Original Research

Impact of Patient Portal Use on Duplicate Laboratory Tests in Diabetes Management

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Abstract

Background: Patients seek care across multiple health care settings. One coordination issue is the unnecessary duplication of laboratory across different health care settings. This analysis examined the association between patient portal use and duplication of laboratory testing among Veterans who are dual users of Veterans Affairs (VA) and non-VA providers.

Materials and Methods: A national sample of Veterans who were newly authenticated users of the portal during fiscal year (FY) 2013 who used Blue Button at least once were compared with a random sample of Veterans who were not registered to use the portal. From these two groups, Veterans who were also Medicare-eligible users in FY2014 were identified. Duplicate testing was defined as receipt of more than five HbA1c (hemoglobin A1c) in 1 year.

Results: Use of the Blue Button decreased the odds of duplicate HbA1c testing in VA and Medicare-covered facilities across three comparisons: (1) overall between users and nonusers: portal users were less likely to have duplicate testing; (2) pre-post comparison: there was a trend toward lower duplicate testing in both groups across time; and (3) pre-post comparisons accounting for use of the portal: the trend toward lower duplicate testing was greater in Blue Button users.

Conclusion: Duplicate HbA1c testing was significantly lower in dual users of VA and Medicare services who used the Blue Button feature of their VA patient portal. Non-VA providers encounter barriers to access of complete information about Veterans who also use VA health care. Provider endorsement of consumer-mediated health information exchange could help further this model of sharing information.

Keywords: telemedicine, patient portals, health information exchange, electronic health records, Veterans, diabetes

Introduction

As modern health care continues to become more fragmented and patients seek care across multiple settings, there is increased potential for coordination issues. One pressing coordination issue is the potential for waste, including the unnecessary duplication of laboratory or imaging test ordering by providers working in different health care settings. While duplication of these services may be driven by provider preferences, patient requests, and other factors,¹ repeated laboratories and images are often due to lack of sharing of patient information across providers and systems of care.² Duplication of laboratory testing has been estimated at 32%, with 20% of duplicated tests not clinically indicated, meaning that the test would not have been ordered if prior results were known to the provider.³ While there are limited studies on duplicate testing in Veterans Affairs (VA) facilities, Maciejewski et al.⁴ examined overtesting and undertesting among Veterans who used only VA services and those who were “dual users” (i.e., Veterans who are eligible for and receive care through VA and in non-VA care settings). Overtesting was defined as five or more HbA1c tests per year.

They found that compared with VA-only users, dual users were twice as likely to have too many glycohemoglobin (i.e., hemoglobin A1c or HbA1c) tests, which reflect a patient's average blood sugar level over the previous 3 months and are used to diagnose and monitor type 1 and type 2 diabetes, and too many albumin tests, which are used to diagnose and monitor liver and kidney conditions. Across health care systems, the potential for duplication of services is highest and most problematic among patients with chronic diseases such as diabetes.⁵ Prevalence rates of diabetes continue to rise and the self-management tasks associated with the condition are ongoing, often requiring patients to undergo a variety of tests, laboratories, and consultations with different providers to address related issues.

Use of electronic health records (EHRs) is purported to facilitate electronic health information exchange (HIE) across providers and systems of care. However, the evidence is mixed as to whether EHRs and HIE systems reduce duplicate diagnostic and laboratory testing, and thus costs of care. In a recent systematic review of 25 studies that evaluated the effect of HIE on quality and/or costs, slightly over half (60%) found HIE cost-effective.⁶ Conversely, some studies found higher costs associated with HIE adoption.^{7,8} Any patient may at times choose to seek care beyond his or her usual provider or health care system, thus increasing the risk of duplication of services. However, dual use is an ongoing coordination issue for VA facilities, where Veterans who are ≥65 years of age are eligible for VA services and may also use Medicare to access care and cover health expenses. Recent studies have also shown that dual use is common among working-age Veterans (those under age 65) to address both inpatient and outpatient care needs,^{9–11} particularly in rural areas. One study found that 54% of rural dwelling Veterans used both VA and private insurances.⁹ Furthermore, higher risk Veteran patients (i.e., those with higher Hierarchical Condition Category [HCC] scores) are more likely to be dual users.¹⁰

CONSUMER-MEDIATED HIE AND THE ROLE OF PATIENT PORTAL FEATURES

Although dual use can increase access to care for some patients, it also increases the likelihood of care discontinuity across settings.¹² Consumer-mediated HIE, a term that refers to patients aggregating and controlling their own health information,¹³ is becoming increasingly available and may help alleviate problems associated with lack of communication across systems and providers. Blue Button, one feature of consumer-mediated HIE, enables patients to have more direct access to view, download, and transmit their health information in formats that are machine and human readable.^{14,15}

An initiative launched by VA in 2010 to promote the adoption and use of Blue Button functionality has since expanded to other federal agencies and private sector organizations committed to advancing consumer-mediated HIE.¹⁶ Although wide variation exists in the frequency with which patients access and use portal features,¹⁷ online laboratory test results are among the most commonly used portal features.¹⁸

VA PATIENT PORTAL

In VA, the patient portal is called My HealtheVet (MHV). MHV employs a tiered access model, with varied access to information and features depending on a Veteran's portal account type. Full access to portal features is available to those who complete a one-time, identity authentication process either in-person or online. Importantly, users with these premium accounts have access to key portions of their VA medical record, including laboratory results, through the VA Blue Button. The VA Blue Button enables Veterans to access and download a copy of their VA health records into a text, PDF, or XML file that can be read, printed, or saved on a computer. Veterans may select the date range and type of information to include for text and PDF files. They may also generate a VA Health Summary; a single standardized interoperable electronic file called the Continuity of Care Document (CCD)^{19–21} that includes a comprehensive summary of their VA health information focusing on the prior 24 months of treatment.

The number of Veterans who use MHV continues to increase, with >2.9 million having identity-authenticated, premium accounts as of February 2019.²² The effect of the MHV portal on care coordination issues has received scant attention, with the exception of some preliminary studies, suggesting that engaging patients in portal use to access laboratory information may empower them to improve information sharing between disparate providers and health care systems.^{21,23} Specific to the context of diabetes, although some studies have found improved glycemic control in patient portal users,^{24–26} there is limited evidence that use of portal features actually impacts duplicative tests. To our knowledge, there are no studies examining the effect of portal use on duplication of services among dual users of VA and Medicare services despite the many Veterans who seek care in both VA and Medicare fee-for-service settings. As such, the purpose of this analysis was to examine the association between MHV portal use and duplication of laboratory testing among patients who are dual users of VA and Medicare services. We hypothesized that patient use of the Blue Button feature of the MHV portal to download and share health information is associated with decreased duplication of HbA1c tests in this population.

Materials and Methods

STUDY DESIGN AND SAMPLE

Data for this analysis were drawn from a larger study²⁷ examining MHV use among Veterans receiving health care from VA facilities, including impacts on VA health care use and dual use of services from VA and non-VA providers covered by Medicare. We chose to focus on the impact of MHV use on duplication of HbA1c tests from VA and non-VA providers among VA users with diabetes based on input from VA primary care providers. Although HbA1c is relatively inexpensive, it is a frequently used laboratory test, and there are longstanding national guidelines for frequency of HbA1c measurement. Furthermore, overutilization of HbA1c testing has been attributed to a lack of care coordination,²⁸ which is common in VA dual users.

The study included a national sample of Veterans who were newly authenticated users of MHV during fiscal year (FY) 2013 (i.e., October 1, 2012 to September 30, 2013; pregroup) and who used Blue Button at least once to obtain laboratory data. We compared these Blue Button users with a random sample of Veterans who were not registered to use MHV. From these two groups, we identified Veterans who were also Medicare-eligible users in FY2014 (October 1, 2013 to September 30, 2014; 1-year post). Dual users were defined as Veterans who had two VA outpatient visits or one VA hospitalization and two Medicare encounters in the same year. Veterans who were deceased, aged <18 or >104, and those with missing data on variables included as covariates in adjusted models (distance to nearest VA; region of residence; urban residence; enrollment; income) were excluded from the sample. Among all Veterans meeting the inclusion and exclusion criteria, we took a 10% random sample, resulting in a final analytic sample for this analysis composed of 30,186 Veterans who use VA and Medicare health care services (Fig. 1).

MEASURES AND DATA SOURCES

Duplicate tests. We defined duplication of testing as a dichotomous indicator of receipt of more than five HbA1c tests from both a VA and a non-VA provider in 1 year. Receipt of an HbA1c test from a non-VA provider was assessed using Medicare claims data. VA performance metrics (consistent with standards of the American Diabetes Association)^{29–31} during the analysis time period indicated that HbA1c should be measured in patients with diabetes at least annually, and more frequently (up to four times per year) if clinically indicated, to assess glycemic control over time.

Demographics. Information about Veteran characteristics was obtained from the VA Medical SAS Databases,³² and in-

Fig. 1. Sample derivation diagram.

cluded gender, age, race, ethnicity, and U.S. geographic region of residence (i.e., Midwest, Northeast, South, West, other). The distance between the nearest VA facility to the Veteran and the ZIP code associated with the Veteran's address were used to determine Veteran distance to their nearest VA. A Veteran's VA enrollment group, a classification system used to determine copayment for VA services based on disability rating, income, and other factors (e.g., prisoner of war status), was determined using the VA Enrollment file (a file of all Veterans enrolled for care in the VHA, maintained by the VHA). Veteran's estimated income bracket was determined using census data detailing the median household income for the ZIP code associated with their residence³³; this ZIP code was also used to determine the urbanicity of where the Veteran lived.³⁴ Overall health status was estimated through the CMS HCC risk-adjustment model for community-dwelling populations.^{35,36}

MHV registration and Blue Button use. Registration for MHV and use of the Blue Button laboratory feature was calculated for the Veterans in our sample within 1 year of their respective index date. Veterans were considered to have used a MHV portal feature if they had any use of that feature in this time frame (as opposed to no use).

ANALYSIS

To balance characteristics between Veterans who used the MHV Blue Button laboratory feature or nonusers, we used propensity score weighting.³⁷ We calculated the propensity score for each Veteran as the predicted probability of being a MHV Blue Button laboratory feature user, using multiple logistic regression analysis of the patient characteristics in *Table 1*. Each Veteran was assigned a propensity score weight based on this propensity score. To examine the impact of the propensity score weighting, we calculated weighted and unweighted standardized differences. While several of the unweighted standardized differences were >10, indicating a substantial difference between the Blue Button User and comparison groups, the weighted standardized differences were all <10.³⁸

Because other factors may have influenced trends over time, we used difference-in-differences methodology to examine whether use of the MHV Blue Button laboratory feature was associated with receipt of duplicate HbA1c testing from VA and Medicare-covered facilities. Difference-in-differences estimates of duplicate receipt of HbA1c testing were obtained using logistic regression analysis with propensity score weighting. The logistic regression models included indicator variables for time (pre- vs. postperiod), MHV use group, and the interaction between time and evaluation group.³⁹

An alpha level of 0.05 was used to determine statistical significance. Statistical analyses were performed with STATA MP Version 14.2 software (StataCorp, College Station, TX). This study was approved by the Institutional Review Boards at the Edward Hines Jr. VA Hospital and Edith Nourse Rogers Memorial Veterans Hospital.

Results

Demographic and risk factor variables between MHV and non-MHV users were statistically significant ($p < 0.01$) (*Table 1*). MHV users tended to be younger, married, white, urban dwelling, and had higher incomes and better health status (HCC score). Propensity scores standard differences were all <0.10, indicating balance between the two groups.

DUPLICATE HbA1c TESTS

During the baseline period (FY13), 2.34% ($n=88$) of new users and 3.09% ($n=817$) of nonusers had greater than five HbA1c tests. The following year (FY14) 33 (<1%) of new users and 699 (2.65%) of nonusers had >5 HbA1c tests. Use of the MHV Blue Button laboratory feature was associated with a lower proportion of duplicate HbA1c testing in VA and Medicare-covered facilities across three comparisons: (1) overall between users and nonusers: MHV users were less likely to have duplicate testing; (2) pre-post comparison: there was a trend toward lower

duplicate testing in both groups across time; and (3) pre-post comparisons accounting for use of MHV Blue Button: the trend toward lower duplicate testing was greater in the Blue Button users (*Table 2*). Other significant differences between the two groups included distance to provider, eligibility group, and risk scores (*Table 2*).

Discussion

Duplicate HbA1c testing was significantly lower in dual users of VA and Medicare services who used the Blue Button feature of their VA patient portal compared with those who did not. While the cost per HbA1c is relatively low, the frequency of use is high, thus lowering duplicative testing will likely result in cost savings. Veterans and health care providers report satisfaction and perceived value in consumer-mediated HIE supported by PHR portal features.⁴⁰ A next step in building the evidence for this model of information exchange is further study of its impact on markers of safety and quality, including duplicate testing. Our study is among the first to consider this in a sample of Veterans who receive services through both VA and Medicare.

Prior work has demonstrated a decrease in duplication in diagnostic studies with HIE,^{41–46} but these studies focused on provider-provider exchange. Veteran patients who are downloading and sharing data with their non-VA providers have essentially developed a workaround (e.g., using patient-mediated medical records) in which they share information between their VA and non-VA providers because it is needed due to systems structures, including the challenges of non-VA physician access to the VA EHR.

Recent studies have examined the potential for MHV to reduce duplication of services. In single arm interventional study, 90% of providers reported that the CCD available through the VA Blue Button improved their ability to have an accurate medication list and helped them make medication treatment decisions, and 50% reported that they did not order a laboratory test or another procedure because of information available in the CCD.²³ In one small pilot randomized trial ($N=52$), Veterans trained to share their CCD with non-VA providers had significantly fewer duplicate laboratory tests than the comparator attention control group. However, the intervention was not effective when providers ordered laboratories to be drawn in the week before the actual medical visit.²¹ It is important to note that not all patients will download data and share it with their various health care providers. Often, as the recent study by Turvey et al. illustrates, laboratories get ordered before appointments, and patients bringing their data to appointments will not decrease duplicate testing.²¹ However, until efficient systems are

Table 1. Sociodemographic and Clinical Characteristics of Veterans by My HealthVet Status Before and After Index Date

CHARACTERISTIC	PRE			POST		
	NEW USER (<i>N</i> = 3,762), <i>N</i> (%)	NONUSER (<i>N</i> = 26,424), <i>N</i> (%)	<i>P</i>	NEW USER (<i>N</i> = 3,762), <i>N</i> (%)	NONUSER (<i>N</i> = 26,424), <i>N</i> (%)	<i>P</i>
Age			<0.0001			<0.0001
25–49	95 (2.53)	161 (0.61)		95 (2.53)	161 (0.61)	
50–64	382 (10.15)	2,280 (8.63)		382 (10.15)	2,280 (8.63)	
65–74	2,264 (60.18)	9,073 (34.34)		2,264 (60.18)	9,073 (34.34)	
75–84	803 (21.35)	10,134 (38.35)		803 (21.35)	10,134 (38.35)	
85 and 85+	218 (5.79)	4,776 (18.07)		218 (5.79)	4,776 (18.07)	
Gender			<0.0001			<0.0001
Male	3,642 (96.81)	25,941 (98.17)		3,642 (96.81)	25,941 (98.17)	
Female	120 (3.19)	483 (1.83)		120 (3.19)	483 (1.83)	
Marital status			<0.0001			<0.0001
Not married	774 (20.57)	7,806 (29.54)		792 (21.05)	8,036 (30.41)	
Married	2,988 (79.43)	18,618 (70.46)		2,970 (78.95)	18,388 (69.59)	
Ethnicity			0.0536			0.0536
Not Hispanic	3,681 (97.85)	25,713 (97.31)		3,681 (97.85)	25,713 (97.31)	
Hispanic	81 (2.15)	711 (2.69)		81 (2.15)	711 (2.69)	
Race			<0.0001			<0.0001
White	3,482 (92.56)	23,201 (87.8)		3,482 (92.56)	23,201 (87.8)	
Black	230 (6.11)	2,731 (10.34)		230 (6.11)	2,731 (10.34)	
Other	50 (1.33)	492 (1.86)		50 (1.33)	492 (1.86)	
Region			<0.0001			<0.0001
Northeast	544 (14.46)	4,537 (17.17)		542 (14.41)	4,527 (17.13)	
South	1,796 (47.74)	11,538 (43.66)		1,798 (47.79)	11,542 (43.68)	
West	536 (14.25)	3,114 (11.78)		543 (14.43)	3,127 (11.83)	
Midwest	875 (23.26)	7,112 (26.91)		870 (23.13)	7,108 (26.9)	
Other	11 (0.29)	123 (0.47)		9 (0.24)	120 (0.45)	
Distance to nearest Medicare, miles			0.0084			0.0057
0–4	1,146 (30.46)	8,326 (31.51)		1,166 (30.99)	8,323 (31.5)	
5–19	2,371 (63.02)	15,994 (60.53)		2,354 (62.57)	15,981 (60.48)	
20–39	226 (6.01)	1,961 (7.42)		223 (5.93)	1,983 (7.5)	
40–59	17 (0.45)	128 (0.48)		16 (0.43)	124 (0.47)	
60+	2 (0.05)	15 (0.06)		3 (0.08)	13 (0.05)	

continued →

Table 1. Sociodemographic and Clinical Characteristics of Veterans by My HealthVet Status Before and After Index Date
continued

CHARACTERISTIC	PRE			POST		
	NEW USER (<i>N</i> = 3,762), <i>N</i> (%)	NONUSER (<i>N</i> = 26,424), <i>N</i> (%)	<i>P</i>	NEW USER (<i>N</i> = 3,762), <i>N</i> (%)	NONUSER (<i>N</i> = 26,424), <i>N</i> (%)	<i>P</i>
Distance to nearest VA, miles			0.0006			0.0001
0–4	935 (24.85)	5,947 (22.51)		950 (25.25)	5,950 (22.52)	
5–19	1,115 (29.64)	7,492 (28.35)		1,112 (29.56)	7,535 (28.52)	
20–39	759 (20.18)	5,885 (22.27)		757 (20.12)	5,845 (22.12)	
40–59	477 (12.68)	3,627 (13.73)		468 (12.44)	3,627 (13.73)	
60+	476 (12.65)	3,473 (13.14)		475 (12.63)	3,467 (13.12)	
Rural			<0.0001			<0.0001
Urban	2,175 (57.81)	14,203 (53.75)		2,236 (59.44)	14,433 (54.62)	
Rural	1,587 (42.19)	12,221 (46.25)		1,526 (40.56)	11,991 (45.38)	
Enrollment group			<0.0001			<0.0001
Group 1	1,695 (45.06)	7,116 (26.93)		1,695 (45.06)	7,116 (26.93)	
Group 2	265 (7.04)	1,485 (5.62)		265 (7.04)	1,485 (5.62)	
Group 3	424 (11.27)	2,563 (9.7)		424 (11.27)	2,563 (9.7)	
Group 4	85 (2.26)	1,112 (4.21)		85 (2.26)	1,112 (4.21)	
Group 5	421 (11.19)	4,878 (18.46)		421 (11.19)	4,878 (18.46)	
Group 6	135 (3.59)	428 (1.62)		135 (3.59)	428 (1.62)	
Group 7	70 (1.86)	800 (3.03)		70 (1.86)	800 (3.03)	
Group 8	667 (17.73)	8,042 (30.43)		667 (17.73)	8,042 (30.43)	
Score community (HCC score)			<0.0001			<0.0001
0–0.49	1,193 (31.71)	4,043 (15.3)		662 (17.6)	3,104 (11.75)	
0.50–0.99	1,367 (36.34)	12,636 (47.82)		1,426 (37.91)	12,284 (46.49)	
1.00+	1,202 (31.95)	9,745 (36.88)		1,674 (44.5)	11,036 (41.77)	
Median household income			<0.0001			<0.0001
<\$25K	11 (0.29)	141 (0.53)		12 (0.32)	136 (0.51)	
\$25K to \$49,999	1,957 (52.02)	14,781 (55.94)		1,952 (51.89)	14,797 (56)	
\$50K to \$64,999	1,214 (32.27)	8,104 (30.67)		1,210 (32.16)	8,092 (30.62)	
\$65K+	580 (15.42)	3,398 (12.86)		588 (15.63)	3,399 (12.86)	
% Families below poverty			0.0191			0.0088
<5	22 (0.58)	76 (0.29)		23 (0.61)	78 (0.3)	
5–9	504 (13.4)	3,332 (12.61)		507 (13.48)	3,313 (12.54)	
10–14	1,124 (29.88)	8,144 (30.82)		1,127 (29.96)	8,153 (30.85)	
15–19	1,447 (38.46)	10,109 (38.26)		1,447 (38.46)	10,115 (38.28)	
20+	665 (17.68)	4,763 (18.03)		658 (17.49)	4,765 (18.03)	

HCC, Hierarchical Condition Category; VA, Veterans Affairs.

Table 2. Hemoglobin A1c Regression Results

	OR	P	95% CONFIDENCE INTERVAL
MHV Blue Button user	0.75	0.016	0.60–0.95
Pre-post comparison	0.85	0.013	0.75–0.97
MHV Blue Button user ^a pre-post	0.36	0.000	0.24–0.54
Age			
50–64	1.28	0.558	0.56–2.97
65–74	1.44	0.377	0.64–3.26
75–84	1.17	0.709	0.51–2.72
85+	0.80	0.620	0.33–1.92
Gender	0.57	0.074	0.31–1.06
Married	1.24	0.058	0.99–1.56
Ethnicity (Hispanic)	2.27	0.000	1.50–3.42
Race (White)			
Black	1.12	0.399	0.86–1.48
Other	0.91	0.793	0.44–1.88
Region (northeast)			
South	1.01	0.920	0.78–1.31
West	0.78	0.160	0.55–1.10
Midwest	0.84	0.217	0.63–1.11
Other	1.10	0.867	0.36–3.41
Distance to nearest Medicare (0–4 miles), miles			
5–19	0.91	0.374	0.74–1.12
20–39	0.80	0.314	0.52–1.24
40–59	0.92	0.917	0.19–4.49
60+	3.77	0.200	0.50–28.55
Distance to nearest VA (0–4 miles), miles			
5–19	0.94	0.615	0.74–1.19
20–39	0.75	0.036	0.57–0.98
40–59	0.97	0.856	0.71–1.34
60+	1.11	0.496	0.82–1.51
Rural	1.07	0.548	0.86–1.31
Enrollment group (Group 1)			
Group 2	0.72	0.113	0.47–1.08
Group 3	0.75	0.066	0.55–1.02
Group 4	0.91	0.695	0.57–1.46
Group 5	0.80	0.138	0.60–1.07

Table 2. *continued*

	OR	P	95% CONFIDENCE INTERVAL
Group 6	0.43	0.011	0.23–0.82
Group 7	0.49	0.053	0.24–1.01
Group 8	0.84	0.146	0.66–1.06
Score community (HCC score)			
0.50–0.99	1.26	0.061	0.99–1.61
1.00+	2.23	0.000	1.75–2.86
Median household income (\$0 to \$24,999)			
\$25K to \$49,999	0.62	0.389	0.21–1.84
\$50K to \$64,999	0.79	0.680	0.26–2.43
\$65K+	0.76	0.649	0.24–2.44
% Families below poverty (<5%)			
5–9	1.94	0.219	0.67–5.60
10–14	1.79	0.292	0.61–5.26
15–19	2.03	0.210	0.67–6.11
20+	2.41	0.124	0.78–7.41
^a Controlled for VA facility. MHV, My Health@Vet.			

designed to allow providers in different organizations to access key data such as laboratory test or radiologic images, a tool like the VA Blue Button may be a means to complement provider-mediated HIE. A still larger policy question is whether patients should be responsible for sharing their data across systems of care.

Other factors were also associated with duplicate testing in our analysis. Veterans who lived between 20 and 39 miles to VA were less likely to have duplicate testing (*Table 2*). Reliance on VA care is associated with distance, that is, as distance to a VA facility, relative to the nearest Medicare hospital, increased, outpatient reliance on the VA decreased monotonically.⁴⁷ However, the importance of distance to care is relative to the health status and resources of patients, complexity of service provided, and urgency of service needed.⁴⁸ We found that sicker patients (HCC scores) were twice as likely to receive duplicate testing. Thus, Veterans who have better health status and live closer to a VA facility may choose to use care at that facility, potentially reducing duplicate testing. Veterans in Priority Group 6, which includes Vietnam and Persian Gulf War Veterans, among others, were also less

likely to have duplicate testing. Although the reason for this finding is unknown, it is possible that these Veterans are relatively low users of the VA overall. Although we found a significant and important association using administrative data, we do not have any insights regarding reasons for differences in HbA1c testing frequency. Patients may, for example, be requesting additional tests be done by each provider. Some Medicare providers might not trust what is in Blue Button report, although this has not been found to be the case in previous studies.^{21,23} Non-VA providers may have limited knowledge of VA and its tests or even hold negative perceptions of the VA health care system, and so are inclined to reorder. Finally, as described above, providers may also order laboratory tests before visits, thus patient-provided information at the time of the visit cannot prevent duplication.²¹

LIMITATIONS

There are various limitations to this analysis. First, the raw number of individuals with duplicate testing is very small overall. However, Blue Button use is growing. The results of this study are significant because of the potential to decrease overlap among users who are not currently using the Blue Button. While the Veterans in the MHV group used Blue Button and downloaded laboratory data, it is not clear whether they shared laboratory data with their non-VA provider. If they downloaded the report, there is no way to know whether they were specifically reviewing their laboratory data. We also do not know the reasons a provider ordered the HbA1c; in some cases, the repeat test may have been clinically indicated. Duplication of HbA1c decreased over time in both groups, and the reasons for this finding are not known. The need for authentication on the portal might have introduced bias in unknown ways. This analysis focused on one laboratory test, and thus we cannot comment on whether we would find the same differences in other tests or procedures. We were not able to address non-VA duplication of testing in younger Veterans. Zip code was used to determine urbanicity, but a person may have moved during study period. Furthermore, county-level data about income are only surrogate. We used HCC to make a single estimation of overall health status for each patient, however an individual's overall health status changes over time, and HCC is a proxy measure of health. We coded portal use as a dichotomous variable; however more use, or more recent use, may be a better predictor of information availability to the provider. Finally, Veterans using Blue Button may be different from those not using it in ways that could not be examined in this study, for example, patient engagement in their care.⁴⁰

Conclusion

Patient portal features such as Blue Button and other consumer-oriented technologies can facilitate patient sharing of health information with providers across health care systems.⁴⁹ Existing structures and processes create barriers for non-VA providers to access complete information about their patients who also use VA health care services. To fully realize an effective model of consumer-mediated HIE to improve care coordination, we must address the needs of different stakeholder groups. Patients may need more education and training about how best to leverage portal features to support HIE. Providers may need to be similarly educated and convinced of the value of the information that patients can access and share with them. Provider endorsement of consumer-mediated HIE could help further this model of sharing information.

Future work might examine the potential of portal features to reduce duplicate testing in other disease contexts. Future work must also focus on understanding what information is being shared between a patient and provider, when and why, necessitating the complementary use of mixed data collection and analysis approaches.

Acknowledgments

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs or the U.S. government.

Disclosure Statement

No competing financial interests exist.

Funding Information

This study was supported by the Department of Veterans Affairs, Office of Research and Development, Health Services Research and Development Service (IIR 14-041, *Impact of My HealtheVet on Healthcare Use and Costs*).

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Received: September 8, 2019

Revised: November 20, 2019

Accepted: November 22, 2019

Online Publication Date: February 11, 2020