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BRIEF REPORT

"Tweak Your Order Set!" Implementation of Modified Laboratory Order Set Improves Hepatitis C Virus Screening Rates in People Living With Human Immunodeficiency Virus

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There are several barriers to annual hepatitis C virus antibody (HCVAb) testing, including lack of provider knowledge of the changing HCV epidemic and provider underestimation of a patient's risk. We identified low rates of testing for HCVAb in people living with human immunodeficiency virus (HIV) in our outpatient HIV Infectious Diseases clinic, and we developed a quality improvement project to increase rates of HCVAb screening.

Keywords. hepatitis C virus; HIV; quality improvement; screening; HCV antibody.

The incidence of hepatitis C virus (HCV) in people living with human immunodeficiency virus (PLWH) is increasing, especially in men who have sex with men (MSM) [1–6]. Human immunodeficiency virus (HIV)-care guidelines recommend annual HCV antibody (HCVAb) testing in people with ongoing risks, including people who report injection drug use and MSM [7, 8]. Despite these recommendations, HCV screening rates remain low in PLWH [9–14]. Barriers to annual HCV screening include patient underreporting of risk behaviors and increasing burden on clinicians to keep track of recommended annual infectious (eg, syphilis and tuberculosis) and noninfectious (eg, malignancy, diabetes, kidney disease) screening tests [2, 14, 15].

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In a retrospective analysis of PLWH seen in our clinic, we identified a low rate of new HCV infections (0.46/100 person-years), suggesting a low rate of screening for new HCV infections [10]. In this cohort, less than two thirds of those with negative HCVAb had repeat HCVAb screening as recommended in national guidelines. In this study, we report the results of a quality improvement project in which physician education and a change in an electronic medical record ordering system dramatically improved HCV screening rates.

METHODS

We have previously reported the results of a retrospective study of HCV screening rates in our Infectious Diseases (ID) clinic [10]. This cohort was composed of 359 HCVAb-negative PLWH who were seen in our clinic, and there were 7 incident HCV infections. After publication of the data, we identified another incident case, and we found another patient who vacillated between "equivalent" HCVAb result and "negative" result in the setting of a low CD4 count. The remaining 350 patients were the focus of our current study; they were followed through the intervention for 24 months.

After review of the SQUIRE 2.0 guidelines and HIV/HCV and HCV screening literature, we devised a 2-pronged strategy for improving HCVAb screening rates in PLWH [16]. Our intervention consisted of 2 parts: (1) changes to the outpatient electronic laboratory ordering system (eClinicalworks) and (2) education of providers. We worked with the Information Technology group at our hospital to modify the automated order set for follow-up visits to include HCVAb (Figure 1). The new order set was activated on January 1, 2014. In early January 2014, we circulated an e-mail with the updated guidelines promoting annual HCVAb testing in PLWH and informed providers of the changes to order set. We also held conferences in January 2014 and January 2015 to review these guidelines and discuss interval results after implementation. The Tufts Health Science Institutional Review Board granted an exemption as a quality improvement study.

Assessing the Impact of Intervention

We calculated the proportion of patients receiving HCVAb testing for the 4 years before the intervention and the 2 years after the intervention. This proportion was calculated as the number of patients who received HCVAb testing over the number of patients seen in clinic and due for HCVAb screening in that year. We also calculated and compared the annual incidence rate of new HCV infection based on the amount of time each patient was followed in clinic. The number of unnecessary tests—defined as having an HCVAb test performed on a patient

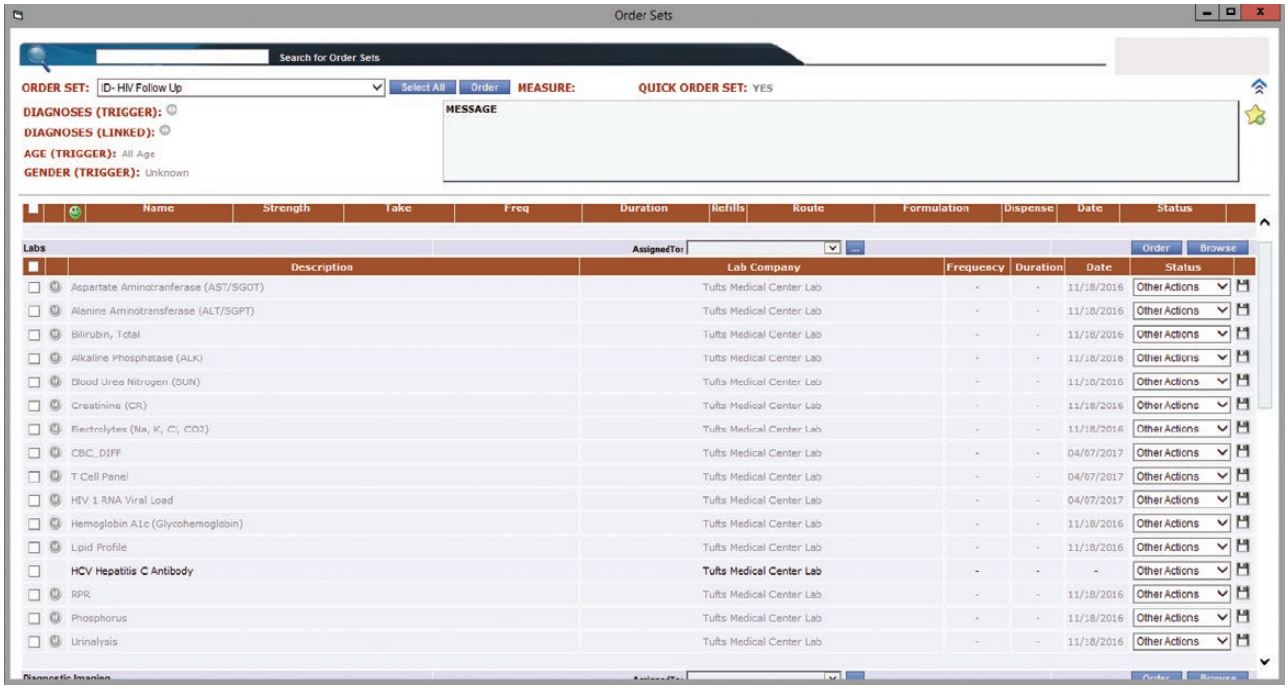

Figure 1. Modified human immunodeficiency virus (HIV) follow-up order set. HCV, hepatitis C virus; RNA, ribonucleic acid; RPR, rapid plasma regain.

with a previous HCVAb-positive test—were compared before and after the intervention and by provider. Due to the small sample sizes, we used the Mann-Whitney *U* test. Similar to our previously published analysis, we used logistic regression models to determine characteristics associated with the outcome of HCVAb testing [10]. The first model used univariate logistic regression and examined independent variables including the following: sex, age, gender/sexual preference (MSM, non-MSM males, women), race (white or not white), time observed in the clinic before intervention, number of clinic visits during the intervention, history of positive syphillis (+rapid plasma reagin [RPR]) result. For the multivariable model, we based our variable selection on an a priori conceptual framework used in our previous study [10]. Statistical significance was determiend based on $P < .05$. All statistical analyses were conducted using Stata (version 13.1; StataCorp, College Station, TX).

RESULTS

The cohort was 57% white and 80% male. 74% of the males were MSM. Fifteen percent of the cohort had a history of a +RPR. The median length of time followed in clinic preintervention was 6.9 years, and 90% had an undetectable HIV viral load. There was no change in the median number of visits per patient in the 2 years before the study period compared with the study period (14 vs 13; $P = .45$; Mann-Whitney *U* test).

In the 2 years after implementation, 287 of the original 350 patients (82%) had clinic visits. Of the subset with visits, 229 (80%) were screened for HCVAb in either 2014 or 2015. The majority of patients were screened in both 2014 and 2015 (143 of 229, 62%). There were 7 confirmed incident cases of HCV infection in 2 years (3.1% HCV incidence, 1.57 new cases per 100 person-years). Five of the 7 patients with incident HCV (71%) were MSM, and 3 patients had spontaneous clearance of the virus. The 4 patients with chronic HCV were referred into treatment.

Table 1 displays the results of the univariate and multivariable analysis of factors associated with testing for HCVAb preintervention and postintervention. In contrast to our previously published analysis, several patient characteristics including race, MSM, and history of +RPR were no longer associated with screening for HCVAb in either the univariate or multivariable model. Younger age and increased number of visits remained associated with screening for HCVAb.

The percentage of the patient population tested per year increased from an average of approximately 11% in the 4 years before quality improvement implementations to 54% in the 2 years after implementation. The majority of patients (75% in 2014 and 60% in 2015) were screened in the first half of the year. When examining the ratio of necessary to unnecessary testing, there was no statistical difference preintervention compared with postintervention with an overall average of 5.9 necessary tests ordered for every unnecessary test ordered ($P = .64$; Mann-Whitney *U* test) (Figure 2). There was one provider who frequently ordered unnecessary HCVAb tests, and this provider accounted for over half of all unnecessary ordered tests before and after the intervention, respectively.

Table 1. Factors Associated With Being Tested for HCVAb in 2014 or 2015 and Compared With Preintervention[a]: Results of Univariate and Multivariable Logistic Regression Analyses

	Univariate			Multivariable			Multivariable, Preintervention[a]		
Associated Factors	n	OR (95% CI)	*P* Value[b]	n	OR (95% CI)	*P* Value[b]	n	OR (95% CI)	*P* Value[b]
Sex									
Female	62	Referent							
Male	225	0.93 (0.44–1.85)	.85						
Gender/Sex Preference			.43						
Female	62	Referent		62	Referent		70	Referent	
Male, non-MSM	61	0.68 (0.28–1.57)	.37	61	0.83 (0.31–2.17)	.70	78	1.88 (0.96–3.72)	.67
Male, MSM	164	1.07 (0.49–2.21)	.86	164	1.77 (0.68–4.59)	.24	211	2.62 (1.38–5.04)	<.001
Age (years)[c]	287	0.95 (0.92–0.98)	.002	287	0.94 (0.90–0.97)	<.001			
Race									
Not white	128	Referent		128	Referent		155	Referent	
White	159	0.78 (0.43–1.39)	.40	159	1.05 (0.48–2.29)	.90	204	0.72 (0.43–1.18)	.045
Time observed (years)	287	1.13 (1.01–1.27)	.041	287	1.16 (1.02–1.33)	.023	359	1.06 (.97–1.16)	.006
Total number of clinic visits in 2014 and 2015	287	1.13 (1.07–1.19)	<.00	287	1.13 (1.07–1.19)	<.001			
History of Positive RPR									
No history of +RPR	247	Referent		247	Referent		306	Referent	
History of +RPR	40	1.23 (0.54–3.16)	.65	40	0.61 (0.23–1.73)	.32	53	0.93 (0.50–1.78)	.08

Abbreviations: Ab, antibody; CI, confidence interval; HCV, hepatitis C virus; IDU, injection drug user; MSM, men having sex with men; OR, odds ratio; RPR, rapid plasma reagin.

[a]Wurcel, A et al. OFID 2016.[10]

[b]*P* value indicates the overall significance level of the 3-level independent variable.

[c]In the preintervention study, the associated factor for age did not meet the criteria to be included in the multivariable analysis.

DISCUSSION

We were able to effectively increase HCVAb screening in our ID clinic through education and simple modifications to electronic medical record laboratory ordering. The increase in HCVAb testing identified 7 incident HCV infections, and it tripled detection of HCV (annual incidence in our clinic 0.46 new cases/100 person-years before the quality improvement intervention to 1.57 cases/100 person-years postintervention).

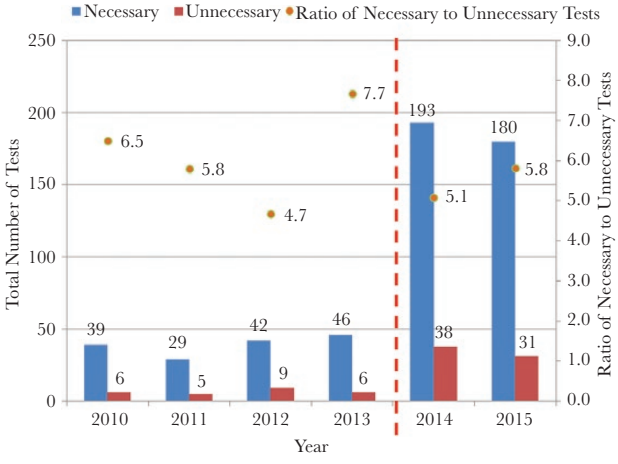

Figure 2. Balancing measures: necessary testing vs unnecessary testing. Ratio of necessary to unnecessary tests calculation example: in 2010, there were 39 necessary tests completed and 6 unnecessary; therefore, 39/6 = 6.5. Overall ratio of necessary to unnecessary tests is 5.9. The red dashed line indicates the time of implementation of the intervention.

After the intervention, race, MSM, and history of +RPR were no longer associated with increased odds of HCVAb screening. This would suggest that some of the risk assessment performed by providers was removed by the computer-based intervention, leading to more universal screening practices. Similar to preintervention, younger age remained associated with increased odds of HCV screening, suggesting that risk assessment based on age continued. Analysis of risk factors for HCV seroconversion in the Swiss Cohort of PLWH found no relationship between younger age and increased risk of incident HCV, further supporting that HCVAb screening should be provided to all patients in HIV clinics regardless of age [6].

Testing was clustered in the first part of the year, which may reflect the impact of January education of providers. The interventions led to an increase in unnecessary tests, although the ratio of necessary to unnecesseary tests did not change. Postintervention, there were approximately 34 HCVAb tests done each year on patients with known HCV—a rate of approximately 7 unnecessary tests ordered for every 100 patients per year seen at the clinic. This was the result of a failure to "un-check" laboratory tests that were not needed. The list price of the HCVAb at our institution was approximately $20. Considering that annual health costs of untreated HCV are estimated to be between $810 and $2575 per person depending on the extent of liver damage, the cost of unnecessary testing seems

small in comparison [17]. We observed high variability in the number of unnecessary tests by provider, with one provider responsible for 60% of unnecessary testing. Identification and education of outlier providers on appropriate ordering should reduce unnecessary HCVAb testing.

Limitations to the generalizability and utility of our study findings should be noted. Our clinic population had a median number of 13 visits over 2 years, which far exceeds the threshold definition of engagement in care, usually defined as having 2 visits in a year [18]. More frequent visits potentially allowed for more reminders that the patient was due for annual HCVAb testing. The high number of visits, which may reflect high rates of comorbid diseases, may limit the generalizability of our findings to other clinic populations who are seen less frequently. There are many different electronic medical records used at HIV clinics, and the modifications we made may not work well with other computer programs. In addition, although our intervention increased HCVAb screening, HCVAb will not detect incident HCV reinfection, which was reported to be as high as 25% in MSM in Western Europe [19]. Some clinicians have advocated for screening with HCV viral load or liver enzymes rather than HCVAb to address this issue [20].

CONCLUSIONS

Early diagnosis and treatment of HCV in people living with HIV will decrease morbidity, mortality, and slow the HCV epidemic. The success of our intervention is encouraging, and we hope that the lessons learned will spread to other HIV practices nationally and internationally.

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