)
Location type				
Outpatient (reference)	–	–	–	–
Emergency department	0.892	(0.789, 1.009)	0.788	(0.696, 0.893)
Inpatient	0.696	(0.623, 0.777)	0.609	(0.546, 0.680)
Order type				
Lab (reference)	–	–	–	–
Imaging	0.846	(0.792, 0.903)	1.010	(0.955, 1.068)

[a] Abbreviations: CI, confidence interval; GEE, generalized estimating equation.
[b] Models assumed the slope of time (month) changed after February 2021.

Table 7

Results of GEE predicting 2 viewing outcomes (viewed within 1 day and 30 days) of tests belonging to pediatric patients between 12 and less than 14 years old with active MyChart accounts.[a,b]

Predictors	Tests viewed within 1 day		Tests viewed within 30 days	
	Odds ratio	95% CI[b]	Odds ratio	95% CI
Time (month)	1.063	(0.971, 1.165)	1.073	(0.968, 1.188)
Multiplicative change in odds ratio of Time after Feb 2021	1.017	(0.956, 1.082)	1.014	(0.945, 1.087)
Age	1.224	(1.019, 1.470)	1.190	(0.949, 1.494)
Sex – Male vs Female	1.063	(0.900, 1.256)	1.014	(0.848, 1.212)
Race – White vs Non-White	1.144	(0.917, 1.427)	1.180	(0.948, 1.47)
Language – English vs Not English	2.698	(1.502, 4.845)	2.184	(1.281, 3.723)
Payment source – Public/uninsured vs Private	0.924	(0.732, 1.166)	0.884	(0.717, 1.091)
Location type				
Outpatient (reference)	–	–	–	–
Emergency department	0.939	(0.750, 1.176)	0.715	(0.557, 0.918)
Inpatient	0.861	(0.706, 1.051)	0.682	(0.504, 0.922)
Order type				
Lab (reference)	–	–	–	–
Imaging	0.801	(0.69, 0.931)	1.036	(0.929, 1.155)

[a] Abbreviations: CI, confidence interval; GEE, generalized estimating equation.
[b] Models assumed the slope of time (month) changed after February 2021.

Table 8

Results of GEE predicting 2 viewing outcomes (viewed within 1 day and 30 days) of tests belonging to pediatric patients between 14 and less than 18 years old with active MyChart accounts.[a,b]

Predictors	Tests viewed within 1 day		Tests viewed within 30 days	
	Odds ratio	95% CI[b]	Odds ratio	95% CI
Time (month)	1.073	(1.023, 1.125)	1.063	(1.025, 1.102)
Multiplicative change in odds ratio of Time after Feb 2021	1.005	(0.974, 1.038)	1.009	(0.986, 1.032)
Age	1.042	(0.990, 1.097)	1.057	(1.008, 1.109)
Sex – Male vs Female	0.852	(0.724, 1.002)	0.784	(0.679, 0.904)
Race – White vs Non-White	1.634	(1.281, 2.086)	1.605	(1.285, 2.005)
Language – English vs Not English	2.323	(1.443, 3.740)	2.770	(1.674, 4.585)
Payment source – Public/uninsured vs Private	0.947	(0.809, 1.109)	0.970	(0.784, 1.198)
Location type				
Outpatient (reference)	–	–	–	–
Emergency department	0.842	(0.716, 0.990)	0.811	(0.702, 0.936)
Inpatient	0.878	(0.741, 1.042)	0.800	(0.698, 0.916)
Order type				
Lab (reference)	–	–	–	–
Imaging	0.762	(0.651, 0.891)	1.051	(0.908, 1.217)

[a] Abbreviations: CI, confidence interval; GEE, generalized estimating equation.
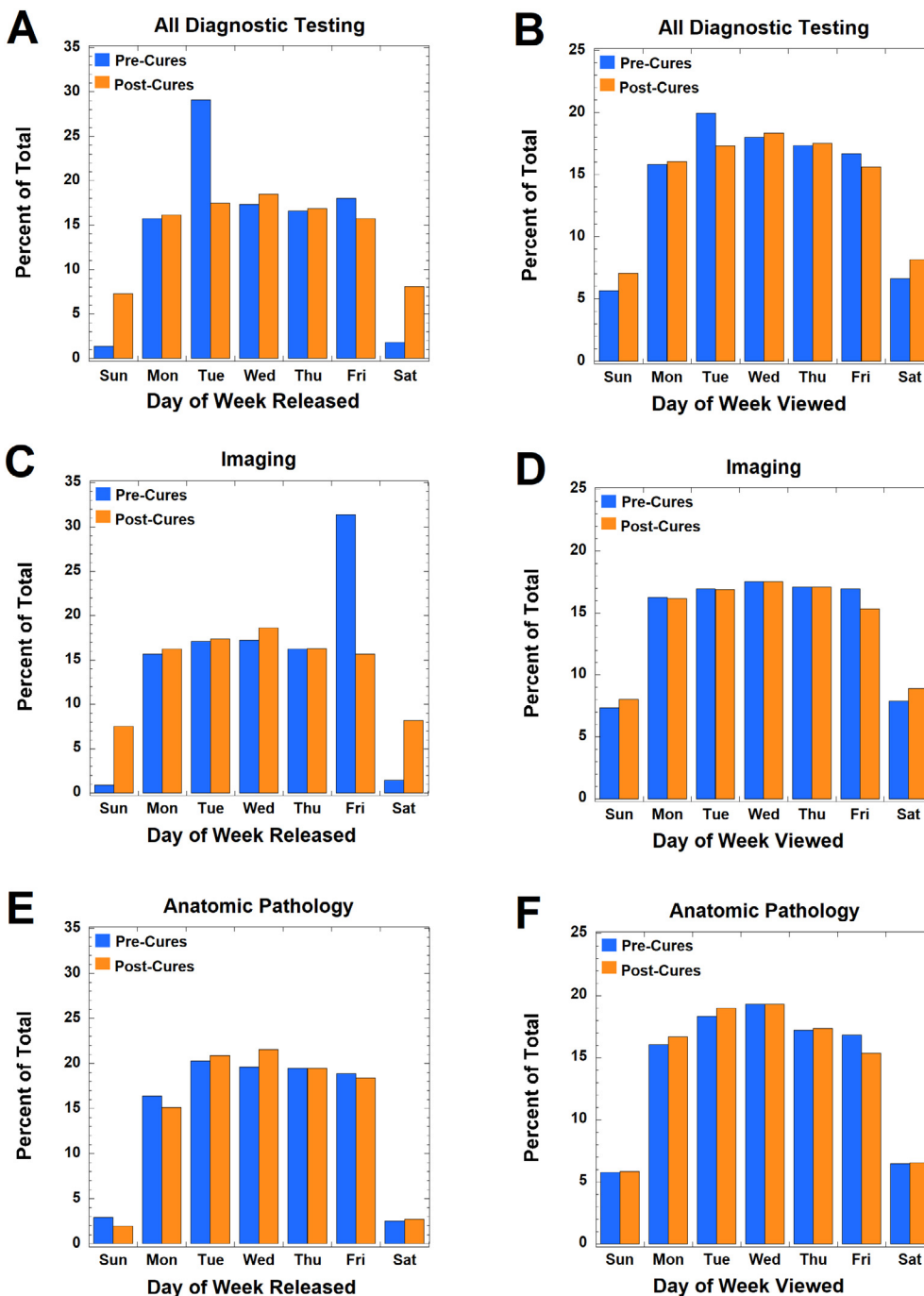[b] Models assumed the slope of time (month) changed after February 2021.

Fig. 3. Day of week for diagnostic test release to patient portal (A, C, E) and patient viewing in patient portal (B, D, F). The data is broken down into all diagnostic testing (laboratory and imaging; A and B), imaging only (C and D), and anatomic pathology only (encompassing surgical pathology and cytopathology; E and F). Blue bars indicate data from time periods before immediate release, while orange bars indicate data from time periods after immediate release.

to MyChart, the pre-Cures Act and post-Cures Act data have overall similar pattern but each with their own discontinuities throughout the day (Supplemental Fig. 3A). Pre-Cures Act data showed peaks in result release at around 9:00 AM, 3:00 PM, and 9:00 PM which may reflect consequences of batched auto-release and times of higher manual release of results by outpatient providers to MyChart (see Supplemental Text for more details). Post-Cures Act peaks at around 4:00 AM and 5:00 AM may reflect resulting of high-frequency laboratory tests from early morning phlebotomy draws on the inpatient side. In contrast to the discontinuities seen with result release, result viewing patterns in MyChart were very similar before and after the immediate release changes (Supplemental Fig. 3B).

Discussion

Viewing of diagnostic test results in MyChart by patients or proxies at our academic medical center increased after implementation of immediate result release. This was observed for both pediatric and adult patients. These changes were mostly attributable to increased viewing by those with existing MyChart accounts (as opposed to growth of new MyChart users) and by increased viewing of results within 1 day of release. This was most notable for results viewed within 1 day with an relative increase of almost 50% overall after implementation of immediate release. By age, the impact was greater in pediatrics with a 117% relative increase in viewing within 1 day.

In the retrospective timeframe analyzed, the overall view rates for active MyChart users increased from approximately one-third (February 2020) to one-half (December 2021) of diagnostic test results viewed within 30 days. For adults, the odds of tests being viewed within 1 and 30 days had already been increasing monthly prior to the Cures Act-related changes. After implementing immediate release, the odds continued to increase but at a significantly higher rate. Our findings are consistent with other reports that rates of portal utilization nationally have been increasing, especially when recommended by a healthcare provider.[23,24] Additionally, viewing diagnostic test results has been reported to be the most utilized portal function by patients, with 86% of users viewing tests results according to a national survey.[4,23,25] In our study, the increase in result viewing does not appear to be influenced much by new MyChart account activations, as the percentage of test results associated with a patient with an inactive MyChart account remained relatively stable throughout the study. The change to immediate release seemed to have prompted increased patient engagement with review of results, which could due to a combination of factors such as improved patient engagement and impact of marketing.[26–29]

Increased and faster viewing of test results was seen across all clinical care settings, but variation by location remained. Tests obtained in the outpatient setting were viewed more than those obtained in the emergency department or inpatient setting across all populations. This is consistent with prior work at our institution.[21,22,30–32] In both the emergency department and inpatient settings, less than 50% of test results for active MyChart users were viewed as of December 2021. Overall viewing of results in the emergency department and inpatient settings is also influenced by the patient's MyChart status at the time of testing, as the percentage of results associated with inactive MyChart accounts was more than double in the emergency department and inpatient setting compared to the outpatient setting. Similarly, Sangal et al. found that portal utilization to view clinical notes in the emergency department was low, with only 13.7% of active users reading a clinical note.[33]

As expected after implementation, immediate result release resulted in changes in both time of day and day of week that results were released. The percentage of test results released over the weekend increased and results were more evenly released throughout the week compared to prior when Tuesdays and Fridays peaked for diagnostic testing and imaging, respectively, due mainly to patterns of auto-release prior to Cures Act-related changes. Despite these changes in release timing, viewing patterns by patients remained essentially unchanged, with more results viewed on weekdays compared to weekends. In addition, the time of day that patients accessed results was very similar before and after switch to immediate release. This may indicate that many patients review results at patterns convenient to their schedule, regardless of when exactly tests release to the patient portal.

A shift to immediate release of diagnostic test results may unintentionally increase provider workload responding to patient test result queries, which sometimes occur within just minutes of result release.[20] Some providers at our institution who were previously diligent in communicating results to patients (specifically regarding unfavorable news) have reported that it is more challenging to communicate bad news in patients who utilize the portal for immediate release. Some providers have focused on adding time for pre-emptive counseling, but that can be difficult especially in the scenario of low incidence but high impact results. Providers have also expressed worry about patient well-being.[6,18,19] To our knowledge, there have been no reports of serious patient self harm at our institution from immediate release to the patient portal. Our institution does allow providers to delay or block release of a very limited group of genetic test results but must document their reasoning for doing so. Similar functionality also exists for some clinical notes, intended for those with risk of causing harm to patient or others.

Patient portal utilization, including at our own institution, has been shown to be lower in patients with lower income, lower education, non-White race, preferred language other than English, public or no health insurance, male sex (for adult patients), and older age.[22,24,32]

Like other studies, we found that these disparities persisted after implementation of Cures Act-related changes.[33] For adults, white race, English as preferred language, and private insurance were associated with higher odds of test results being viewed. Similarly, for our pediatric population, we found English as preferred language and white race increased the odds of test results being viewed but not across all subgroups analyzed. Another study concluded that healthcare policies like Stage 2 Meaningful Use may help attenuate disparities in portal utilization by increasing usage amongst subgroups, but additional efforts to reduce disparities are needed.[24]

Limitations of our study include that it was performed at a single academic center serving a semi-urban and rural population that was predominately white and preferred English speaking. This may limit generalizability of results. For pediatric patients age 12 and older, we were unable to differentiate proxy from patient activity within the online portal. While we included some examples of challenges with immediate release, our study did not include any detailed survey of patient or provider opinions on the impact of immediate release. Thus, the true value of immediate results release including risks and benefits has yet to be fully elucidated and would be appropriate for future studies.

Conclusions

Implementation of immediate test result release resulted in increased and faster test result viewing in a patient portal at an academic medical center. Changes were mostly attributable to an increase in viewing results less than 1 day after release. Increased and faster viewing of test results was seen across all patient care areas but most notable in the outpatient setting. Despite increased weekend result release, patient viewing remained higher for weekdays.

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Conflicting Interest

The authors all declare no conflicts of interest.

CRediT authorship contribution statement

Kelly E. Wood: Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Hanh T. Pham:** Methodology, Formal analysis, Writing – review & editing. **Knute D. Carter:** Methodology, Formal analysis, Supervision. **Kenneth G. Nepple:** Conceptualization, Writing – review & editing. **James M. Blum:** Conceptualization, Writing – review & editing. **Matthew D. Krasowski:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Project administration.

Data availability

The raw data for the patient demographics and characteristics can be found in Mendeley repository data (https://data.mendeley.com/datasets/3x273v2hpg; 10.17632/3x273v2hpg.2).

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jpi.2023.100323.

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