

Research and Applications

Enhancing patient engagement and understanding: is providing direct access to laboratory results through patient portals adequate?

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Abstract

Objectives: To explore patients' use of patient portals to access lab test results, their comprehension of lab test data, and factors associated with these.

Materials and Methods: An online survey was administered to 276 adults 18+ years. Multivariate logistic regression was used to determine factors associated with patient portal use to view lab test results and lab test comprehension.

Results: The sample was predominantly White (72.5%), female (55.4%), with mean age 50.7 ± 15.5 years. Overall, participants had low numeracy (10.79 ± 2.71) and eHealth literacy skills (23.91 ± 5.29), and moderate lab test comprehension scores (18 ± 2.3). White participants with greater eHealth literacy were more likely to access lab test results via patient portals, whereas those with a college education were less likely to do so ($\chi^2 [3] = 31.23, P < .001$). The regression showed that older age, fewer chronic conditions, and use of patient portals were significantly related to higher lab test comprehension scores ($F [22, 250] = 8.73, P < .001$). Older adults performed better on comprehension tests but reported having difficulty understanding lab tests, expressing a preference for their doctors to explain them.

Discussion: The findings shed light on the experiences and needs of different user groups that must be addressed to enhance their ability to effectively use patient portals for obtaining lab test results.

Conclusion: More research is needed to determine patient barriers to comprehending lab test results online and to develop tailored strategies to improve patients' self-efficacy to meaningfully use medical information in patient portals.

Lay Summary

We surveyed 276 adults to find out how well they understand lab test results and why they may not use patient portals to access them. While most used patient portals to view lab tests, half said these are hard to understand and they would rather have their doctors explain them. White, more health-literate, or less educated people are more likely to use patient portals to view lab results. People who are older, have fewer long-term illnesses, or who view lab tests online find it easier to understand lab test data. By law, patients should get immediate access to lab tests online. But we have to find better ways to present them so that people can benefit from having digital access to their health information.

Key words: patient portals; patient access to records; clinical laboratory tests; comprehension; patient engagement.

Background and significance

Patient portals and patient engagement

A key goal of the Health Information Technology for Economic and Clinical Health (HITECH) Act is to engage health consumers in their own care by requiring health care organizations to provide patients with the ability to view their medical records online and to communicate with their providers electronically.¹ Patient portals are the most efficient way to satisfy this meaningful use requirement by providing secure access to personal health information (eg, laboratory results, health history, medications, vaccination records, clinical notes, billing information, etc.), and by supporting medication management, appointment scheduling, and secure messaging with providers.²⁻⁴ Studies show that patient portals help patients: understand their health better; prepare for

appointments by enabling them to review their lab results and formulate questions related to their symptoms or lab results; improve care coordination; and communicate with providers between visits.⁴⁻⁶

Further, several initiatives have promoted the use of patient portals to enable patients to access medical information. The OpenNotes initiative was established in 2010 to improve transparency and communication by giving patients access to their clinical notes through online portals.⁷ Similarly, the Information Blocking Provision of the 21st Century Cures Act, which went into effect in 2021, requires health care organizations to release laboratory test results to patients immediately upon request.⁸ Research shows that when patients have direct access to their clinical notes and lab results, they feel more in control of their care, are better

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prepared for visits, participate more in shared decision making with improved patient-provider communication, are more likely to adhere to treatment plans, and receive more accurate and timely clinical diagnosis.^{9–11} Patients find the ability to view laboratory and radiology test results as one of the most useful and popular features of patient portals.^{9,12,13} In a multisite survey of adult patients, Steitz et al¹⁴ found that majority of patients (95.7% of all respondents and 95.3% of those who received abnormal test results) preferred to receive their test results through patient portals prior to having follow-up appointments with their health care providers. However, while direct access to lab results is highly valued by patients and has the potential to enhance patient engagement, concerns related to the ability of patients to access and accurately interpret lab results persist.^{15,16} Many studies show that patients have difficulties finding, viewing, and comparing lab test results and other health information.^{17,18} Czaja et al¹⁹ tested the usability of 3 different patient portal systems on 54 patients with low health literacy and lower socioeconomic status. They found that 61% could not find previous test results, 30% failed to provide reasons for concern, 25% had difficulty finding lab test results, 20% were not able to accurately determine the level of normality of test results, and 18% were unable to name tests.¹⁹ Moreover, there are concerns that providing direct access to medical data may increase the possibility that patients will access them before their doctors and attempt to interpret them without professional guidance.^{20–22}

Factors influencing access to and comprehension of lab test results online

The ability of patients to gain actionable insights from their lab test results hinges on their ability to understand and accurately interpret their lab values. Unfortunately, most patient portals are not designed with lay users in mind.¹⁹ Lab results presented in patient portals are not that different from clinical lab reports, which are usually information-heavy, typically formatted as tables, and include a lot of medical terminology and acronyms that most patients find hard to understand and interpret.^{16,17,23}

Difficulties in comprehending and interpreting lab test results online are further compounded in disadvantaged and vulnerable populations who are at most risk for poorer health outcomes.¹¹ Differences in age, gender, race, educational levels, and chronic conditions have been found to be significantly associated with difficulties in using patient portals. In a survey of 272 older adults (ages 50–92 years) with chronic conditions, Nahm et al.²⁴ found that a majority (71.3%) used one or more patient portals but in limited ways. Another study found that immediate access to lab test results online, younger age, and lower levels of education were significantly related to lower self-reported lab test comprehension.²⁵

Research also shows that patients with poor eHealth literacy and numeracy skills experience more difficulty performing tasks and understanding numeric data in portals.²⁶ *Electronic health (eHealth) literacy* encompasses a suite of skills required for patients to effectively perform important health-related tasks in an increasingly complex electronic health care environment.^{27,28} *Numeracy*, a subdomain of health literacy, is the “degree to which individuals have the capacity to access, process, interpret, communicate, and act on numerical, quantitative, graphical, biostatistical, and probabilistic health information needed to make effective

health decisions.”²⁹ Studies show that eHealth literacy is a significant predictor of patient portal use especially among older adults and those with multiple chronic conditions.³⁰ Research also shows that patients with low health numeracy tend to have greater difficulty comprehending lab test results, understanding associated risks, acting on this information, and participating in medical decision-making.^{26,31,32} For example, in an online survey targeting adults aged 40–70 years, researchers found that higher levels of numeracy and health literacy significantly predicted participants’ ability to interpret test results and assess their blood glucose levels more accurately.²⁶ Taha et al.³³ found that numeracy and technology skills significantly influenced older adults’ ability to perform health management tasks including the ability to understand numerical information in a simulated patient portal.

Purpose and rationale of the study

While many studies have focused broadly on patient portal use, few have delved deeply into the specific challenges patients face in understanding lab results presented in these portals. The main goals of this exploratory study were to: (1) explore patients’ perceptions about the use of patient portals for accessing lab test results; (2) determine patients’ comprehension of lab results and factors related to this; and (3) examine factors associated with patients’ use of patient portals for viewing lab test results. Based on previous research, we hypothesize that there are significant relationships between age, race, education level, eHealth literacy, health numeracy, number of chronic conditions, lab test comprehension, and use of patient portals for viewing lab test results.

Methods

Design and participants

A cross-sectional survey research design was used to examine patients’ perceptions about using patient portals for viewing lab test results, their comprehension of lab results, and factors that may be associated with these. An online survey was administered to a sample of 276 adults (18+ years) living in the United States. To be eligible for the study, a participant must: (1) be 18 years of age or older; (2) speak English; and (3) have at least 1 chronic condition. Studies show that people who have 1 or more chronic diseases are more likely to use patient portals and get lab tests more often.²⁴ We used 2 strategies to recruit potentially eligible participants—push recruitment (ie, MTurk) and pull recruitment (ie, listservs).³⁴ Mixed recruitment approaches have been found to be acceptable and effective methods for improving participation rates, coverage, and representation of populations that are harder to reach with any 1 method (eg, older adults).^{35–37}

From December 6, 2022 and February 28, 2023, we recruited 220 participants using Amazon Mechanical Turk (MTurk)—a web-based platform for crowd-sourcing research participants.³⁸ Compared to other modes of recruitment, research shows that MTurk is a feasible and cost-effective method for recruiting large and diverse samples of participants for web-based surveys.^{39–41} Moreover, research shows that responses from MTurk samples are not significantly different from other convenience samples.^{39,41,42} MTurk research participants (MTurk workers) receive small incentives based on the complexity and time required to

complete surveys.^{43–45} For our study, each MTurk participant received an average of \$2.00 for completing all sections of the survey.

To ensure wider representation of older adults in the sample, we also recruited participants through the Florida State University Institute for Successful Longevity (ISL) Volunteer Registry listserv from February 3 to March 26, 2023. The mailing list includes individuals over 60 years old living in the Florida Big Bend and Florida Panhandle regions. The listserv contained about 2000 email addresses. Fifty-six participants were recruited using this method, yielding a response rate of 2.8%. The low response rate from the ISL recruitment is only an estimate because data about undeliverable emails was not available due to limitations of the software used by the administrators, and the ISL listserv is not regularly updated, so it is possible that some emails were no longer active. Eligible participants who completed the survey were included in a random drawing for an opportunity to win 1 out of 6 \$50 gift cards.

A post-hoc analysis using G*Power version 3.1.9.7 confirmed that the total number of participants recruited using the 2 methods ($N=276$) was sufficient to achieve 80% power for detecting a small effect size of predictor variables on the dependent variables using logistic regression at a significance criterion of $\alpha=.05$.⁴⁶ This study was approved by the Florida State University Institutional Review Board (Protocol ID: STUDY00002904).

Measures and variables of interest

The dependent variables were use of patient portals to access lab test results and comprehension of lab test results. A general lab test comprehension score was calculated using a 19-item comprehension test (see [Appendix S1](#) for the test). Participants were presented scenarios of common lab test results (eg, lab values, units, reference ranges for lab tests in the lipid and comprehensive metabolic panels, blood pressure, and hemoglobin A1c). They were then asked to identify results outside the reference range for each and abnormal hemoglobin A1c values.

In addition to sociodemographic factors, we examined other potential predictors of the dependent variables, including health status, number of chronic conditions, perceived barriers to using patient portals to view lab results, numeracy, and eHealth literacy. Age was entered into prediction models as a continuous variable. Numeracy was measured using a 3-item version of the Subjective Numeracy Scale (SNS-3; $\alpha=.75$) developed by McNaughton et al.⁴⁷ to assess respondents' ability to understand health-related numerical information like lab test results. Each item (eg, "How good are you at working with fractions?") used a 6-point Likert-type scale (1 = not good at all to 6 = extremely good). Despite few items, the internal consistency reliability was adequate for this 3-item measure ($\alpha=.752$, $\omega=.784$).

Respondents' ability to use and understand electronic health sources to complete health-related tasks was measured using the e-Health Literacy Skills (eHEALS) scale developed by Norman and Skinner.⁴⁸ This is a highly reliable ($\alpha=.93$), 8-item Likert-type scale (sample item: "I know what health resources are available on the Internet") with 5 response options (1=strongly disagree to 5=strongly agree). We measured eHealth literacy to capture not only technical skills needed to access patient portals, but also higher order skills needed to navigate, find, and evaluate health information in

these systems. In the current study, the internal consistency reliability was excellent for this 8-item measure ($\alpha=.926$, $\omega=.927$).

Data analysis

Prior to data analysis, we evaluated the quality of the responses from MTurk participants by monitoring completion times and flagging responses that were unrealistically fast, that may indicate possible careless clicking and low-effort responses. We also removed participants who missed answering more than 30% of the questions. Lastly, we evaluated the responses to certain questions, such as lab test comprehension, and removed outliers in the final analysis.

For our analysis, we used descriptive statistics to summarize the demographic characteristics and other variables of interest. Internal consistency reliability coefficients (Cronbach alpha, α , and McDonald's omega, ω) were calculated for each measure. Bivariate generalized linear modeling (GLM) and logistic regression were then used to determine bivariate relationships between predictors and the dependent variables of interest. Lastly, multivariate GLM and logistic regression models were examined to determine which sets of predictors best predicted outcomes. The GLM analyses were used to predict lab value comprehension, given the nonnormal distribution of those scores. Gamma regression, a type of GLM, was used to predict the negatively skewed continuous outcome of lab value comprehension, as this approach uses an inverse link function to appropriately model the inverse relationship between the outcome and the predictors. All variables from bivariate models were used in a hierarchical process that aimed to maximize variance explained in the outcome by selecting the most predictive remaining predictor for each iteration until no more statistically significant predictors remained (forward entry). The data were cross-sectional, and therefore no causal relationships were posited following analyses. Statistical significance tests were set to a significance level of $\alpha=.05$. All analyses were carried out in SPSS v29.0.

Results

Participant characteristics

A total of 276 participants were included in the final analysis. The sample was predominantly White (72.5%), female (55.4%), with a mean age of 50.7 ± 15.5 years ([Table 1](#)). On average, the participants had lower numeracy and eHealth literacy skills compared to those in similar studies,^{36,38–40} and with little variance among age groups. The mean numeracy skills score was 10.79 ± 2.71 (range: 1–15) out of the possible highest score of 18. Out of the highest possible score of 40, the average self-reported eHEALS score was 23.91 ± 5.29 (range: 7–32). The mean lab test comprehension score for the sample was 18 ± 2.39 (range: 9–21) out of the highest possible score of 21.

Chronic conditions and lab tests ordered

Half (50%) of the participants had 1 chronic disease, 37.3% had 2–3, and 12.7% had more than 3 chronic conditions ([Appendix S2A](#)). The most reported chronic conditions were depression (32.6%), hypertension (32.6%), and arthritis (23.2%). When asked about what lab tests were ordered for them in the past 12 months, a majority indicated receiving orders for complete blood count (77.9%), lipid panel

Table 1. Participant characteristics (N = 276).

Characteristics	n	%	M	SD
Age			50.7	15.5
18-34 (young adults)	39	14.0		
35-54 (early mid-middle age)	125	45.3		
55-64 (late middle age)	39	14.0		
65+ (older adults)	56	25.9		
Gender				
Female	153	55.4		
Male	123	44.6		
Race				
White	200	72.5		
Asian	54	19.6		
Black or African American	14	5.1		
American Indian or Alaska Native	4	1.4		
Two or more races	4	1.4		
Marital status				
Married	155	56.2		
Single, never married	59	21.4		
Living as married or living with a romantic partner	15	5.4		
Divorced	30	10.9		
Widowed	15	5.4		
Separated	2	0.7		
Employment				
Employed	170	61.6		
Self-employed	31	11.2		
Unemployed	3	1.1		
Student	2	0.7		
Retired	64	23.2		
Disabled	5	1.8		
Highest education attained				
Less than high school	2	0.7		
High school graduate	12	4.3		
Some college	55	19.9		
College graduate	135	48.9		
Graduate degree	72	26.1		
Health care coverage	257	93.1		
Numeracy skills (highest possible score=18)			10.79	2.71
e-Health literacy skills (highest possible score=40)			23.82	5.48
Lab test comprehension score (highest possible score=21)			18.0	2.39

tests (72.8%), and basic metabolic panel tests (69%) (Appendix S2B). The majority of the participants reported receiving abnormal test results for hemoglobin A1c (68.2%) and lipid panel tests (61.2%).

Patient access to lab test results through patient portals

General patient portal use

A great majority of the participants were aware that their providers maintained a patient portal (87.6%) and reported that their providers had explicitly offered them access to their medical records online (69.7%) (Appendix S2C). About 71.7% of the participants in the study had accessed patient portals at least once in the past year. Among these, the most mentioned reasons for using patient portals were to look up

test results (67.2%), make appointments (41.4%), and request prescription refills (41.4%).

Patient access to lab test results

We asked respondents how they typically receive their lab test results. Overall, the majority of the participants accessed their lab test results through patient portals (60.4%) or during follow-up visits with their doctors (57.8%). The results also showed differences by age and number of chronic conditions (Appendix S2D). For older adults 65+ years of age, most (63.9%) commonly access their lab test results via patient portals compared to other conventional means. While most young adults 18-34 years (64.1%) received their lab test results during follow-up doctor visits. Patients with multiple chronic conditions (2 or more) reported accessing lab test results most commonly through patient portals (63.7%), while those without multiple chronic conditions usually followed up with their physicians (58.4%).

Participants said that the primary way they received abnormal test findings was during follow-up appointments with their physicians (60%), with patient portals being the second most prevalent option (46.5%) (Appendix S2D). This trend was true for patients regardless of the number of chronic conditions and for patients aged 18-34 years (64%), 35-54 years (67.2%), and 65+ years (51.4%). However, 61.5% of older adults aged 55-64 years reported they are informed about abnormal test results mostly through their patient portal.

Preferred modes for receiving lab test results

Patients, regardless of their age, ranked patient portals as one of their top 3 preferred modes for receiving lab test results (Appendix S2E). Despite the overall preference for patient portals, among older adults 65+ years, 37.4% said they preferred to get their lab test results directly from their health care providers. Also, a greater proportion (63.6%) of individuals in the 35-54 year age group preferred to receive their lab test results through text. There was limited variance in preferred modes of delivery among those in the 18-34 year age range.

Perceived barriers to using patient portals to view lab test results

The predominant perceived barrier to viewing lab test results online was a preference for getting in-person explanations from their doctors (50.4%) (Table 2). The primary barriers indicated by older adults (65+ years) include a preference for having their doctor explain lab test results (45.5%), uncertainty about where to find patient portals (27.3%), and difficulty interpreting lab test values (25.9%). On the other hand, younger adults aged 18-34 years indicated a preference for having their doctor explain their lab test results (69.2%), with some stating they are only interested if the results are abnormal (25.6%).

Further analysis of the perceived barriers to using patient portals showed that significantly different proportions of the age groups reported not caring to know unless lab test results are abnormal ($\chi^2=18.26$, $df=3$, $P<.001$, $\phi=.27$), not knowing which patient portal to access ($\chi^2=10.37$, $df=3$, $P=.016$, $\phi=.20$), and not knowing where to find the patient portal ($\chi^2=8.14$, $df=3$, $P=.043$, $\phi=.18$). Specifically, a significantly greater proportion of individuals 18-34 and 35-54 years of age reported not wanting to know lab results unless they were abnormal compared to older age groups. No other

Table 2. Perceived barriers to using patient portals for viewing lab test results.

Perceived barriers for using patient portals to view lab test results	Total (N =258 ^a) n (%)	Age groups (years)				χ^2	Effect size (ϕ)
		18-34 (n=39) n (%)	35-54 (n=125) n (%)	55-64 (n=39) n (%)	≥65 (n=56) n (%)		
<i>I prefer my doctor to explain these to me</i>	130 (50.4%)	27 (69.2%)	59 (47.2%)	19 (48.7%)	25 (45.5%)	6.63 ^b	.16
<i>I don't know how to interpret lab test values</i>	63 (24.5%)	7 (17.9%)	30 (24.0%)	12 (30.8%)	14 (25.9%)	1.81	.08
<i>I don't care to know unless I have abnormal lab test results</i>	59 (22.9%)	10 (25.6%)	41 (32.8%)	4 (10.3%)	4 (7.3%)	18.26 ^c	.27
<i>I don't know what patient portal to access</i>	57 (22.1%)	9 (23.1%)	33 (26.4%)	1 (2.6%)	14 (25.5%)	10.37 ^d	.20
<i>I don't know where to find lab test results in patient portals</i>	57 (22.1%)	8 (20.5%)	31 (24.8%)	4 (10.3%)	14 (25.5%)	4.12	.13
<i>I didn't know I could access lab test results through a patient portal</i>	52 (20.1%)	9 (23.1%)	29 (23.2%)	3 (7.7%)	11 (19.6%)	4.71	.14
<i>I don't know where to find the patient portal</i>	54 (20.9%)	7 (17.9%)	30 (24.0%)	2 (5.1%)	15 (27.3%)	8.14 ^d	.18
<i>I don't know how to read lab test results</i>	49 (19.0%)	6 (15.4%)	25 (20.0%)	9 (23.1%)	9 (16.4%)	1.08	.07
<i>I don't understand what normal or abnormal lab test values are</i>	48 (18.6%)	8 (20.5%)	27 (21.6%)	7 (17.9%)	6 (10.9%)	3.00	.11
<i>I don't know how to access patient portals</i>	47 (18.2%)	9 (23.1%)	22 (17.6%)	3 (7.7%)	13 (23.6%)	4.63	.14

^a Respondents who have answered the question about perceived barriers to using patient portals for viewing lab results.

^b $P < .10$.

^c $P < .001$.

^d $P < .05$.

reported barrier to patient portals demonstrated a significant association with age groups.

Factors influencing the use of patient portals to access lab test results

We used logistic regression to further analyze factors that were associated with the likelihood of accessing lab test results via patient portals (Table 3). Bivariate models indicated that age of the respondent, having a college degree, racially identifying as White, and higher eHEALS test scores each was significantly associated with ($P < .05$) the likelihood of respondents reporting accessing lab test results through a patient portal. The final multivariate logistic regression model, however, found that only having a college degree, identifying as White, and having higher eHEALS scores were significantly associated with the likelihood of accessing lab test results via patient portals. Specifically, those with a college degree ($\beta = -0.68$, $P = .04$, $\text{Exp}(\beta) = .51$, 95% CI [0.27, 0.97]) were found to be 49% less likely to access lab tests via patient portals after controlling for other predictors in the model. White participants were found to be 3 times more likely to use patient portals ($\beta = 1.10$, $P < .001$, $\text{Exp}(\beta) = 3.00$, 95% CI [1.68, 5.27]) controlling for other predictors. Lastly, for each 1-point increase in eHEALS test scores, participants were 9% more likely to report using patient portals ($\beta = 0.08$, $P = .001$, $\text{Exp}(\beta) = 1.09$, 95% CI [1.03, 1.14]). The logistic regression model significantly explained the likelihood to use patient portals ($\chi^2 [3] = 31.23$, $P < .001$), explained about 15% of the variability in likelihood of using patient portals (Nagelkerke $r^2 = 0.15$), and demonstrated satisfactory goodness of fit (ie, nonsignificant Hosmer and Lemeshow test, $\chi^2 = 13.25$, $df = 8$, $P = .10$). No evidence of multicollinearity was found among the predictors in the model (tolerance > 0.946 , Variance Inflation Factor [VIF] < 1.056).

Comprehension of lab test results

We also assessed participants' general comprehension of lab test results. In the overall sample, lab test comprehension scores ranged from 9 to 21 and the mean score was 18.0 (SD: ± 2.39) out of the highest possible score of 21 (Appendix S2F). Descriptive analysis indicated that older seniors 65+ years had relatively higher average scores (18.56) compared to those 55-64 years (18.3), 35-54 years (17.84), and 18-34 years (16.95). Lastly, participants with 1 or no chronic condition had slightly higher mean lab test comprehension scores (18.11) than those with multiple chronic conditions (17.90).

Likelihood of accessing patient portals and comprehension of lab test results

Patients who reported typically using patient portals to access lab results had significantly higher general comprehension of lab test results (mean of 18.49 ± 1.82 , $t = 4.15$, $df = 273$, $P < .001$) when compared to those patients not reporting using patient portals (mean of 17.30 ± 2.91). The size of the differences between these groups demonstrated a medium effect (Cohen's $d = .51$).

Relationship between lab test comprehension and other variables

Further analysis was done to test the significance of these trends. OLS (Ordinary Least Squares) regression models were first used to test the bivariate relationships between each predictor and lab test comprehension scores (Table 4). In bivariate tests, older age, racially identifying as White, numeracy test scores, and reporting use of patient portals each was significantly associated with lab test comprehension ($P < .05$).

The final multivariate model found that 3 factors significantly explained lab test comprehension ($\chi^2 [3] = 27.36$, $P < .001$, McFadden $r^2 = .06$): patients reporting use of patient portals, older age, and having fewer chronic health conditions. Specifically, older adults were found to have better lab test comprehension scores ($\beta = 0.02$, Wald $\chi^2 [1] = 13.03$, $P < .001$, 95% CI [0.01, 0.03]) after controlling for number

Table 3. Factors influencing accessing lab test results via patient portals (logistics regression).

Predictor		χ^2	Nagelkerke r^2	Wald	β	Exp(β)	95% CI
Bivariate models	Age	4.02 ^a	.02	3.94 ^a	0.01	1.02	1.00, 1.03
	Gender (male)	3.59 ^b	.02	3.58 ^b	-0.47	0.63	0.38, 1.02
	Education level (college degree)	9.06 ^c	.04	8.36 ^c	-0.90	0.41	0.22, 0.07
	Race (white)	16.59 ^d	.08	16.16 ^d	1.12	3.06	1.77, 5.28
	Ethnicity (Hispanic)	1.87	.01	1.85	-0.76	0.47	0.16, 1.40
	Employment (full-time, part-time, or self-employed)	1.08	.01	1.06	-0.29	0.75	0.43, 1.30
	Health care coverage (yes)	2.77 ^b	.01	2.73 ^b	0.08	2.22	0.86, 5.70
	Multiple chronic health care conditions (yes)	1.34	.01	1.34	0.29	1.33	0.82, 2.16
	Numeracy test score	0.87	.01	0.87	0.04	1.04	0.95, 1.14
	eHEALS test score	9.42 ^c	.05	8.92 ^c	0.07	1.07	1.03, 1.12
Multivariate model	Overall model	31.23 ^d	.15				
	Education level (college degree)			4.19 ^a	-0.68	0.51	0.27, 0.97
	Race (White)			13.71 ^d	1.10	3.00	1.68, 5.37
	eHEALS test score			10.48 ^c	0.08	1.09	1.03, 1.14

^a $P < .05$.^b $P < .10$.^c $P < .01$.^d $P < .001$.**Table 4.** Analysis of predictors of lab test comprehension ($n=276$).

Model	Predictor	Model χ^2	McFadden's r^2	Wald χ^2	β	95% CI
Bivariate prediction	Age	11.46 ^a	.01	3.59 ^a	0.01	0.01 to 0.02
	Gender (male)	3.73 ^b	.01	3.76 ^b	-0.03	-0.07 to 0.01
	Education level (college degree)	0.19	.01	0.19	0.01	-0.03 to 0.05
	Race (White)	4.64 ^c	.01	4.71 ^c	0.04	0.01 to 0.08
	Ethnicity (Hispanic)	0.02	.01	0.02	-0.01	-0.08 to 0.07
	Employment (full-time, part-time, or self-employed)	3.42 ^b	.01	3.42 ^b	-0.04	-0.07 to 0.02
	Health care coverage (yes)	3.14 ^b	.01	3.14 ^b	0.06	-0.01 to 0.13
	Multiple chronic conditions (yes)	0.45	.01	0.45	-0.12	-0.05 to 0.02
	Numeracy test score	4.08 ^c	.01	4.08 ^c	0.01	0.01 to 0.01
	eHEALS test score	0.27	.01	0.27	0.01	-0.01 to 0.01
Multivariate model	Use of patient portals for lab values (yes)	14.12 ^a	.02	14.55 ^a	0.07	0.03 to 0.10
	Overall model	27.36 ^a	.06			
	Use of patient portals for lab values (yes)			12.88 ^a	0.06	0.03, 0.10
	Age			13.03 ^a	0.02	0.01, 0.03
	Multiple chronic conditions (yes)			4.90 ^c	-0.04	-0.08, -0.01

^a $P < .001$.^b $P < .10$.^c $P < .05$.

of chronic health conditions and their reported use of patient portals. Compared to individuals with only 1 chronic condition, those with 2 or more had lower average lab test comprehension scores ($\beta = -0.68$, Wald $\chi^2 [1] = 4.90$, $P = .027$, 95% CI [-0.07, -0.01]) after controlling for age and patient use of portals. Similarly, use of patient portals was significantly and positively associated with lab test comprehension in the model ($\beta = 0.06$, Wald $\chi^2 [1] = 12.88$, $P < .001$, 95% CI [0.03, 0.10]). These 3 variables in the model collectively explained about 6% of the variance in lab test comprehension with no issues with multicollinearity (tolerance > 0.905 , VIF < 1.10).

Discussion

Main findings

Various studies have reported that the ability to view laboratory and radiology test results is the most useful and popular feature of patient portals.^{9,12,13} But, while there is ample research on the use of patient portals, there is still a dearth of

research focusing on the use of these systems specifically for accessing lab test results. Our findings provide insight into the relationships between patient portal use for viewing lab test results, lab test comprehension, and other factors. The study also sheds light on why patients may not use patient portals to view lab results, despite the advantages of having direct access.

Like previous research, our study found that patient portals was the primary means that our sample accessed their lab test results (60.4% of all participants). In the overall logistic regression model, not having a college degree, identifying as White, and higher eHealth literacy were the only variables found to be significantly associated with patient portal use for accessing lab test results. The results on race and eHealth literacy align with previous research. But there is a need for future research to confirm or explain why the participants with a college degree in our sample were less likely to use patient portals to view lab test results. This result contradicts earlier studies that found more education greatly increases the likelihood of using patient portals in general.^{21,22,41,42}

Overall, while the regression analysis indicated no significant age-related differences in patient portal use, the descriptive analysis revealed some interesting age-related trends. For example, patient portals were the most common modality for receiving lab test results for those with multiple chronic conditions and for older adults aged 55+ years. On the other hand, younger adults and those without multiple chronic conditions usually receive lab test results during doctor visits. In our study, the most common way by which younger and middle-aged adults learned about *abnormal test results* was during follow-up visits with their doctors, while older adults typically received information about abnormal test results through patient portals. Interestingly, while younger adults had higher mean eHealth literacy scores compared to older adults, they were more inclined to use conventional means to access their lab test results. However, in a cross-sectional survey of 340 emerging adults (ages 18-29 years), Wright et al.¹² found that patient engagement and total number of health care encounters were the only significant predictors of patient portal use in this group. In our study, we found that a significant proportion of young (18-34 years) and middle-aged (35-54 years) adults were less inclined to use patient portals, except when their lab results were abnormal. Overall, these results suggest the need to assess other potential predictors of patient portal use for viewing lab test results (eg, patient activation, physician recommendation, perceived benefits, etc.) especially among different user groups.^{21,22}

Although participants typically accessed their lab test results via patient portals, most *preferred* to receive lab test results through traditional methods (eg, through their doctors or via email). In fact, a preference for having their doctor explain the results to them in person was also reported as a significant *barrier* to using patient portals for viewing lab test results across all age groups.

Additional analyses were conducted to determine factors associated with lab test comprehension. Among the variables that indicated individual significant bivariate relationships with lab test comprehension (ie, older age, gender, White, employment, and numeracy scores), only age was found to be a significant predictor in the final multivariate model. We found that older patients, those with fewer chronic conditions, and those who use patient portals for viewing lab test results typically had higher lab test comprehension scores. It is reasonable to assume that older individuals are better able to comprehend lab test results because they may have had more experience viewing them. We also expected that those with multiple chronic conditions are likely to get lab tests done more regularly, so they should be able to understand them better over time. However, we found the opposite in our study—controlling for age and patient portal use, those with fewer chronic conditions had higher comprehension scores. These findings seem contradictory, as older adults typically have more chronic conditions. Future research is needed to further test these associations or to tease out individual difference variables that may influence lab test comprehension. For example, known predictors of health behaviors and health maintenance behaviors (eg, health beliefs and motivations, perceived susceptibility, perceived risk, social determinants of health, among others) may also influence lab test comprehension or the propensity to use patient portals to view lab tests.

We also found that, controlling for age and number of chronic conditions, patient portal users had higher lab test

comprehension scores. One way to interpret this finding is that patient portal users generally have greater aptitude for understanding lab test results, so they may be more comfortable viewing lab test results online. This implies that people who do not use patient portals to view lab tests are those who typically need more support to help them understand their lab test results. These may include higher need populations like individuals who are disadvantaged, less health literate, minorities, and those with multiple chronic conditions.

Even though older adults had relatively higher lab test comprehension scores, more older adults (55+ years) reported difficulty comprehending and reading lab test results online as a barrier to using patient portals compared to young and middle-aged adults. This suggests that a general aptitude for comprehending lab test results does not necessarily translate into greater confidence in understanding lab test results online.

Previous research indicates that most patients have difficulty understanding lab test results online and require additional explanations and informational support in order to use this information in more meaningful ways.⁴⁹⁻⁵¹ Studies also show that both patients and physicians are concerned that interpreting lab test results without contextual information may cause anxiety or confusion or limit their ability to act on them in a timely manner.^{50,52} Kelman et al.⁵⁰ found that physicians were concerned about patients' ability to understand false-negative and false-positive results, while patients expressed the desire to understand the meaning of results, how these relate to other tests, and what follow-up steps they need to take. In their study, Fraccaro et al.⁵³ found that most patients had difficulties interpreting lab test results, with 65% of participants underestimating the need for action. To address these issues, research has shown that comprehension of lab test results can be enhanced by providing patients with contextualized advice, recommendations to improve values, additional information, and follow-up advice.^{15,49,54,55} For example, Kopanitsa⁵⁶ found that patients who received automatically generated interpretations of abnormal test results (70%) had significantly higher follow-up rates compared to those who received test results without interpretations.

Overall, our results suggest that in order to improve the accessibility of lab test results online, the needs of patients who do not use patient portals or who typically have poorer understanding of lab test results (eg, non-White, low health literate, patients with multiple chronic conditions) should be considered. These findings support the Centers for Disease Control and Prevention (CDC) Clinical Laboratory Improvement Advisory Committee's recommendations, which emphasized the importance of using educationally, culturally, and linguistically appropriate formats to improve the comprehensibility of laboratory test results and to facilitate patient engagement through more equitable access to their health records.⁵⁷

Limitations

Notwithstanding these interesting findings, we acknowledge the following limitations. A more diverse sample and greater variance in the main predictors of interest could reduce potential bias and improve generalizability of the results. Participants recruited from crowd-sourcing research platforms like MTurk are typically reported as being predominantly younger, White, highly educated, and more technologically savvy. To address this issue, we used multiple strategies to

recruit participants. Prior research has shown that mixed-method recruitment is an acceptable and cost-effective way to improve participation in survey research.^{36,37} Studies have also shown that responses from participants recruited through MTurk and other online methods (eg, email, social media, flyers, etc.) are comparable or have negligible differences compared to other convenience samples.^{43–45} Because age was a primary variable of interest in our study, we also recruited older adults using the ISL Registry listserv to improve coverage and representation across age groups. While there was a low response rate using this method, this is typical for mailing list-based recruitment. Participants are slower to respond to listserv invitations compared to other methods; emails from listservs are commonly disregarded or flagged as spam; and some populations (eg, older adults, minorities) are less responsive to these.^{40,41,58} Due to the use of cross-sectional data, no causal relationships were examined or should be inferred from the results.

We also observed low variability in 2 predictors of interest: numeracy and eHealth literacy. Despite this, compared to participants from previous research, our participants had relatively lower numeracy and eHealth literacy scores. The mean numeracy score in our study (10.79; SD=±2.71) was comparable to or lower than those from other studies, which ranged from 9.83 to 13.52 (SD range=±3.85 to ±4.21).⁴⁷ Also, the mean eHealth literacy (eHEALS) score for our study (23.8; SD=±5.48) was significantly lower than related studies, which ranged from 30.34 to 30.94 (SD range=±5.3 to ±6).^{59–61}

Previous studies have found a significant association between health literacy and patient portal use. However, while we measured health literacy using a 3-item measure for health literacy developed by Chew et al,⁶² it did not demonstrate good internal consistency reliability for this study. For this reason, we used eHEALS in combination with health numeracy to measure 2 dimensions of health literacy that are more relevant to digital health contexts. We had considered using other health literacy measures like Rapid Estimate of Adult Literacy in Medicine,⁶³ Test of Functional Health Literacy in Adults,⁶⁴ and Newest Vital Sign,⁶⁵ but these are difficult to administer online because they are either too long or were originally designed to be administered in clinical settings to help identify patients with inadequate or marginal health literacy.

Lastly, there may be other factors that can better explain the variance in lab test comprehension scores. For example, future research can measure or control for other health-related or motivational variables that can influence patients' understanding of and engagement with their lab test results such as frequency of lab tests done, family health history, perceived susceptibility or risk, patient activation, among others.

Conclusions

While providing direct access to patients to their lab test results through patient portals is critically important and federally mandated, concerns about the ability of patients to interpret results accurately persist. Patient portals pose a wide range of literacy and cognitive demands that limit the ability of at-risk and vulnerable populations to fully benefit from online access.

This study affirms previous research highlighting the need for innovative approaches to enhance the comprehensibility

of lab test data in patient portals. These strategies, however, should not only focus on improving the visualization of lab test results and the usability of patient portals but also on helping patients with different literacy levels, needs, and challenges understand and gain more meaningful insights from personal health information accessed through these systems. To this end, advances in computational sciences present exciting opportunities to develop innovative strategies for improving this process. For example, our recent work suggests that generative large language models could be used to generate contextualized interpretations of lab results tailored to patients' needs and skill levels.⁶⁶ Such solutions may not only help improve patients' comprehension of their lab results but also facilitate more meaningful discussions with their doctors about how to manage chronic conditions better.

Author contributions

Mia Liza A. Lustria (Conceptualization, Formal analysis, Investigation, Methodology, Supervision, Writing—original draft), Obianuju Aliche (Data curation, Formal analysis, Investigation, Writing—original draft, Writing—review & editing), Michael O. Killian (Formal analysis, Methodology, Writing—review & editing), and Zhe He (Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Supervision, Writing—original draft, Writing—review & editing)

Supplementary material

[Supplementary material](#) is available at *JAMIA Open* online.

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Conflicts of interest

None declared.

Data availability

The data underlying this article are available upon request.

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