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Implementation of an electronic medical record does not change delivery of preventive care for HIV-positive patients

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Abstract

Purpose—This study sought to determine the impact that an electronic medical record (EMR) had on the provision of preventive health measures—including obtaining serologies for viral hepatitis and administering vaccinations to non-immune patients—to HIV patients at a hospital-based clinic.

Methods—Using a pre-post study design, we compared rates of preventive health delivery to HIV patients at an outpatient clinic during the use of a paper medical record (PMR) and after implementation of an EMR. Retrospective chart reviews were conducted at two time points: 12-16 months prior to and 24 months following EMR implementation. The records of 160 active patients were randomly selected for review during both time periods.

Results—There was no difference between the PMR and EMR samples with regard to the proportion of patients who had Hepatitis A (83% in PMR group; 77% in EMR) and Hepatitis C (94% in both groups) serologies measured or the proportion of eligible patients who were given hepatitis vaccinations. Slightly fewer patients had a serology for Hepatitis B measured in the EMR sample.

Conclusions—As EMR implementation expands, it is important to evaluate the effects that EMRs have on patient outcomes, including preventive health provision. Our study showed that after implementation of an EMR, the provision of most preventive care measures did not improve. This finding is in agreement with many published studies. Some studies have found positive

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effects from EMRs that may be attributable to specific aspects of EMRs. Further study of the effect of specific EMR attributes on health care outcomes is needed.

Keywords

HIV; preventive health services; physicians' practice patterns; medical records systems, computerized; reminder systems

INTRODUCTION

Optimal care of HIV-positive persons requires obtaining and evaluating numerous laboratory test results, and administering appropriate vaccinations and other prophylactic measures. HIV-positive persons are at increased risk for adverse health outcomes due to at least three mechanisms: (1) acquiring other infectious illnesses through the same route of transmission by which they were infected with HIV, most commonly sexual activity and injection drug; (2) being at greater risk for developing opportunistic infections and malignancies as a result of HIV's deleterious effect on the immune system; and, (3) developing adverse health outcomes related to the use of antiretroviral therapy, such as hyperlipidemia, diabetes, and heart disease.[1-3]

Clinicians caring for HIV -infected individuals must provide all preventive health measures recommended for HIV-negative individuals plus all of those measures that are specific to HIV-positive patients, as outlined in published guidelines.[4] Examples include: (1) screening for concomitantly transmitted infections, such as syphilis, and Hepatitis A, B, and C; (2) screening for exposure to potential opportunistic infections, such as toxoplasmosis; (3) screening for complications of anti-HIV therapies, such as hyperlipidemia and diabetes; (4) screening for cancers for which HIV patients are at elevated risk (e.g., cervical cancer); and, (5) administering vaccinations to prevent infections for which HIV-positive patients may be at increased risk or which may be worsened by being HIV-positive, such as Hepatitis A and B. Attention to preventive health is becoming increasingly significant in HIV patients. Advances in antiretroviral therapy have improved and lengthened the lives of people living with HIV. Life expectancies of HIV-infected individuals in developed nations are approaching those of the general population.[5-7] Thus, preventing other illnesses in HIV-positive patients is of utmost importance.

The provision of preventive health care measures in clinical practice is suboptimal. Rates of Hepatitis A and B vaccination in HIV-positive patients in whom vaccinations are indicated range from 23 to 28% and from 32 to 65%, respectively.[8-10] Undoubtedly, some clinicians may not be aware of, may not concur with, or may not adhere to the recommendations for these vaccinations.[11,12] However, even for those clinicians who are aware of the vaccination recommendations, critical clinical data must be available at the time of a patient encounter to allow clinicians to determine whether either vaccination is appropriate for an individual patient. The necessary data includes both the patient's vaccination history and laboratory data demonstrating whether the individual is already infected with the virus or whether he or she has been previously vaccinated against each infection. The type of medical record used by a clinic—paper medical records (PMR) or

electronic medical records (EMR)—may differ in how easily this data are accessed by clinicians.

To our knowledge, there have been no published studies evaluating the effect of EMR use on hepatitis serology attainment and hepatitis vaccination among HIV-positive patients. Some studies on EMRs have been conducted on other aspects of preventive care among HIV-positive patients. One study found significant increases in rates of screening for syphilis and cervical cancer, as well as for the administration of prophylactic medications to prevent opportunistic infections after implementation of an EMR with clinical decision support systems (CDSS)—electronic reminders and alerts for clinicians.[13] An earlier study demonstrated increased provision of vaccines against S. pneumoniae and H. influenza among HIV care providers who received electronic reminders suggesting vaccination in eligible patients.[14] However, data regarding the effects of EMRs on the quality of health care overall is mixed. Some studies have demonstrated positive effects of EMRs on some measures of quality [15-21] while many larger studies and reviews have found mixed results [22-27] or no positive effects of EMRs on quality outcome measures.[28-31]

Our study sought to determine the effect that an EMR (without CDSS) had on the provision of preventive health measures to HIV-positive patients at an outpatient, hospital-based clinic. We assessed rates of completion of preventive care measures before and after the implementation of an EMR.

METHODS

Using a pre-post study design, we compared rates of preventive health measure delivery to HIV-positive patients at an outpatient clinic during the use of a paper medical record (PMR) and after implementation of an EMR. Retrospective chart reviews were conducted at two time points: 12-16 months prior to and 24 months following implementation of the EMR. The records of 160 active patients were randomly selected for review from among all active HIV-positive clinic patients during the each of the two time periods.

We collected the following data from each patient record: demographic information; HIV risk factors; duration of HIV infection; type of insurance; nadir and most recent CD4 count; most recent viral load; and, current antiretroviral therapy. In addition, we also ascertained whether each patient had had a hepatitis A serology performed (if indicated, such as among men who have sex with men); the number of hepatitis A vaccinations that were given if the patient did not have evidence of immunity; whether a hepatitis B serology had been performed; and, the number of hepatitis B vaccinations given to each patient not immune to hepatitis B. Finally, we recorded whether a syphilis test and lipid panel had been performed on each patient during the prior 12 months. No data that could be used to identify an individual patient were collected.

The records of HIV-positive clinic patients were eligible for inclusion in the study if the patient had been receiving care at the clinic for more than 3 months, had had a clinic visit with an HIV provider within the prior 6 months, and was at least 18 years of age. The study protocol was approved by the Institutional Review Board at [Blinded Institution].

A total of 316 medical records were included in the study: 156 patients in the PMR group and 160 in the EMR group. Chi-square tests were used to evaluate differences between the two samples with respect to demographics, hepatitis A virus serology and hepatitis B virus serology attainment and vaccination rates, and lipid panel and syphilis screening rates. Multivariable logistic regression was performed to evaluate the EMR's effect on these medical care outcomes, controlling for demographic and other relevant variables (e.g., insurance status).

RESULTS

Patients whose records were included in the PMR and EMR groups were mainly demographically similar, as shown in Table I. There were no differences in the mean age, type of insurance, HIV risk factor, duration of HIV infection, or history of AIDS. There were racial differences between the groups. White patients represented 58% of the PMR group and 36% of the EMR group while African-Americans represented 34% of the PMR sample and 51% of the EMR sample ($p=0.001$). This difference reflected a change in the patient population observed at the clinic during the time between the two sampling periods. The mean CD4 count and the proportion of patients taking antiretroviral medications at the time of sampling were similar in the two samples. Table 2 shows the proportion of patients who received preventive health measures in each sample. In univariate analyses, the proportion of patients whose Hepatitis A and Hepatitis C serologies were obtained was similar in the PMR and EMR groups. A smaller proportion of patients had Hepatitis B serologies performed in the EMR group (91%) than in the PMR group (91% vs. 97%, $p=0.04$). However, in a multivariable analysis that controlled for race and insurance status, the effect of the EMR on obtaining Hepatitis B serology disappeared.

The rates of Hepatitis A and B vaccination among eligible patients were similar in the PMR and EMR groups. Among eligible patients, 64% were given at least one Hepatitis A vaccination in both groups. Of those patients eligible for Hepatitis B vaccination, 83% in the PMR group and 71% in the EMR group ($p=0.077$) were administered at least one Hepatitis B vaccine.

Among those patients on antiretroviral therapy within each group, the proportion of patients who had had a lipid panel drawn within 12 months was similar in the PMR and EMR groups. However, the number of patients screened for syphilis during the prior year was higher in the EMR than the PMR group (76% vs. 45%, $p<0.001$).

DISCUSSION

Our study evaluated the effect of the implementation of a passive EMR on the provision of preventive health measures for HIV-positive patients seen in an outpatient clinic. Several results from this study are notable. First, the prevalence of Hepatitis A and B vaccination among eligible patients, similar in both the PMR and EMR samples, were substantially higher than those published in prior research. Whereas published prevalence rates of Hepatitis A and B vaccination among eligible patients range from 23% to 28% and from

32% to 65%, respectively, this study found an overall vaccination prevalence of 64% for Hepatitis A and 77% for Hepatitis B.

Although these vaccination prevalence rates are higher than observed in other studies, the implementation of an EMR did not have any effect on vaccination administration. Similarly, there was no change in the attainment of lipid panels between the two sampling periods. Thus, the results for most of our outcome measures demonstrated no improvement with EMR implementation. Our findings are consistent with many studies of EMR effects on health care quality. While there are some studies which have found improvements with specific health outcomes measures [14-21], others have found that only some of the health measures studied showed improvement with EMRs [22-27]. Other studies, including the study with the largest sample size to date showed that there was no improvement in outcomes when an EMR was used.[28-31]

One notable difference between the PMR sample and the EMR sample in our study was that the rate of syphilis screening was significantly higher within the EMR sample. It is possible that the EMR allowed clinicians to more easily determine whether syphilis screening had been done in the previous year, a relatively short period of time. This may be in contrast to the type of information-seeking that is needed when a clinician examines a patient's medical record to determine whether hepatitis screening and vaccination had been performed. To determine whether a patient should be vaccinated, multiple steps of data searching are required. Clinicians must search for vaccination and lab data over an indefinite time period —essentially, the patient's lifetime—to determine whether a vaccination had ever been given and whether a patient's immunization status was later documented. Then, for patients who appear to be eligible to receive a vaccine, they must determine whether the patient had ever received that vaccine, and how many shots were given previously. Thus, the amount of skill and time required to determine vaccine eligibility can be greater than determining the last time a specific laboratory test was done.

Alternatively, this difference may have been due to changes in secular trends in clinicians' prioritization of syphilis screening between the two data collection periods, one of the inherent limitations of the study design employed in this project. Between the period in which PMR data collection was performed and when EMR data collection was performed, there was a 41% increase in syphilis cases in the state where this study was performed. [Blinded] Therefore, clinicians may have purposefully increased syphilis screening over that period of time.

The main limitations of this study are those inherent to the study design, a pre-post comparison. The rates of health maintenance provision in the EMR group were compared to a sample of patient records from an earlier time when a PMR was in use, and not with a contemporaneous cohort.

CONCLUSIONS

No differences for most preventive health measures were found between the EMR and PMR groups in this study. These findings provide additional evidence that EMR implementation

alone may not necessarily improve the provision of health prevention measures. The effects of electronic medical records on patient care need additional study. Specifically, to maximize the potential benefits of EMRs, additional research on the effects of particular aspects of EMRs and the way providers use EMRs is needed. Such data will allow healthcare systems to adopt or adapt EMR systems to produce the greatest benefit for patient outcomes.

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Table 1

Characteristics of study samples

	PMR (n=156)	EMR (n=160)	
Age (years)	44.59	44.54	t= 0.047; p= .963
Male	79.4%	73.8%	X^2=1.376; p=0.241
AIDS	60.6%	66.9%	X^2 = 1.323, p=0.25
Duration of HIV (years)	11.56	10.92	t = .891, p= .374
CD4 count (cells/mL)	514	506	t=0.238. p=0.812
On antiretrovirals	71.6%	69.4%	X^2=0.189, p =0.663
Race			
White	58.1%	35.6%	**X^2 = 18.15, p=0.001**
Black	33.5%	50.6%	
Latino	7.1%	11.3%	
Provider			
Staff Physician	57.4%	70.0%	X^2 = 5.429, p = 0.066
Fellow Physician	16.1%	11.1%	
Nurse Practitioner	26.5%	18.1%	
Insurance			
Medicare	30.3%	35.6%	**X^2 = 10.36, p=0.035**
Medicaid	15.5%	23.8%	
Private	49.7%	35.6%	
Other	4.5%	3.1%	
HIV Risk factor			
MSM	62.6%	50.6%	X^2=7.135,p=0.211
IVDU	5.8%	6.9%	
Heterosexual	25.8%	32.5%	

Statistically significant results are shown in bold.

Table 2

Provision of preventive health measures

	PMR (n=155)	EMR (n=160)	
Hepatitis A serology obtained	82.6% (128)	76.9% (123)	X^2=1.583, p=0.208
Hepatitis B serology	96.8% (150)	91.3% (146)	**X^2=4.239, p=0.040**
Hepatitis C serology	94.2% (146)	94.4% (151)	X^2=0.005, p= 0.945
If eligible, HAV vaccine given	64.2% (42/66)	63.6% (42/66)	X^2=0.003, p=0.954
If eligible, HBV vaccine given	83.1% (64/77)	71.3% (57/80)	X^2=3.127, p=0.077
Lipid panel within 1yr*	64.0%	64.9%	X^2=0.020, p=0.889
Syphilis screening (12m)	44.5% (69)	76.3% (122)	**X^2=33.22, p=0.000**

* If on antiretroviral therapy

Statistically significant results are shown in bold.