Results of a Rapid Hepatitis C Virus Screening and Diagnostic Testing Program in an Urban Emergency Department

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Study objective: We describe the results of an emergency department (ED) hepatitis C virus testing program that integrated birth cohort screening and screening of patients with a history of injection drug use, as well as physician diagnostic testing, according to national guidelines.

Methods: We conducted a retrospective cohort study using data collected as part of clinical care. The primary outcome was the hepatitis C virus prevalence among tested patients. We evaluated factors associated with testing positive with logistic regression.

Results: Of the 26,639 unique adults aged 18 years or older and presenting to the ED during the 6-month study, 2,581 (9.7%) completed hepatitis C virus screening (2,028) or diagnostic testing (553), of whom 267 were antibody positive (10.3% prevalence). Factors associated with testing positive for hepatitis C virus included injection drug use (38.4% prevalence; odds ratio [OR] 10.8; 95% confidence interval [CI] 7.5 to 15.5), homeless (25.5% prevalence; OR 3.1; 95% CI 1.5 to 6.8), diagnostic testing (14.8% prevalence; OR 2.6; 95% CI 1.7 to 3.9), birth cohort (13.7% prevalence; OR 3.6; 95% CI 2.4 to 5.3), and male sex (12.4% prevalence; OR 1.4; 95% CI 1.0 to 2.0). Of the 267 patients testing positive for hepatitis C virus antibody, 137 (51%) had documentation of result disclosure and 180 (67%) had confirmatory ribonucleic acid testing performed, of whom 126 (70%) had a positive result. Follow-up appointments at the hepatitis C virus clinic were arranged for 57 of the 126 (45%) patients with confirmed positive results, of which 30 attended.

Conclusion: This ED screening and diagnostic testing program found a high prevalence of hepatitis C virus antibody positivity across all groups. Challenges encountered with hepatitis C virus screening included result disclosure, confirmatory testing, and linkage to care. Our results warrant continued efforts to develop and evaluate policies for ED-based hepatitis C virus screening. [Ann Emerg Med. 2015;■:1-10.]

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INTRODUCTION

Background

Hepatitis C virus is the most common chronic bloodborne infection in the United States, affecting an estimated 3 million persons, and is a leading cause of end-stage liver disease, hepatocellular carcinoma, and liver transplants.[1,2] Since 1998, the Centers for Disease Control and Prevention (CDC) has recommended risk-based hepatitis C virus screening, which includes screening patients with a history of injection drug use, the risk group with the highest burden of infection, with a prevalence in most studies of 50% or more.[3,4] In the past few years, both the CDC and the US Preventive Services Task Force have expanded their hepatitis C virus screening guidelines to also include 1-time screening of persons born in the baby boom between 1945 and 1965 ("birth cohort").[4,5] It is estimated that the US prevalence of hepatitis C virus among persons born between 1945 and 1965 is 3% to 4%, that baby boomers account for 75% of persons living with hepatitis C virus infection, and that 1.25 to 1.75 million of them do not know they are infected.[5]

Urban emergency departments (EDs) may play an important role as safety net providers for hepatitis C virus screening because many of the 3 million Americans infected with the virus are unaware of their status, and studies have shown high rates of ED utilization among this population.[1,6-8] Until recently, however, recommendations for hepatitis C virus screening have been impractical for EDs. With advances in rapid hepatitis C virus testing technology, the development of new therapies that can halt disease progression and provide virologic cure, and health care reform that provides reimbursement for selective screening, there has been a renewed movement supporting hepatitis C virus screening in a variety of health care

Editor's Capsule Summary

What is already known on this topic

The Centers for Disease Control and Prevention recommends hepatitis C screening for intravenous drug users and individuals born between 1945 and 1965, but few emergency departments (EDs) currently do so.

What question this study addressed

Hepatitis C antibody results were retrospectively studied at a busy urban ED after initiation of a triage-based screening program. Barriers to screening, result disclosure, and follow-up are discussed.

What this study adds to our knowledge

Among 26,639 visits during 6 months, 2,581 antibody tests were performed; 267 (10.3%) were positive. Of 180 ribonucleic acid tests for active infection, 126 were positive, and 30 patients (1.2% of all tested) attended an appointment in the hepatitis C clinic.

How this is relevant to clinical practice

Urban EDs may find a high prevalence of hepatitis C but will likely encounter similar challenges to implementing screening and linking patients to follow-up.

settings, including EDs.[9-12] Although clinical experience is limited, one recent study showed that ED birth cohort screening is feasible and high yield, with a reported prevalence of 11%.[13]

In April 2014, we implemented an ED-based screening program for both HIV and hepatitis C virus into our triage processes according to CDC and US Preventive Services Task Force recommendations.[4,5] As an adjunct to screening, physicians could order HIV and hepatitis C virus diagnostic testing when clinically indicated. To our knowledge, this is the first program to integrate into ED triage processes both nontargeted HIV screening and targeted hepatitis C virus screening for the birth cohort, as well as patients with a history of injection drug use.

Importance

Evaluation of novel clinical programs with public health consequences is important to inform best practices, define policy, and serve as a foundation for screening program refinement, expansion, and dissemination.

Goals of This Investigation

Because the clinical experience with hepatitis C virus screening in EDs is limited, the goals of this investigation are to report the results of the hepatitis C virus portion of our screening program.

MATERIALS AND METHODS

Study Design

This is a descriptive analysis of the results of a clinical protocol integrating screening for HIV and hepatitis C virus into ED services. The outcomes of the first 6 months of hepatitis C virus screening and diagnostic testing are reported. The study received institutional review board approval from the Alameda Health System, with a waiver of written informed consent. We adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cohort studies.[14]

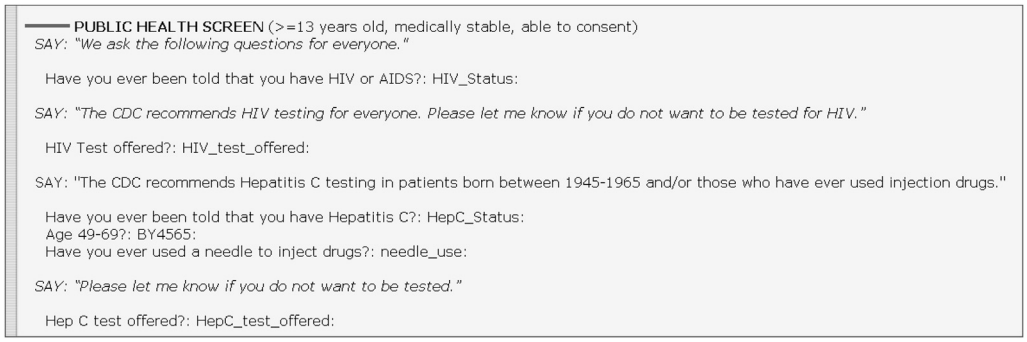
Setting

The study was conducted at the Highland Hospital–Alameda Health System, a single-center urban ED that supports an emergency medicine residency and serves predominantly adult patients of racial and ethnic minorities. The annual ED census is approximately 90,000 patients. Two percent of patients are younger than 12 years; approximately 45% are black, 30% are Hispanic, and 20% are white; and approximately 44% are female patients. Approximately 85% of patients have public insurance, 10% are uninsured, and 5% have private insurance. Patients presenting for emergency care are triaged in a nonprivate centralized area and designated for treatment in either the main ED (70%) or the fast-track/urgent care (30%). The 2 sites, collectively referred to as the ED, share a common staff consisting of attending and resident physicians, physician assistants, nurses, and technicians.

Selection of Participants

Participants were eligible to be offered hepatitis C virus screening by the triage nurse if they were born between 1945 and 1965 or if they reported ever using injection drugs. Eligible patients were also required to be medically stable, to be competent to complete verbal consent, and not known to be hepatitis C virus positive. Eligibility was determined by triage nurse assessment.

ED screening was integrated into the triage process as a recommended, nonmandated, clinical policy. The triage template of the ED electronic medical record (Wellsoft Corporation, Somerset, NJ) was modified to include specific prompts (Figure 1). Guided by these prompts, triage nurses determined patient eligibility, completed a


PUBLIC HEALTH SCREEN (>=13 years old, medically stable, able to consent)
SAY: "We ask the following questions for everyone."

Have you ever been told that you have HIV or AIDS?: HIV_Status:

SAY: "The CDC recommends HIV testing for everyone. Please let me know if you do not want to be tested for HIV."

HIV Test offered?: HIV_test_offered:

SAY: "The CDC recommends Hepatitis C testing in patients born between 1945-1965 and/or those who have ever used injection drugs."

Have you ever been told that you have Hepatitis C?: HepC_Status:
Age 49-69?: BY4565:
Have you ever used a needle to inject drugs?: needle_use:

SAY: "Please let me know if you do not want to be tested."

Hep C test offered?: HepC_test_offered:

Figure 1. Nurse triage template: HIV and hepatitis C virus screening questions.

series of screening questions, and offered screening for HIV, hepatitis C virus, or both, depending on patient responses. The protocol designated nontargeted HIV screening for patients older than 13 years and targeted hepatitis C virus screening for the subset of patients born between 1945 and 1965, as well as for patients who answered affirmatively to having ever used a needle to inject drugs. Consent for screening was opt out, verbal, and documented in the electronic medical record. For consenting patients, triage nurses electronically ordered screening tests. Screening tests ordered by nurses were visible to physicians in the "Order" field of the electronic medical record. Physicians could order hepatitis C virus tests as part of a hepatitis panel or as a rapid hepatitis C virus antibody test at their clinical discretion. The indications for physician diagnostic testing included, but were not limited to, the evaluation of jaundice, abnormal liver function test results, cirrhosis, and confirmation of patient self-reporting of hepatitis C virus infection. Blood was then obtained with existing staff and standard procedures, and specimens were processed in the hospital laboratory. After receipt of the samples, the laboratory estimated that turnaround time was 1 to 1.5 hours.

Training for the nurses consisted of presentations on the specifics of the program during daily preshift meetings conducted by study investigators. Study staff also met individually with triage nurses to review the screening protocol, and a database was kept to ensure that all nurses' training completion was documented. Nurses were also directly observed by study staff during the first 4 weeks of program implementation, with sporadic on-the-job training to ensure continued compliance. Training for physicians consisted of a 30-minute lecture during staff meeting and departmental grand rounds on the program specifics and indications for physician diagnostic testing.

To minimize disruption of ED flow, providers were not required to disclose negative test results and patients were not required to wait for results before discharge. Laboratory technicians notified the attending emergency physician about all positive test results (whether or not patients were still in the department). When possible, results were disclosed at the bedside with the aid of an informational packet that outlined the procedures for disclosure, counseling, confirmatory testing, and linkage to care. Physicians were instructed to complete a newly hepatitis C virus–positive patient intake form that included write-in fields for patient contact information and check boxes for whether the result was disclosed and a follow-up appointment was scheduled. Intake forms were placed in a secure cabinet for research staff. Physicians were also instructed to document any hepatitis C virus result disclosure in the electronic medical record. After disclosure, all patients with a positive hepatitis C virus antibody test result had blood drawn for confirmation, with a quantitative polymerase chain reaction test to detect hepatitis C virus ribonucleic acid (RNA) (Quest Diagnostics, San Juan Capistrano, CA). Patients with positive hepatitis C virus antibody test results who were discharged before result availability were contacted by telephone by the program coordinator, who disclosed the results and made arrangements for confirmatory testing and linkage to care. The program coordinator made 4 attempts at telephone contact, and if contact could not be made, the coordinator added an automated chart flag to the electronic medical record, alerting clinicians that the patient had been discharged without disclosure or confirmatory testing. These flags followed the patient from visit to visit and could be easily viewed if the patient presented to the ED at a later date. The flag was visible only in the ED electronic medical record; the inpatient medical record is a distinct program that does not support such an alert. No attempts were made to contact patients testing hepatitis C virus antibody negative who were discharged before results were available. All disclosure data were kept in a single encrypted file in the locked research office.

At the beginning, patients with positive hepatitis C virus antibody were referred to primary care for immediate

follow-up, and the program coordinator assisted with linking them to the medical center's hepatitis C virus clinic once the test result was RNA confirmed. In October, process improvements enabled ED clerks to make up to 5 hepatitis C virus clinic appointments each week for patients newly identified as being positive for hepatitis C virus antibody. Clinic appointments could be cancelled if confirmatory RNA test results were negative.

Screening and diagnostic testing for hepatitis C virus was not free to patients. Ordering was linked to billing codes in a manner similar to that used for other tests ordered for clinical care.

Data Collection and Processing

At the visit, triage nurses recorded the following information in specific fields that were incorporated into the triage template of the electronic medical record: whether patients reported known hepatitis C virus infection, whether they were born between 1945 and 1965 or had ever used injection drugs, and whether hepatitis C virus testing was offered and accepted. These data, as well as data routinely collected during an ED visit, including demographic information (age, sex, race, and ethnicity), housing status (homeless or address listed), and insurance status (Medicaid, Medicare, private, uninsured/self-pay, and other), were exported to spreadsheets (Microsoft Excel 2007; Microsoft, Redmond, WA). Patient-specific laboratory data, including results of hepatitis C virus screening, physician diagnostic hepatitis C virus testing, and confirmatory RNA testing, were captured from the laboratory electronic medical record (Novius; Siemens Healthcare, Malvern, PA) and linked to the spreadsheet by patient account numbers unique to each visit.

Patients who had both a screening and diagnostic test ordered during the study period were classified as completing screening to more accurately reflect all patients captured by the triage-based screening program. For each patient with a hepatitis C virus antibody positive test result, study investigators (D.A.E.W., E.S.A., and S.K.P.), who were not blinded to the purpose of the study, reviewed their newly hepatitis C virus–positive patient intake form, as well as the physician notes section of the electronic medical record, for all visit dates during the study period to determine whether the patient had previous knowledge of hepatitis C virus infection and whether results were disclosed. Follow-up information was obtained from review of clinic intake records and entered into the spreadsheets by the program coordinator, who then stripped patient identifying information and assigned each visit a unique study number. When nurses did not document injection drug use in our data set, we considered that patient status to be unknown. Multiple investigators reviewed a proportion of charts, but Cohen's κ was not calculated for these variables. Any missing data were addressed by individual chart review by study investigators, and discrepancies in data abstraction were reviewed as a group and decided on by consensus.

Outcome Measures

The primary outcome was the proportion of hepatitis C virus–tested patients with positive antibody results. The secondary outcome was the proportion of unique, adult ED patients aged 18 years or older for whom hepatitis C virus screening and diagnostic testing was completed. For patients who were tested more than once during the project period, we assessed the median number of tests and median time in months between tests. For patients testing hepatitis C virus antibody positive, we assessed the proportion who were previously known to have a positive status, the proportion to whom a result was disclosed during the index ED visit or delayed (either by telephone or at a subsequent visit), the proportion who had confirmatory hepatitis C virus RNA testing performed during the index ED visit or delayed (at a subsequent visit), and the proportion with positive hepatitis C virus RNA test results. Last, we evaluated the proportion of patients with positive hepatitis C virus RNA test results who successfully received follow-up care (defined as attending at least 1 visit for care at the medical center's hepatitis C virus clinic) and the median time in days from the index visit hepatitis C virus antibody test to follow-up.

Primary Data Analysis

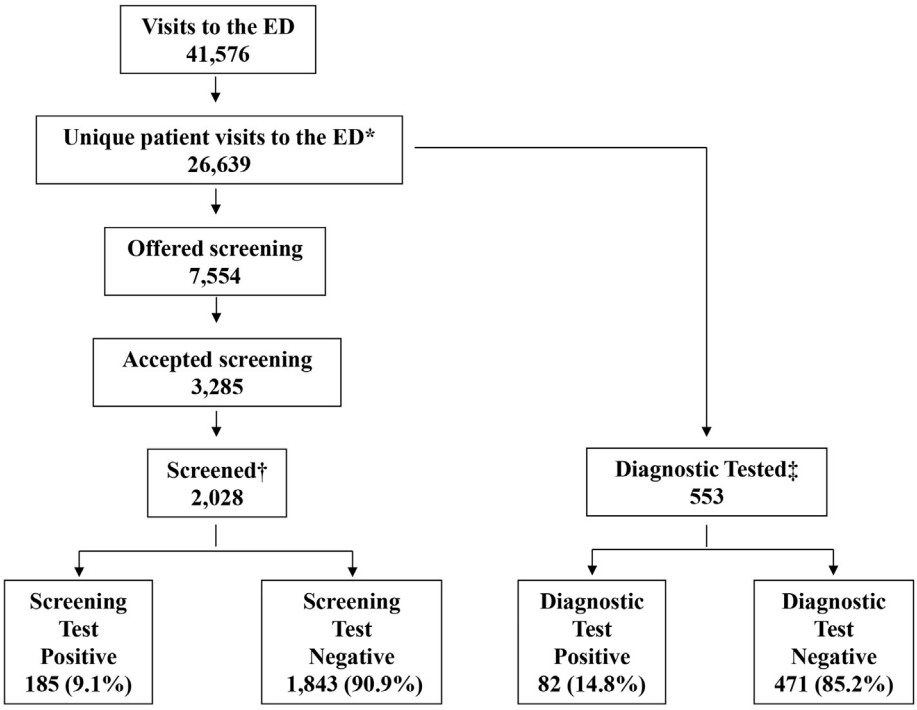
Descriptive analyses were performed for all variables, and unique patient data, rather than visit-level data, are presented. Continuous data are reported as medians with interquartile ranges (IQR) or means with SDs and categorical data are reported as percentages. Bivariate analyses were performed to explore the relationships between various patient and ED visit characteristics and testing positive for hepatitis C virus antibody. We then specified logistic regression models to explore relationships between clinically relevant variables excluding subjects with missing injection drug use data, using hepatitis C virus antibody positive as the dependent variable. We performed no a priori sample size calculation because this was a descriptive analysis of a clinical protocol. All statistical analyses were performed with Stata (version 13; StataCorp, College Station, TX).

RESULTS

Figure 2 shows the flow of screening and results of screening and diagnostic hepatitis C virus testing. From April 17 through October 31, 2014, the medical center recorded 41,576 visits to the ED by 26,639 unique patients aged 18 years or older. Triage nurses excluded 742 patients who reported being hepatitis C virus positive. Other potential reasons for exclusion (eg, medically unstable, not competent to complete verbal consent), as well as the potential reasons hepatitis C virus screening was not offered to eligible patients (eg, being too busy, forgetting, and being uncomfortable asking the screening questions) were not recorded. Overall, 9.7% (2,581/26,639) of the unique, adult ED census completed hepatitis C virus screening and diagnostic testing, and the prevalence of hepatitis C virus antibody positivity was 10.3% (267/2,581). Of the 2,581 hepatitis C virus antibody tests completed, 2,028 (79%) were screening tests and 553 (21%) were diagnostic tests. The hepatitis C virus positivity rate for screening was 9.1% (185/2,028) compared with 14.8% (82/553) for diagnostic testing (difference 5.7%; 95% confidence interval [CI] 2.5% to 8.9%; $P<.001$).

Table 1 shows the demographics and characteristics of patients undergoing hepatitis C virus screening and diagnostic testing. Triage hepatitis C virus screening was offered to 7,554 of the 26,639 unique, adult patients (28%), of whom 3,304 were outside of the birth cohort and 5,446 denied using injection drugs; accepted by 3,285 patients (43% of those offered); and completed by 2,028 patients (62% of those accepting). The prevalence of hepatitis C virus antibody positivity exceeded 5% in nearly all demographic and risk groups. Six hundred thirteen patients outside of our prespecified targeted risk groups also received triage-based screening; the hepatitis C virus prevalence for patients outside the birth cohort and who did not have a history of injection drug use was 2.6%. For the 64 patients screened more than once, the median number of hepatitis C virus screening tests performed was 2 (range 2 to 4 tests), with a median of 51 days (IQR 24 to 93 days) between tests.

In our logistic regression models, we selected covariates based on known risk factors for hepatitis C virus, as well as the results of our bivariate analyses. We chose not to include insurance status in our logistic regression model because 80% of our patients were enrolled in Medicaid and because the insurance market conditions in our area are relatively atypical. Additionally, 585 patients with unknown injection drug use status were excluded from the model. Inclusion of "injection drug use unknown" as a covariate in the logistic regression, however, had no



*Data for unique patients ≥18 years of age
†Includes 25 patients who also completed diagnostic testing at a separate visit
‡Testing was initiated by physicians on the basis of perceived Hepatitis C virus risk behaviors or clinical manifestations of infection.

Figure 2. Hepatitis C virus screening and diagnostic testing, April 2014 to October 2014. *ED*, Emergency department.

Table 1. Results of hepatitis C virus screening and diagnostic testing, unique patients, April 2014 to October 2014.

Characteristic	Unique ED Census, N=26,639 (%)	Offered Screening, N=7,554 (%)	Accepted Screening, N=3,285 (%)	Screening Test Performed, N=2,028 (%)	Screened Positive, N=185 (%)	Diagnostic Test Performed, N=553 (%)	Diagnostic Test Result Positive, N=82 (%)
Age, mean (SD), y	43.7 (15.2)	49.3 (13.4)	48.7 (13.3)	49.0 (13.2)	53.3 (10.7)	43.5 (14.2)	52.8 (10.6)
Age group, y							
18–24	3,621 (13.6)	560 (7.4)	249 (7.6)	138 (6.8)	3 (1.6)	45 (8.2)	0
25–34	6,511 (24.4)	1,054 (14.0)	445 (13.5)	272 (13.4)	16 (8.7)	127 (23.0)	5 (6.1)
35–44	5,158 (19.4)	1,041 (13.8)	440 (13.4)	242 (11.9)	20 (10.8)	120 (21.7)	8 (9.8)
45–54	5,011 (18.8)	2,136 (28.3)	954 (29.0)	599 (29.5)	43 (23.2)	125 (22.6)	32 (39.0)
55–64	4,192 (15.7)	2,155 (28.5)	978 (29.8)	644 (31.8)	89 (48.1)	97 (17.6)	30 (36.6)
≥65	2,099 (7.9)	608 (8.0)	219 (6.7)	133 (6.6)	14 (7.6)	38 (6.9)	7 (8.5)
Unknown	47 (0.2)	0	0	0	0	1	0
Sex							
Male	14,085 (52.9)	4,038 (53.5)	1,721 (52.4)	1,077 (53.1)	119 (64.3)	320 (57.9)	54 (65.9)
Female	12,546 (47.1)	3,515 (46.5)	1,564 (47.6)	951 (46.9)	66 (35.7)	233 (42.1)	28 (34.1)
Unknown	8 (0.0)	1	0	0	0	0	0
Race/ethnicity							
Black	10,389 (39.0)	3,444 (45.6)	1,536 (47.8)	950 (46.8)	118 (63.8)	221 (40.0)	46 (56.1)
Hispanic	8,433 (31.7)	1,979 (26.2)	914 (27.8)	559 (27.6)	21 (11.4)	147 (26.6)	8 (9.8)
Asian	2,111 (7.9)	558 (7.4)	198 (6.0)	131 (6.5)	2 (1.1)	47 (8.5)	4 (4.9)
White	3,593 (13.5)	1,037 (13.7)	435 (13.2)	262 (13.0)	40 (21.6)	98 (17.7)	19 (23.2)
Other/unknown	2,113 (7.9)	536 (7.1)	202 (6.1)	126 (6.2)	4 (2.2)	40 (7.2)	5 (6.1)
IDU*							
Yes	743 (2.8)	547 (7.2)	352 (10.7)	223 (11.0)	79 (42.7)	32 (5.8)	19 (23.2)
No	13,526 (50.8)	5,446 (72.1)	2,303 (70.1)	1,438 (70.9)	83 (44.9)	303 (54.8)	29 (35.4)
Unknown	12,370 (46.4)	1,561 (20.7)	630 (19.2)	367 (18.1)	23 (12.4)	218 (39.4)	34 (41.5)
Birth cohort							
Born after 1965	17,036 (64.0)	3,122 (41.3)	1,314 (40.0)	772 (38.1)	46 (24.9)	341 (61.8)	22 (26.8)
Born 1945–1965	8,367 (31.4)	4,250 (56.3)	1,922 (58.5)	1,228 (60.6)	138 (74.6)	192 (34.8)	57 (69.5)
Born before 1945	1,189 (4.5)	182 (2.4)	49 (1.5)	28 (1.4)	1 (0.6)	19 (3.4)	3 (3.7)
Language							
English	18,887 (70.9)	5,682 (75.2)	2,490 (75.8)	1,535 (76.7)	179 (96.8)	396 (71.6)	77 (93.9)
Spanish	5,484 (20.6)	1,294 (17.1)	602 (18.3)	367 (18.1)	5 (2.7)	107 (19.4)	1 (1.2)
Other/unknown	2,268 (8.5)	578 (7.7)	193 (5.9)	126 (6.2)	1 (0.5)	50 (9.0)	4 (4.9)
Insurance							
Medicare	2,055 (7.7)	703 (9.3)	294 (8.9)	183 (9.0)	24 (13.0)	38 (6.9)	10 (12.2)
Medicaid	21,152 (79.4)	6,141 (81.3)	2,709 (82.5)	1,675 (82.6)	145 (78.4)	457 (82.6)	63 (76.8)
Private	1,147 (4.3)	203 (2.7)	86 (2.6)	54 (2.7)	1 (0.5)	23 (4.2)	2 (2.4)
Uninsured/self-pay	1,748 (6.5)	325 (4.3)	107 (3.3)	67 (3.3)	6 (3.2)	21 (3.8)	5 (6.1)
Other/unknown	537 (2.0)	182 (2.4)	89 (2.7)	49 (2.4)	9 (4.9)	14 (2.5)	2 (2.4)
Homeless†							
Yes	617 (2.3)	152 (2.0)	72 (2.2)	43 (2.1)	12 (6.5)	12 (2.2)	2 (2.4)
No	26,022 (97.7)	7,402 (98.0)	3,213 (97.8)	1,985 (97.9)	173 (93.5)	541 (97.8)	80 (97.6)

IDU, Injection drug use.

*Past or current IDU documented by the triage nurse.

†Documented as homeless by registration.

influence on the odds ratios (ORs) (data not shown). The prevalence of hepatitis C virus antibody positivity was highest among patients with a history of injection drug use (38.4%; adjusted OR 10.8; 95% CI 7.5 to 15.5), who were homeless (25.5%; adjusted OR 3.1; 95% CI 1.5 to 6.8), who underwent diagnostic testing (14.8%; adjusted OR 2.6; 95% CI 1.7 to 3.9), who were in the birth cohort (13.7%; adjusted OR 3.6; 95% CI 2.4 to 5.3), and who were men (12.4%; adjusted OR 1.4; 95% CI 1.0 to 2.0) and was lowest among races and ethnicities other than white or black (Table 2).

Of the 267 hepatitis C virus antibody positive patients, record review of physician documentation identified that 64 (24%) had previous knowledge of hepatitis C virus infection. There were also 17 patients who reported having hepatitis C virus but were tested and found to be hepatitis C virus antibody negative. Overall, 137 (51%) of the 267 hepatitis C virus antibody positive patients had

Table 2. Factors associated with testing hepatitis C virus antibody positive: unadjusted and adjusted ORs.

Characteristic	Number Tested, N=2,581	HCV Antibody Reactivity 267 (10.3%)	Unadjusted OR (95% CI), N=2,580	Adjusted OR* (95% CI), N=1,995
Birth cohort				
Born after 1965	1,113	68 (6.1)	[Reference]	[Reference]
Born 1945–1965	1,420	195 (13.7)	2.5 (1.8–3.3)	3.6 (2.4–5.3)
Born before 1945	47	4 (8.5)	1.4 (0.5–4.1)	2.8 (0.8–10.3)
IDU†				
No	1,741	112 (6.4)	[Reference]	[Reference]
Yes	255	98 (38.4)	9.1 (6.6–12.5)	10.8 (7.4–15.5)
Unknown	585	57 (9.7)	1.6 (1.1–2.2)	
Sex				
Female	1,184	94 (7.9)	[Reference]	[Reference]
Male	1,397	173 (12.4)	1.6 (1.3–2.1)	1.4 (1.0–2.0)
Race/ethnicity				
White	360	59 (16.4)	[Reference]	[Reference]
Black	1,171	164 (14.0)	0.8 (0.6–1.1)	1.2 (0.8–1.9)
Hispanic	706	29 (4.1)	0.2 (0.1–0.4)	0.4 (0.2–0.7)
Asian	178	6 (3.4)	0.2 (0.1–0.4)	0.3 (0.1–0.8)
Other	166	9 (5.4)	0.3 (0.1–0.6)	0.6 (0.2–1.3)
Reason for testing				
Screening	2,028	185 (9.1)	[Reference]	[Reference]
Diagnostic	553	82 (14.8)	1.7 (1.3–2.3)	2.6 (1.7–3.9)
Homeless				
No	2,526	253 (10.0)	[Reference]	[Reference]
Yes	55	14 (25.5)	3.1 (1.7–5.7)	3.1 (1.5–6.8)

HCV, Hepatitis C virus.

*Adjusted OR for patients with complete data only. Five hundred eighty-five patients with IDU unknown were excluded. Model adjusts for all covariates in the table.

†Past or current IDU documented by the triage nurse.

documentation of result disclosure, 86 during their index ED visit and 51 over the telephone or at a subsequent ED visit. For the 51 patients with delayed result notification, the median interval between test and disclosure was 29 days (IQR 6 to 84 days).

Of the 267 hepatitis C virus antibody positive patients, 180 (67%) had confirmatory RNA testing performed, of which 126 tests (70%) were positive. Dates of testing were available for 174 patients; 103 of these 174 confirmatory RNA tests (59%) were conducted at the index visit and 71 (41%) at a subsequent ED visit. For the 71 patients with delayed confirmatory testing, the median time between index visit antibody test and confirmatory RNA test was 39 days (IQR 8 to 110 days).

Follow-up appointments at the hepatitis C virus clinic were arranged for 57 of the 126 (45%) patients with confirmed positive results, with a 24% overall attendance rate (30/126). The median interval from index to follow-up visit was 97 days (IQR 49 to 153 days).

LIMITATIONS

This study was carried out in an urban, academic ED that provides care to large numbers of high-risk patients, including homeless, uninsured, and injection drug use populations, which may influence the yield of screening and limit generalizability to similar programs implemented elsewhere. Furthermore, the effect of triage HIV screening, which was implemented in parallel with hepatitis C virus screening, is unknown.

Because this was a descriptive analysis of a clinical protocol, we were limited to data collected electronically as part of standard ED processes. Certain assessments were therefore not possible, such as determining why triage nurses offered hepatitis C virus screening to some but not all of the birth cohort, or why injection drug use assessments were variably queried, or why screening tests were not ordered or not performed when patient acceptance was documented. Also, the number of patients who tested hepatitis C virus antibody positive who had previous knowledge of hepatitis C virus infection and whether results were disclosed was assessed from chart review of physician notes and is likely an underestimate. Although the process for disclosing positive hepatitis C virus results was standardized, physicians did not complete the newly hepatitis C virus–positive patient intake form and document result disclosure in the electronic medical record in all cases.

Additionally, the indications for diagnostic hepatitis C virus testing were not documented. Physicians were encouraged to order hepatitis C virus at their clinical discretion, and it is possible that a significant proportion of the positive hepatitis C virus antibody test results identified by physicians were performed merely to provide "confirmation" of patient-reported hepatitis C virus infection. An accurate assessment of patient hepatitis C virus status awareness, the scope of duplicate hepatitis C virus testing, and reasons physicians perform hepatitis C virus testing deserve study.

Our data also do not allow us to evaluate the effect of hepatitis C virus screening on other ED processes, such as patient flow, length of stay, patient care, clinical outcomes, and staff productivity and satisfaction, which are important measures of feasibility.

Although patients were billed for testing, we did not evaluate costs to the patient, nor did we determine levels of reimbursement to the medical center for hepatitis C virus testing. Such cost analyses are important determinants for long-term program sustainability and require study.

DISCUSSION

Our protocol was designed to integrate hepatitis C virus screening for adult injection drug use patients and those born between 1945 and 1965 at the point of ED triage, and to integrate physician diagnostic hepatitis C virus testing into ED care. Although we screened fewer patients than expected, the results highlight the importance of the ED as a venue for hepatitis C virus testing. In the first 6 months of implementation, 10% of the unique, adult patient census was tested for hepatitis C virus, equating to 2,581 individual patients, of whom 267 (10.3%) were hepatitis C virus antibody positive, with 70% confirmed as chronically infected.

Galbraith et al[13] recently described their early experience with integrated birth cohort hepatitis C virus screening at the University of Alabama, an academic ED with an annual census of 60,000 visits. During a 6-week period, their triage staff screened 85% of the eligible birth cohort and performed 1,529 tests, of which 170 were positive (prevalence 11%).[13] We found similarly high rates of hepatitis C virus among screened baby boomers (prevalence 14%). In addition to birth cohort screening, our program included hepatitis C virus screening for patients who use injection drugs (prevalence 38%), as well as those who completed physician diagnostic hepatitis C virus testing (prevalence 15%). A significant number of patients outside of the prespecified targeted risk groups received triage-based screening, although it was unplanned. The prevalence among these "no-risk" patients who were outside the birth cohort and who were not injection drug users was significantly lower, at 2.6%.

Although we demonstrated high rates of hepatitis C virus antibody reactivity among nearly all subgroups tested, screening offer and test completion rates for the birth cohort and the injection drug use population were lower than we had hoped. Triage nurses often deviated from the protocol, frequently failed to assess injection drug use risk, and regularly offered screening to patients outside the birth cohort. In fact, triage nurses offered hepatitis C virus screening to more than 2,000 patients outside the birth cohort whose injection drug use status was unknown. Additionally, triage nurses documented only 743 patients to have used injection drugs, a number we believe to be low, which may have led to an overestimation of the screening rate for this high-risk subpopulation. Focused informal discussions with our nurses highlighted the main reasons they did not adhere to the triage screening protocol. Nurses would have preferred a more "universal" hepatitis C virus offer and found targeting by injection drug use and birth year cumbersome. Additionally, nurses commonly reported being uncomfortable asking sensitive questions at triage, such as hepatitis C virus status and injection drug use histories, which lacks privacy. They uniformly cited a preference for moving screening to the bedside assessment.

The discrepancy between the number of accepted screening tests and number of tests actually performed is not unusual in ED screening programs[15] and can be explained by a variety of factors. Not all patients had blood drawn and some patients were discharged before venipuncture could take place. Informal discussions with nurses also revealed they often forgot to order the hepatitis C virus test, citing a "lack of familiarity" with test ordering. Test ordering required nurses to exit the triage screen, a process they found inconvenient.

Disclosing results and obtaining confirmatory hepatitis C virus RNA testing before patient discharge also posed a challenge. Roughly two thirds of the 267 patients testing hepatitis C virus antibody positive were discharged before result disclosure and before confirmatory testing could be conducted. Many patients also had their results disclosed and blood drawn for hepatitis C virus RNA at a subsequent, unscheduled ED visit. Hepatitis C virus screening protocols, however, cannot rely on ED recidivism as a rescue tool to ensure result disclosure. Mechanisms to increase the availability of positive test results before discharge are needed and may include improved laboratory-to-physician communication for critical values, faster test processing, limiting testing to the main ED rather than

fast-track/urgent care, and patient notification of pending results before discharge, with established telephone care nurse follow-up protocols.

Linking patients with newly diagnosed hepatitis C virus infection to care also proved more difficult and resource intensive than anticipated. A substantial portion of the research coordinator's time was spent contacting patients and arranging follow-up. Initially, we attempted to arrange hepatitis C virus clinic follow-up through consultation with primary physicians and telephone referrals, which was unsuccessful. After demonstrating the need for date- and time-specific appointments, the medical center's hepatitis C virus clinic provided access to 5 clinic spots weekly, designated for newly identified ED patients with RNA-confirmed chronic hepatitis C virus infection. ED clerks were given access to these clinic appointments for direct scheduling, an intervention that helped relieve some of the burden on study staff. Even with this programmatic improvement, appointment nonattendance rates remained high (approximately 76%), and ongoing outreach and surveillance was required by research staff. We recognize that not all patients with reactive hepatitis C virus antibody tests require immediate referral to a specialist, and referral mechanisms will be site specific and dependent on resources such as access to primary care physicians and the availability of specialists providing hepatitis C virus care.

Although we found high rates of hepatitis C virus antibody among the targeted risk groups (birth cohort and injection drug use), the prevalence of infection was close to 3% even among patients without risk, a rate similar to the national prevalence estimates of 3% to 4% for baby boomers.[4,5] We also found the acceptance rates of hepatitis C virus screening to be lower in the non–injection drug use and birth cohort groups (42% and 45%, respectively) compared with the injection drug use population (64%). We suspect that patients without a history of injection drug use may believe themselves to be stigmatized and therefore may be less likely to accept screening when a targeted hepatitis C virus screening protocol includes questions pertaining to drug use. Last, we know that triage nurses struggled with adhering to the targeted screening inclusion criteria. These findings led us to consider adopting an ED policy of nontargeted hepatitis C virus screening, rather than a targeted birth cohort and injection drug use–only policy. Future studies should focus their efforts on examining various risk- and nonrisk-based approaches to screening. Unlike with HIV screening, however, a minimum hepatitis C virus screening prevalence threshold has not been set by CDC or others. Screening outside of the recommended risk and birth cohort categories may also not be reimbursable.[10-12]

Although we encountered many programmatic barriers to the ED integration of hepatitis C virus screening, payment for screening may pose the biggest challenge. Currently, Centers for Medicare & Medicaid Services reimburses risk-based and birth cohort hepatitis C virus screening that is performed in primary care settings, specifically excluding EDs. To expand hepatitis C virus screening into urban EDs, which provide care to the highest-risk patients in the United States, who often lack access to primary care,[16] reimbursement for screening must also be expanded.[9,10]

During this integrated ED screening program, the prevalence of hepatitis C virus antibody positivity was found to be high across all groups screened, including those outside of the CDC-recommended risk cohorts. Diagnostic testing yielded a higher percentage of hepatitis C virus diagnoses, but screening identified nearly 70% of patients found to be hepatitis C virus positive. Challenges encountered with hepatitis C virus screening included result disclosure, confirmatory testing, and linkage to care. We add to work by Galbraith et al,[13] who screened baby boomers in an academic urban ED, and report our experience with hepatitis C virus screening targeting patients with a history of injection drug use, in addition to the birth cohort. We believe our findings highlight the burden of hepatitis C virus infection among patients receiving care in an urban ED, demonstrate the critical role EDs may serve in identifying patients with undiagnosed hepatitis C virus infection, and call attention to the resources necessary to support efforts to develop and evaluate policies for ED-based hepatitis C virus screening and diagnostic testing.

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