Clinical Infectious Diseases

SUPPLEMENT ARTICLE

A Novel Collaborative Community-Based Hepatitis B Screening and Linkage to Care Program for African Immigrants

Hari Shankar,[1,a] Demetri Blanas,[1,a] Kian Bichoupan,[1] Daouda Ndiaye,[2] Ellie Carmody,[3] Valerie Martel-Laferriere,[1] Joan Culpepper-Morgan,[4] Dougles T. Dieterich,[1] Andrea D. Branch,[1] Mulusew Bekele,[2] Kim Nichols,[2] and Ponni V. Perumalswami[1]

[1]Division of Liver Diseases, Department of Medicine, Mount Sinai School of Medicine, [2]African Services Committee, [3]Division of Infectious Diseases and Immunology, Department of Medicine, New York University School of Medicine, and [4]Division of Gastroenterology, Department of Medicine, Harlem Hospital Center, New York, New York

Background. Sub-Saharan African nations have among the highest rates of chronic hepatitis B virus (HBV) infection worldwide, but little is known about HBV infection in African-born persons in the United States.

Methods. From October 2011 to July 2013, community-based HBV screenings were conducted targeting persons originating from Africa in New York City. Persons were identified as currently HBV infected (HBsAg positive) or exposed (HBcAb positive).

Results. Overall, 955 persons were screened for HBV; the median age was 45 years (interquartile range, 35–54 years) and 75.5% were men. Of these, 919 persons had no history of liver disease, of whom 9.6% (n = 88) had current HBV infection and 73.9% (n = 679) had exposure. In logistic regression, older age (odds ratio [OR], 0.97; 95% confidence interval [CI], .94–.99; $P < .01$) and female sex (OR, 0.35; 95% CI, .14–.75; $P < .01$) were less likely to be associated with HBV infection, whereas having a mother with hepatitis was associated with infection (OR, 18.8; 95% CI, 2.72–164.65; $P < .01$). HBV exposure was associated with older age (OR, 1.03; 95% CI, 1.01–1.04; $P < .01$), whereas female sex (OR, 0.46; 95% CI, .33–.66; $P < .01$) and history of blood transfusion (OR, 0.43; 95% CI, .22–.83; $P = .01$) were negatively associated. A patient navigator linked 97% of infected persons to care. Eleven persons were recommended for treatment, of whom 9 (82%) started therapy. Three persons were diagnosed with hepatocellular carcinoma on the first screening ultrasound.

Conclusions. The high burden of HBV infection among African immigrants in the United States underscores a need for continued screening and linkage to care in this at-risk population.

Keywords. hepatitis B; African; liver cancer; screening; linkage to care.

Approximately 2.2 million people in the United States are chronically infected with hepatitis B virus (HBV), of whom 1.3 million (60%) are foreign-born [1]. The majority (58%) of the foreign-born US residents with chronic HBV infection are from Asia, although more than one-tenth (11%) were born in sub-Saharan Africa as of 2011 [1]. Prevalence rates of chronic HBV infection in Africa are >8% [2, 3]. Since 1980, the number of African immigrants in the United States has increased by >750% [4]. African-born US residents are a diverse population, with no individual country accounting for >14% of the total; however, the majority (93%) originate from West (36%) and East Africa (29%), and smaller numbers from North (17%), South (6%), and Central Africa (5%) [5, 6]. African immigrants are more likely to be recent arrivals, to live below the poverty line, are less likely to have health insurance [7], have greater reliance on emergency rooms for primary care needs [8], and, among men, are less likely to act on health concerns than their African American counterparts [8]. These demographic characteristics describe a rapidly growing and diverse population with limited access to healthcare. The high rates of chronic HBV infection among African-born US residents combined with increasing immigration and limited access to healthcare prompted our assessment of HBV infection prevalence among African-born New York City (NYC) residents.

Our primary objective was to estimate prevalence of current HBV infection among African-born NYC residents. Secondary objectives included testing the effectiveness of a community-based screening and linkage-to-care program that relies on a culturally targeted patient navigator, assessing the role of known risk factors, and identifying previously unknown risk factors in this population. We hypothesized that rates of HBV infection among African immigrants living in NYC mirror those in their countries of origin, that there would be substantial opportunities to provide immunization for nonimmune, noninfected persons, and to further care for those who were infected, and that the culturally targeted patient navigator would be effective in linking persons to care.

[a]H. S. and D. B. contributed equally to this work.

Correspondence: P. V. Perumalswami, Icahn School of Medicine at Mount Sinai, 1468 Madison Ave, Box 1123, Rm 11-70, New York, NY 10029 (ponni.perumalswami@mountsinai.org).

Clinical Infectious Diseases® 2016;62(S4):S289–97

DOI: 10.1093/cid/ciw090

METHODS

Study Design and Patients

With approval from the Icahn School of Medicine at Mount Sinai Institutional Review Board, this study was conducted in NYC between October 2011 and July 2013 through the Hepatitis Outreach Network (HONE) Program, which has been described elsewhere [9]. HONE partnered with a nonprofit organization, African Services Committee, to provide targeted screening for HBV to any African-born adult (≥18 years of age) at community centers, places of worship, and sites of employment throughout NYC. At the time of HBV screening, all persons provided written informed consent for data collection through a questionnaire that assessed demographics and risk factors. The risk factors assessed included established and potential HBV risk factors including country of origin, having a family history of liver disease, history of a transfusion with blood products, sexually transmitted infections, injection drug use, men who have sex with men, human immunodeficiency virus (HIV), end-stage renal disease requiring dialysis, being a healthcare professional, presence of tattoos and/or body piercings, having hemophilia, scarification practices, length of time residing in Africa, and number of current and lifetime sexual partners. We ascertained personal history of known liver disease including HBV to exclude persons in our analysis with a prior diagnosis. We had all questionnaires and consent forms professionally translated and back-translated into French and Arabic and trained multilingual delegates to obtain consent from all persons. Community members were invited to attend the screening events at no cost through public service announcements on local African radio stations, flyers at community venues, announcements by community and religious leaders, and word of mouth by the patient navigator at community events.

A trained phlebotomist collected a blood sample on-site for serological testing for each patient. The Mount Sinai Clinical Laboratories tested all blood samples for hepatitis B surface antigen (HBsAg), hepatitis B surface antibody (HBsAb), and hepatitis B core antibody (HBcAb). All results were interpreted by a hepatologist. In this study, HBV status was defined as follows: current HBV infection if HBsAg was positive, HBV exposure if HBcAb was positive including those who were HBsAg positive, HBV immune from past immunization by the presence of the HBsAb alone, and susceptible to HBV with an opportunity for immunization by the absence of all 3 markers (Supplementary Table 1).

A culturally targeted, multilingual (English-, Arabic-, and French-speaking) professional patient navigator attempted to contact persons with their results via telephone 1 week after their screening. At least 6 attempts at different times of the day were made to reach the tested persons via telephone with their test results. The patient navigator invited all persons with HBV infection to meet in person to provide education and counseling on viral hepatitis, scheduled the first 2 follow-up visits for the patient, escorted them to these office visits, and provided additional support and resources as needed. All persons who tested positive for HBsAg were invited to attend a comprehensive follow-up visit at Mount Sinai Medical Center Liver Medicine Practice at no cost. This first follow-up visit included a complete history and physical exam by a hepatologist, blood tests to assess hepatic synthetic function and complete blood count as well as an HBV viral load, the presence or absence of hepatitis B e antigen (HBeAg) and hepatitis B e antibody (HBeAb), hepatitis delta antibody, an abdominal ultrasound for hepatocellular carcinoma (HCC) screening, and transient elastography measurement via FibroScan to assess the degree of fibrosis. Upon completion of their visit, all persons were provided a round-trip public transportation fare card to cover travel costs and a $20 incentive for attending the visit. The research team attempted to contact all persons who attended a follow-up visit at least 6 times via telephone at different times of the day with their test results and, in consultation with the hepatologist, provided recommendations regarding treatment and further follow-up, as well as a referral for long-term follow-up care. After the initial visit at Mount Sinai Medical Center, HBsAg-positive persons were referred to a designated viral hepatitis provider at a partnering municipal health center, either Bellevue Hospital Center or Harlem Hospital, for long-term management including antiviral treatment if recommended based on American Association for the Study of Liver Diseases (AASLD) guidelines [10].

Statistical Analysis

A research assistant entered the survey data into a secure Web-based database. Laboratory results were directly imported from the Mount Sinai clinical laboratory system into the HONE database. Data were analyzed using SPSS software (version 19.0). Quantitative baseline descriptive variables were expressed as the median with the interquartile range (IQR). The relationship between HBV infection (presence of HBsAg) and exposure (presence of HBcAb) and demographic and risk factors (outlined above) was first assessed in univariate analyses using the Pearson or Fisher exact χ^2 and t tests. To ascertain a complete risk factor analysis for HBV exposure, all persons who were HBcAb positive were included irrespective of the presence of HBsAg or HBsAb. Logistic regression models were built to further assess the relationship of patient characteristics with serostatus. Age and sex were factored into each model. A P value of <.10 was used as a qualifier to enter a variable into the adjusted analysis. Variables with P values <.05 were retained in the final model. As noted above, all persons were asked if they had a prior known diagnosis of liver disease at the time of screening; if they answered "yes," they were offered screening but were excluded from our data analysis of risk factors to attempt to minimize bias in the HBsAg detection rate reported here in this population.

RESULTS

Study Population

Between October 2011 and July 2013, 955 African-born adults were screened for HBV through this collaborative program. The median age of the study sample was 45 years (IQR, 35–54 years) and 721 (75.5%) were male (Table 1). Persons tested were born in 31 different African countries; the majority originated from West African nations, with the highest proportion from Senegal (38%). Compared to national US population estimates, the study sample had a lower percentage of high school graduates (67% vs 81%) [11], lower median household income (<$25 000 vs $52 250) [12], and lower percentage of health insurance coverage (22% vs 87%) [13]. A small proportion of persons had a primary care physician (24%). Four-hundred sixty-one (53%) were employed, and 325 (34%) were married. After excluding those who reported a prior known diagnosis of liver disease including HBV (n = 36), a total of 919 persons underwent further analysis in our cohort. Of this cohort of 919 persons, the median age was 45 years (IQR, 35–54 years) and 75% were male (Table 2). The median number of years spent in Africa was 33 (IQR, 25–39) and in the United States was 11 (IQR, 4–19). Risk factors for HBV infection were assessed; 48% admitted to unprotected sexual intercourse, and only 6 persons had a mother with known viral hepatitis.

Prevalence of Current HBV Infection and Exposure

The overall number of HBsAg-positive or currently HBV-infected persons among the 919 African-born persons tested without a self-reported history of liver disease was 88 (9.6%). Persons who were HBsAg positive were born in 16 different countries (Supplementary Table 2), with the highest proportion originating from Senegal (n = 342 [37%]). There was no association between any country of origin and testing HBsAg positive. The overall number of HBV-exposed persons in this cohort was 679 (73.9%), with 143 (15%) persons who were isolated HBcAb positive.

Risk Factors for Current HBV Infection

The characteristics of persons with and without current HBV infection are shown in Table 3. The mean age in years of those with current HBV infection was significantly lower than those without current infection (39.6 vs 45.3 years, respectively; $P < .01$). Men were more likely to have current infection than women (13.6% vs 5.2%; $P < .01$). People with HBV infection had spent less time residing in Africa (29.6 years vs 33.4 years; $P < .01$) than those who were not infected. Persons who had a mother with a known history of HBV (n = 6) were more likely to test positive for current HBV infection than those who did not have this history (3.4% vs 0.3%; $P = .01$). Persons who had been a healthcare worker were significantly less likely to test positive for HBV infection than those who did not report a history of being a healthcare worker (0% vs 5.1%; $P = .03$). No other risk factors assessed for the presence of current HBV infection were significant.

In a logistic regression model, age, sex, and having a mother with hepatitis were independently associated with HBV infection

Table 1. Baseline Characteristics of 955 African-Born Persons Screened for Hepatitis B Virus

Characteristic	No. (%) or Median (IQR)
Age, y	45 (35–54)
Years in Africa	32 (26–39)
Years lived in the United States	11.0 (4–19)
Sex, male	721 (75.5)
Has health insurance	209 (21.9)
Has a primary care physician	228 (23.9)
Employed	461 (52.6)
Married	325 (34.0)
Annual household income	
<$15 000	335 (35.1)
$15 000–$24 999	110 (11.5)
$25 000–50 000	40 (4.2)
>$50 000	11 (1.2)
Education level	
High school or less	591 (67.2)
College	209 (21.9)
Postgraduate	80 (8.4)
English reading/writing level	
Basic	322 (33.7)
Intermediate	213 (22.3)
Fluent	384 (40.2)

Abbreviation: IQR, interquartile range.

Table 2. Characteristics of Patients (n = 919) Without Self-reported Liver Disease

Characteristic	No. (%) or Median (IQR)
Age	45 (35–54)
Years in United States	11 (4–19)
Years in Africa	33 (25–39)
No. of lifetime sexual partners	2 (1–4)
No. of current sexual partners	1 (0–1)
Sex, male	689 (74.9)
Mother with hepatitis	6 (0.7)
Blood transfusion	48 (5.2)
Unprotected sex	445 (48.4)
History of STI	48 (5.2)
History of IDU	6 (0.7)
MSM	4 (0.4)
HIV infected	8 (0.9)
Healthcare worker	43 (4.7)
Uses herbal medications	36 (3.9)
Ever hospitalized	200 (21.8)
Ever had surgery	120 (13.1)
Has tattoos	3 (4.2)
Has body piercing	91 (9)
Ever an inmate	21 (2.3)
Public service work	8 (0.8)
Raised in rural area	118 (12.8)

Abbreviations: HIV, human immunodeficiency virus; IDU, injection drug use; IQR, interquartile ratio; MSM, men who have sex with men; STI, sexually transmitted infection.

Table 3. Characteristics of Patients With and Without Current Hepatitis B Virus Infection (Hepatitis B Surface Antigen Reactivity)

Characteristic	HBsAg (Infection)		
	Reactive (n = 88 [9.6%])	Nonreactive (n = 831 [90.4%])	*P* Value
Age	39.6 (10.5)	45.3 (12.9)	<.01
Years in United States	10.5 (7.5)	12.3 (9.4)	.13
Years in Africa	29.6 (8.9)	33.4 (11.8)	<.01
No. of lifetime sexual partners	4.1 (8.5)	4.0 (7.8)	.92
No. of current sexual partners	0.8 (1.5)	0.9 (1.7)	.68
Sex, male	72 (81.8%)	572 (68.8%)	<.01[a]
Mother with hepatitis	3 (3.4%)	3 (0.3%)	.01[b]
Blood transfusion	4 (4.5%)	40 (4.8%)	1.00[a]
Unprotected sex	39 (44.3%)	396 (47.7%)	.30[a]
History of STI	2 (2.3%)	44 (5.3%)	.30[b]
History of IDU	0 (0%)	5 (0.6%)	1.00[b]
MSM	1 (1.1%)	3 (0.3%)	.34[b]
HIV infected	1 (1.1%)	7 (0.8%)	.55[b]
Healthcare worker	0 (0%)	42 (5.1%)	.03[b]
Uses herbal medications	2 (2.3%)	34 (4.1%)	.57[b]
Ever hospitalized	17 (19.3%)	175 (21.1%)	.78[a]
Ever had surgery	9 (10.2%)	108 (13.0%)	.50[a]
Has tattoos	2 (2.3%)	36 (4.3%)	.57[b]
Has body piercings	6 (6.8%)	82 (9.9%)	.47[a]
Ever an inmate	1 (1.1%)	20 (2.4%)	.71[b]
Public service work	2 (2.3%)	6 (0.7%)	.18[b]
Raised in rural area	10 (11.4%)	108 (13.0%)	.73[a]

Data are presented as mean (standard deviation) or count (column %).

Abbreviations: HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; STI, sexually transmitted infection.

[a] Pearson χ^2 test.

[b] Fisher exact test.

Table 4. Univariable and Multivariable Logistic Regression Results of Factors Associated With Hepatitis B Virus Infection

Characteristic	Univariable			Multivariable		
	OR	95% CI	*P* Value	OR	95% CI	*P* Value
Age	0.96	.95–.98	<.01	0.97	.94–.99	<.01
Years in United States	0.98	.95–1.01	.13	. . .	. . .	. . .
Years in Africa	0.97	.94–.99	<.01	. . .	. . .	. . .
No. of lifetime sexual partners	1.00	.96–1.03	.92	. . .	. . .	. . .
No. of current sexual partners	0.95	.67–1.11	.65	. . .	. . .	. . .
Sex, female	0.42	.21–.78	<.01	0.35	.14–.75	<.01
Mother with hepatitis	9.78	1.77–53.88	.01	18.8	2.72–164.65	<.01
Blood transfusion	0.95	.28–2.43	.92	. . .	. . .	. . .
Unprotected sex	0.82	.52–1.31	.41	. . .	. . .	. . .
History of STI	0.42	.07–1.38	.17	. . .	. . .	. . .
History of IDU	1.43	.00–7.96	1.00	. . .	. . .	. . .
MSM	3.09	.15–24.48	.38	. . .	. . .	. . .
HIV infected	1.39	.07–7.95	.77	. . .	. . .	. . .
Healthcare worker	0.15	.00–.68	.03	. . .	. . .	. . .
Uses herbal medications	0.53	.08–1.78	.34	. . .	. . .	. . .
Ever hospitalized	0.89	.50–1.54	.70	. . .	. . .	. . .
Ever had surgery	0.75	.34–1.48	.43	. . .	. . .	. . .
Has tattoos	0.51	.08–1.71	.31	. . .	. . .	. . .
Has body piercings	0.65	.25–1.43	.31	. . .	. . .	. . .
Ever an inmate	0.46	.03–2.27	.40	. . .	. . .	. . .
Public service work	3.15	.46–13.99	.21	. . .	. . .	. . .
Raised in rural area	1.20	.62–2.57	.60	. . .	. . .	. . .

Abbreviations: CI, confidence interval; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; OR, odds ratio; STI, sexually transmitted infection.

(Table 4). Persons of female sex (odds ratio [OR], 0.35; 95% confidence interval [CI], .14–.75; $P < .01$) and older age (OR, 0.97; 95% CI, .94–.99; $P < .01$) were less likely to test positive for HBV infection, whereas persons who had a mother with a history of hepatitis were more likely to test positive for HBV infection (OR, 18.8; 95% CI, 2.72–164.65; $P < .01$). Although persons with current HBV infection had a greater number of years residing in Africa, this was not significant in the adjusted analysis.

Risk Factors for HBV Exposure

The characteristics of persons with and without HBV exposure are shown in Table 5. The mean age in years of those with HBV exposure was significantly higher than those without exposure (45.9 years vs 41.6 years, respectively; $P < .01$) and higher in men (73.8% vs 56.1%; $P < .01$). A significant disparity between sexes was present with respect to HBV exposure, with 65.3% of men and 56% of women having evidence of exposure ($P < .01$). People with HBV exposure spent more time residing in Africa (33.7 years vs 30 years; $P < .01$) and the United States (12.6 years vs 10.8 years, respectively; $P = .03$) than those who were not exposed. Persons with a history of a blood transfusion (3.7% vs 7.9%; $P = .01$), employment as a healthcare worker (3.5% vs 7.5%; $P = .02$), tattoos (3.1% vs 7.1%; $P < .01$), and body piercings (7.5% vs 15.5%; $P < .01$) were all less likely to have evidence of HBV exposure than those who did not report these histories. No other known risk factors were associated with HBV exposure.

In a logistic regression model, age, sex, and history of a blood transfusion were independently associated with HBV exposure (Table 6). Older age (OR, 1.03; 95% CI, 1.01–1.04; $P < .01$) was associated with HBV exposure, whereas female sex (OR, 0.46; 95% CI, .33–.66; $P < .01$) and history of blood transfusion (OR, 0.43; 95% CI, .22–.83; $P = .01$) were associated with lack of exposure.

Evidence of Vaccination and Opportunities for Immunization

A total of 100 persons (10.9%) had evidence of prior vaccination and 239 persons (56.6%) were eligible for HBV immunization. Data on HBV vaccination posttesting are not available. There were no significant differences in eligibility for immunization between different demographic or risk factor profile groups.

Table 5. Characteristics of Patients With and Without Hepatitis B Virus Exposure (Hepatitis B Core Antibody Reactivity)

Characteristic	HBcAb (Exposure)		
	Reactive (n = 679 [73.9%])	Nonreactive (n = 239 [26.1%])	*P* Value (*t* test)
Age	45.9 (12.1)	41.6 (14.1)	<.01
Years in United States	12.6 (9.0)	10.8 (9.8)	.03
Years in Africa	33.7 (11.1)	30.0 (12.8)	<.01
No. of lifetime sexual partners	4.2 (8.8)	3.4 (4.5)	.31
No. of current sexual partners	0.9 (1.3)	1.0 (2.4)	.28
Sex, male	501 (73.8%)	134 (56.1%)	<.01[a]
Mother with hepatitis	5 (0.7%)	1 (0.4%)	.53[a]
Blood transfusion	25 (3.7%)	19 (7.9%)	.01[a]
Unprotected sex	318 (46.8%)	117 (49.0%)	.49[a]
History of STI	35 (5.2%)	11 (4.6%)	.86[a]
History of IDU	2 (0.3%)	3 (1.3%)	.12[b]
MSM	1 (0.1%)	3 (1.3%)	.06[b]
HIV infected	6 (0.9%)	2 (0.8%)	1.00[b]
Healthcare worker	24 (3.5%)	18 (7.5%)	.02[a]
Uses herbal medications	23 (3.4%)	13 (5.4%)	.25[a]
Ever hospitalized	136 (20%)	56 (23%)	.40[a]
Ever had surgery	79 (11.6%)	38 (15.9%)	.14[a]
Has tattoos	21 (3.1%)	17 (7.1%)	<.01[a]
Has body piercings	51 (7.5%)	37 (15.5%)	<.01[a]
Ever an inmate	15 (2.2%)	6 (2.5%)	.81[a]
Public service work	6 (0.9%)	2 (0.8%)	1.00[b]
Raised in rural area	91 (13.4%)	27 (11.3%)	.64[a]

Data are presented as mean (standard deviation) or count (column %).

Abbreviations: HBcAb, hepatitis B core antibody; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; STI, sexually transmitted infection.

[a] Pearson χ^2 test.

[b] Fisher exact test.

Table 6. Univariable and Multivariable Logistic Regression Results of Factors Associated With Hepatitis B Virus Exposure (Hepatitis B Core Antibody)

Characteristic	Univariable			Multivariable		
	OR	95% CI	*P* Value	OR	95% CI	*P* Value
Age	1.03	1.01–1.04	<.01	1.03	1.01–1.04	<.01
Years in United States	1.02	1.00–1.04	.03	. . .	. . .	. . .
Years in Africa	1.02	1.01–1.04	<.01	. . .	. . .	. . .
No. of lifetime sexual partners	1.01	.99–1.05	.29	. . .	. . .	. . .
No. of current sexual partners	0.95	.84–1.05	.30	. . .	. . .	. . .
Sex, female	0.45	.32–.63	<.01	0.46	.33–.66	<.01
Mother with hepatitis	2.00	.32–38.50	.50	. . .	. . .	. . .
Blood transfusion	0.44	.24–.83	.01	0.43	.22–.83	.01
Unprotected sex	0.93	.68–1.27	.65	. . .	. . .	. . .
History of STI	1.16	.59–2.42	.68	. . .	. . .	. . .
History of IDU	0.24	.03–1.46	.12	. . .	. . .	. . .
MSM	0.12	.01–.94	.04	. . .	. . .	. . .
HIV infected	1.08	.25–7.38	.93	. . .	. . .	. . .
Healthcare worker	0.46	.25–.89	.02	. . .	. . .	. . .
Uses herbal medications	0.63	.32–1.31	.21	. . .	. . .	. . .
Ever hospitalized	0.85	.59–1.22	.37	. . .	. . .	. . .
Ever had surgery	0.72	.47–1.10	.13	. . .	. . .	. . .
Has tattoos	0.42	.22–.83	.01	. . .	. . .	. . .
Has body piercings	0.45	.28–.71	<.01	. . .	. . .	. . .
Ever an inmate	0.9	.36–2.56	.83	. . .	. . .	. . .
Public service work	1.09	.25–7.48	.92	. . .	. . .	. . .
Raised in rural area	0.87	.53–1.37	.55	. . .	. . .	. . .

Abbreviations: CI, confidence interval; HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; OR, odds ratio; STI, sexually transmitted infection.

Follow-up and Linkage to Care

Of the 88 (9.6%) persons who tested positive for current HBV infection, all were contacted and counseled regarding their test results. A total of 85 (97%) persons attended a first follow-up appointment. Of those 85 who attended the appointment, 82 (96.5%) were HBeAb positive, 1 (1.2%) was HBeAg positive, and 2 (2.4%) had neither serology positive. The median HBV DNA viral load for those who attended the first follow-up visit was 1289 IU/mL (IQR, 74.5–4758 IU/mL). Four (4.7%) persons were positive for hepatitis delta antibody and were referred for further testing to determine active hepatitis delta infection, but all were negative for RNA. The median FibroScan score for all persons with current HBV infection who attended follow-up was 5.7 kPa (IQR, 4.5–6.8 kPa), which is consistent with Metavir fibrosis stage 0–1 [14]. All persons underwent ultrasound for HCC screening at the first follow-up appointment, and 3 (4%) had suspicious liver lesions on initial ultrasound. All 3 persons were confirmed to have HCC by contrast-enhanced imaging and consultation with a hepatobiliary surgeon. The maximum FibroScan score was 72 kPa, which was in a patient with decompensated cirrhosis with ascites and HCC who came in for HBV screening but had no prior diagnosis of infection. The 3 persons who were diagnosed with HCC all were male, had a FibroScan score consistent with cirrhosis, and began antiviral treatment (Table 7). Unfortunately, all had advanced, multifocal HCC at the time of diagnosis and ultimately died. Eleven persons were recommended for treatment based on AASLD criteria, and 9 of these (82%) were navigated for a second follow-up visit to municipal hospital–based clinics or Mount Sinai hospital with viral hepatitis providers and have since begun antiviral treatment. The overall continuum of care for HBV screening and linkage to care is shown in Figure 1*A*, and Figure 1*B* shows the cascade with an emphasis on patient navigation and linkage to care.

DISCUSSION

This study represents a novel, collaborative partnership among a community-based organization, an academic medical center, and community health centers to build a comprehensive HBV screening and linkage-to-care program. We report here the

Table 7. Characteristics of 3 African-Born Patients With Hepatitis B Virus Infection Diagnosed With Hepatocellular Carcinoma on First-time Screening Ultrasound

	Age, y	ALT, U/L	HBV VL, IU/mL	FibroScan, kPa	HCC	Outcome
1	56	52	94 815	72	Multifocal: 8.3-cm × 7.9-cm × 9.2-cm HCC in segment 6; 3.3-cm HCC in segment 8; 2.4-cm HCC in segment 3	Started on entecavir but given decompensated cirrhosis, referred to hospice
2	55	126	1 804 869	17	Multifocal: largest of which is 1.6 × 1.2 × 1.8 cm in L hepatic lobe	Started on entecavir; however, patient refused immediate HCC care and traveled to Senegal and then returned to emergency department 9 mo later with metastatic HCC and bilateral pulmonary embolism; referred to hospice
3	38	59	41 405	14.5	11.3-cm HCC in segment 4; 9.3-cm infiltrative HCC in segment 6 with small satellite lesions	Started on entecavir and enrolled in trial for locally advanced HCC but referred to hospice within a year

Abbreviations: ALT, alanine aminotransferase; HBV, hepatitis B virus; HCC, hepatocellular carcinoma; IU, international units; VL, viral load by DNA polymerase chain reaction.

largest cohort of HBV screening and linkage to care in African-born persons in the United States. In this study, the overall HBsAg detection rate in African-born persons was high (9.6%) in persons without any known history of liver disease, and 73.9% of our cohort had evidence of HBV exposure. Our findings are in line with the 2004 World Health Organization estimates for chronic HBV infection in sub-Saharan Africa that exceed 8%, and HBV exposure that ranges from 65% to 85% [15, 16]. We also identified a 2.6 times higher prevalence of current HBV infection in men compared with women, which corroborates other reports of higher rates of infection among men by 1.13–3 times that of women [15, 17–25]. Reasons for higher rates of HBV infection in men compared to women have not been well delineated. The higher rate in men may be a result of the observed prolonged replicative phase of the virus in boys; increased rates of circumcision in boys compared with girls, which is often performed with previously used instruments or with the same instrument in group settings; and/or differences in the social and sexual behaviors of males and females [21].

In addition to male sex, younger age and having a mother with hepatitis were observed risk factors for current HBV infection. Given that vertical transmission of HBV remains the most common route of transmission worldwide, it follows that having a mother with hepatitis would be a strong risk factor for HBV infection. It is not clear why younger age was a risk factor for current HBV infection in our cohort. As outlined below, spontaneous clearance of HBsAg at older ages could occur more frequently, leading to higher rates of current HBV infection in younger persons. Additional risk factors for current HBV infection may be present in younger persons, and further work to validate this finding and determine a reason will be important in future studies. There were low rates of traditional established risk factors in HBV-infected persons.

We found a very high rate of HBV exposure in our cohort. Older age was one variable associated with HBV exposure, suggesting that ongoing routes of transmission persist into adulthood. As with current HBV infection, male sex was also associated with higher rates of exposure. The discrepancy between the association of older age with HBV exposure and younger age with current HBV infection may in part be accounted for by the 1%–2% per year rate of spontaneous clearance of HBsAg [26]. Another possible factor to account for this difference would be epidemiological differences in HBV exposure and infection rates in African individuals who are currently in the 30- to 49-year age cohort, which are not well understood. One study based on data from a county in Minnesota describing the changing epidemiology of HBV infection included a subgroup of African immigrants, and similarly found a peak in HBV infection in African-born persons 30–49 years of age, with a decreasing rate in older age groups [27]. This has also been described in HBV studies in African nations [28]. Finally, that a history of blood transfusion was less likely to be associated with HBV exposure is interesting but not clearly understood. These results should be verified in future studies. Additionally, it should be noted that the high rate of exposure in this cohort has implications regarding the risk of reactivation of HBV infection in these persons who undergo immunosuppressive treatment (see Gonzalez and Perrillo [29] Supplementary Material). Given the high rates of HBV infection and exposure, additional horizontal modes of transmission may occur in this population. Additional risk factors now being assessed in our HONE program include dental practices and traditional medical procedures including circumcision, scarification, and tattooing [30–34].

Three men in our cohort who attended follow-up were diagnosed with locally advanced, multifocal HCC at the time of their first follow-up appointment and ultrasound examination for liver cancer screening. One of the patients had decompensated cirrhosis with ascites but without a prior diagnosis of current HBV infection. The other 2 patients had no evidence of decompensated liver disease and were asymptomatic at the time of diagnosis, further highlighting the silent nature of infection and long-term adverse sequelae for many patients with current HBV

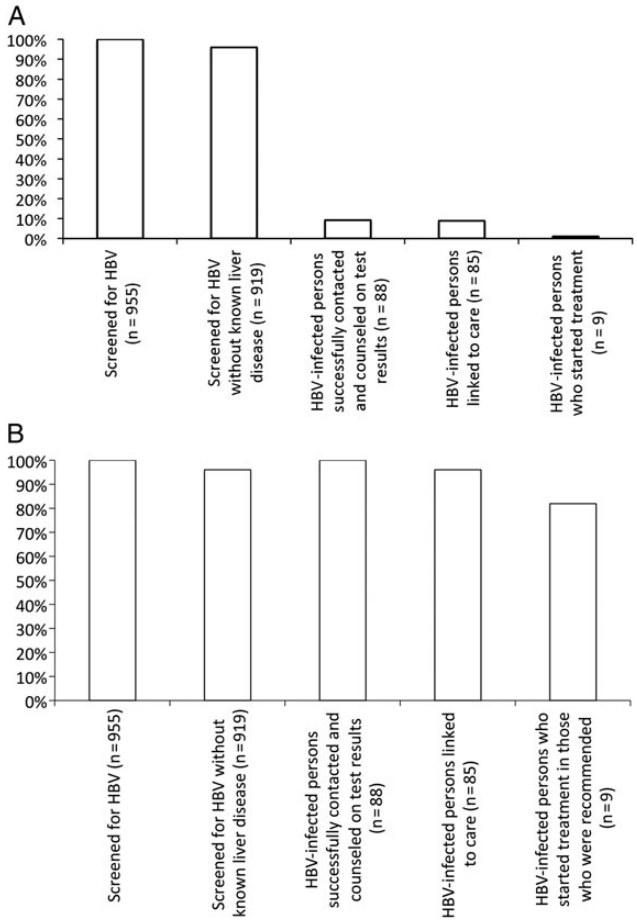

Figure 1. *A*, Overall continuum of care for hepatitis B virus (HBV) screening and linkage to care. The total cohort included 955 African-born persons, of whom 919 (96%) did not have known liver disease. Eighty-eight persons tested positive for HBV infection (9.2%); all were counseled with their test results, and 85 (8.9%) were linked to follow-up care. Eleven persons were recommended for treatment, of whom 9 (1%) began antiviral treatment. *B*, Effect of patient navigation and linkage to care on the overall continuum of care for HBV screening and linkage to care. The total cohort included 955 African-born persons, of whom 919 (96%) did not have known liver disease. Eighty-eight persons tested positive for HBV infection, all of whom (100%) were counseled with their test results; 85 (97%) were linked to follow-up care. Eleven persons were recommended for treatment, of whom 9 (82%) began antiviral treatment.

infection. All 3 patients were initiated on antiviral therapy, but all 3 ultimately died of their underlying malignancy. In one large, placebo-controlled randomized study of nearly 19 000 HBV-infected patients, it was shown that HCC surveillance with both abdominal ultrasound and serum α-fetoprotein repeated at 6-month intervals resulted in a 37% reduction in HCC-related mortality [35]. In persons with current HBV infection, screening for HCC is recommended every 6–12 months [10]. It can be argued that earlier diagnosis of current HBV infection and screening for HCC in these persons may have resulted in a different outcome than death, underscoring the need to continue targeted HBV screening for African-born persons and subsequent HCC screening in those with current infection.

This study had several strengths. This is the largest cohort of African-born persons in the United States that have been screened for HBV infection. We included testing for HBcAb to determine the prevalence of exposure. We excluded persons with a known history of liver disease to minimize selection bias in the risk factor analysis for HBV infection and exposure. Screening events were also conducted at nontraditional venues to better target African-born persons including places of employment and worship and community centers. Many African-born persons in NYC work in the service industry and ascribe to various religious affiliations; therefore, screening in these venues likely increased our ability to effectively target this community. Given that only 21.9% of this cohort was covered with health insurance and <23.9% had a primary care physician, community-based free testing was an important aspect of targeting this community to access screening. Many persons who are at risk in this community may not have the opportunity to undergo screening through visits with a primary care physician given the lack of engagement in routine medical care in the absence of health insurance. Persons who tested positive were also offered comprehensive free follow-up visits and were linked to care irrespective of their insurance and/or documentation status. Lack of insurance was thus not a barrier to follow-up care, linking persons to ongoing care, or treatment due to the presence of municipally funded public hospital–based clinics. Finally, we again demonstrate in this study a major strength of our HBV screening model: the engagement of culturally targeted patient navigators, which substantially increased our ability to educate people to access screening and provide very high rates of follow-up (97%) for HBV-infected persons. Culturally targeted patient navigators are critical to establishing effective community-based viral hepatitis screening and linkage-to-care programs, particularly in programs targeting foreign-born persons [36].

This study had several limitations. One major limitation is selection bias in who attends community-based screening events. As with any screening study, a variety of factors may be facilitators for and/or barriers to accessing screening. Prior knowledge of HBV infection is a potential motivating factor, which we attempted to control for by ascertaining self-reported history and excluding these persons from the risk factor analysis. Based on a 1-time screening test of HBsAg, we are unable to determine which individuals had chronic HBV infection and who had acute infection. Given that the vast majority of transmission in Africa is estimated to be either horizontal during childhood or perinatal, we can presume that most, if not all, individuals who were HBsAg positive had chronic infection. However, repeat measurements of HBsAg over months would be required to confirm chronic, as opposed to acute, infection. We also had a lower than expected number of persons with a self-reported history of HIV (0.9%) and family history of viral hepatitis (0.7%). The World Health Organization estimates the global prevalence of adult HIV infection to be 0.8% with a prevalence in Africa of

4.5%. Sub-Saharan Africa has been the most severely affected by HIV infection with an estimated 24.7 million persons infected in 2013 and accounting for >70% of the global burden of infected persons [3]. At the height of the HIV epidemic in sub-Saharan Africa between 1990 and 2000, the average life expectancy was approximately 49.5 years [37]. From 2002 to 2012, with implementation of antiretroviral treatment regimens for HIV, the life expectancy has increased by 5.5 years. It is quite possible that fewer HIV-infected persons immigrate to the United States given current availability of antiretroviral therapy in Africa, their chronic illness, and other social circumstances that present barriers to immigration. Also, based on our prior work to delineate facilitators for and barriers to HBV screening [38], stigma from chronic illnesses including HBV is a significant barrier and therefore self-report may deter persons from answering these questions truthfully, which may affect our results.

CONCLUSIONS

In this study, we have established a targeted, novel collaborative paradigm for HBV screening and linkage to care comprised of a community-based organization, an academic medical center, and municipal hospital–based outpatient specialty clinics. The screening data reported in this study demonstrate high rates of current HBV infection and exposure among African immigrants in the United States, especially among men, but found no positive relationship between known established risk factors and current infection, highlighting the need for a better understanding of transmission patterns and risk factors for infection in Africa. Finally, we established that there is a significant opportunity for prevention through highly effective immunization in African-born persons; therefore, work to enhance prevention in native countries of origin in these populations remains a significant unmet medical need.

Supplementary Data

Supplementary materials are available at http://cid.oxfordjournals.org. Consisting of data provided by the author to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the author, so questions or comments should be addressed to the author.

Notes

Acknowledgments. The Hepatitis Outreach Network team would like to acknowledge the many community partners that have worked to make viral hepatitis outreach efforts a success, including the many community leaders from the African Community in New York City and public health partners.

Financial support. This work was supported in part by the Centers for Disease Control and Prevention (CDC-RFA-PS12-1209PPHF12), Gilead Foundation, Merck Foundation, and AbbVie.

Supplement sponsorship. This article appears as part of the supplement "Hepatitis B," sponsored by the CDC Foundation and Gilead.

Potential conflicts of interest. K. B. is a paid consultant for Gilead and Janssen. A. D. B. receives grant funding from Gilead and Janssen. D. T. D. serves as a paid lecturer and consultant and is a member on scientific advisory boards of companies that either develop or assess medicines used for the treatment of viral hepatitis. These companies include Gilead Sciences, Boehringer Ingelheim, Vertex Pharmaceuticals, Achillion, Idenix, Merck, Janssen, AbbVie, and Bristol-Myers Squibb. E. C. receives grant funding from Gilead Sciences. P. V. P. receives grant funding from Gilead Sciences and Gilead Foundation. All other authors report no potential conflicts. All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

References

1. Kowdley KV, Wang CC, Welch S, Roberts H, Brosgart CL. Prevalence of chronic hepatitis B among foreign-born persons living in the United States by country of origin. Hepatology **2012**; 56:422–33.
2. Lavanchy D. Hepatitis B virus epidemiology, disease burden, treatment, and current and emerging prevention and control measures. J Viral Hepat **2004**; 11:97–107.
3. World Health Organization. HIV/AIDS fact sheet, **2015**. Available at: http://www.who.int/mediacentre/factsheets/fs360/en/. Accessed 20 August 2015.
4. McCabe K. African immigrants in the United States. Washington, DC: Migration Policy Institute; **2011**.
5. Singh GK, Miller BA. Health, life expectancy, and mortality patterns among immigrant populations in the United States. Can J Public Health **2004**; 95:I14–21.
6. Gambino CP, Trevelyan EN, Fitzwater JT. The foreign-born population from Africa: 2008–2012. American Community Survey Briefs. Washington, DC: US Census Bureau, **2016**. Available at: http://www.census.gov/content/dam/Census/library/publications/2014/acs/acsbr12-16.pdf. Accessed 4 March 2016.
7. Dey AN, Lucas JW. Physical and mental health characteristics of U.S.- and foreign-born adults: United States, 1998–2003. Adv Data **2006**:1–19.
8. Lucas JW, Barr-Anderson DJ, Kington RS. Health status, health insurance, and health care utilization patterns of immigrant black men. Am J Public Health **2003**; 93:1740–7.
9. Perumalswami PV, Factor SH, Kapelusznik L, et al. Hepatitis outreach network: a practical strategy for hepatitis screening with linkage to care in foreign born communities. J Hepatol **2013**; 58:890–7.
10. Lok AS, McMahon BJ. Chronic hepatitis B: update 2009. Hepatology **2009**; 50:661–2.
11. US Department of Education, ed. Public high school graduation rates. National Center for Education Statistics, **2015**.
12. Noss A. Household income: 2013. American Community Survey Briefs. Washington, DC: US Census Bureau, **2016**. Available at: https://www.census.gov/content/dam/Census/library/publications/2014/acs/acsbr13-02.pdf. Accessed 4 March 2016.
13. Health Insurance in the United States: 2013 Current Population Reports, U.S. Department of Commerce Economics and Statistics Administration, U.S. CENSUS BUREAU, Washington, DC, **2013**. Available at: https://www.census.gov/content/dam/Census/library/publications/2014/demo/p60-250.pdf. Accessed 5 March 2016.
14. de Ledinghen V, Vergniol J. Transient elastography (FibroScan). Gastroenterol Clin Biol **2008**; 32(6 suppl 1):58–67.
15. Kramvis A, Kew MC. Epidemiology of hepatitis B virus in Africa, its genotypes and clinical associations of genotypes. Hepatol Res **2007**; 37(suppl 1):S9–19.
16. World Health Organization. Hepatitis B vaccines. Geneva, Switzerland: WHO, **2004**.
17. Abebe A, Nokes DJ, Dejene A, Enquselassie F, Messele T, Cutts FT. Seroepidemiology of hepatitis B virus in Addis Ababa, Ethiopia: transmission patterns and vaccine control. Epidemiol Infect **2003**; 131:757–70.
18. Bovet P, Yersin C, Herminie P, Lavanchy D, Frei PC. Decrease in the prevalence of hepatitis B and a low prevalence of hepatitis C virus infections in the general population of the Seychelles. Bull World Health Organ **1999**; 77:923–928.
19. Chiaramonte M, Trivello R, Stroffolini T, et al. Changing pattern of hepatitis B infection in children: a comparative seroepidemiological study (1979 vs 1989) in north-east Italy. Ital J Gastroenterol **1991**; 23:347–50.
20. Sirisena ND, Njoku MO, Idoko JA, et al. Carriage rate of hepatitis-B surface antigen (HBsAg) in an urban community in Jos, Plateau State, Nigeria. Niger Postgrad Med J **2002**; 9:7–10.
21. Jacobs B, Mayaud P, Changalucha J, et al. Sexual transmission of hepatitis B in Mwanza, Tanzania. Sex Transm Dis **1997**; 24:121–6.
22. Bile K, Mohamud O, Aden C, et al. The risk for hepatitis A, B, and C at two institutions for children in Somalia with different socioeconomic conditions. Am J Trop Med Hyg **1992**; 47:357–64.
23. Abiodun PO, Olomu A, Okolo SN, Obasohan A, Freeman O. The prevalence of hepatitis Be antigen and anti-HBE in adults in Benin City. West Afr J Med **1994**; 13:171–4.
24. Hodges M, Sanders E, Aitken C. Seroprevalence of hepatitis markers; HAV, HBV, HCV and HEV amongst primary school children in Freetown, Sierra Leone. West Afr J Med **1998**; 17:36–7.
25. Uneke CJ, Ogbu O, Inyama PU, Anyanwu GI, Njoku MO, Idoko JH. Prevalence of hepatitis-B surface antigen among blood donors and human immunodeficiency virus-infected patients in Jos, Nigeria. Mem Inst Oswaldo Cruz **2005**; 100:13–6.

26. Liaw YF, Brunetto MR, Hadziyannis S. The natural history of chronic HBV infection and geographical differences. Antivir Ther **2010**; 15(suppl 3):25–33.
27. Kim WR, Benson JT, Therneau TM, Torgerson HA, Yawn BP, Melton LJ 3rd. Changing epidemiology of hepatitis B in a U.S. community. Hepatology **2004**; 39:811–6.
28. Baha W, Foullous A, Dersi N, et al. Prevalence and risk factors of hepatitis B and C virus infections among the general population and blood donors in Morocco. BMC Public Health **2013**; 13:50.
29. Gonzalez SA, Perrillo RP. Hepatitis B virus reactivation in the setting of cancer chemotherapy and other immunosupressive drug therapy. Clin Infect Dis **2016**; 62(suppl 4):S306–13.
30. Martinson FE, Weigle KA, Royce RA, Weber DJ, Suchindran CM, Lemon SM. Risk factors for horizontal transmission of hepatitis B virus in a rural district in Ghana. Am J Epidemiol **1998**; 147:478–87.
31. Sidibe S, Sacko BY, Traore I. Prevalence of serologic markers of the hepatitis B virus in pregnant women of Bamako, Mali. Bull Soc Pathol Exot **2001**; 94:339–41.
32. Jombo GT, Egah DZ, Banwat EB. Hepatitis B virus infection in a rural settlement of northern Nigeria. Niger J Med **2005**; 14:425–8.
33. Otegbayo JA, Fasola FA, Abja A. Prevalence of hepatitis B surface and e antigens, risk factors for viral acquisition and serum transaminase among blood donors in Ibadan, Nigeria. Trop Gastroenterol **2003**; 24:196–7.
34. McCarthy MC, el-Tigani A, Khalid IO, Hyams KC. Hepatitis B and C in Juba, southern Sudan: results of a serosurvey. Trans R Soc Trop Med Hyg **1994**; 88:534–6.
35. Zhang BH, Yang BH, Tang ZY. Randomized controlled trial of screening for hepatocellular carcinoma. J Cancer Res Clin Oncol **2004**; 130:417–22.
36. Perumalswami PV, Factor SH, Kapelusznik L, et al. Hepatitis Outreach Network: a practical strategy for hepatitis screening with linkage to care in foreign-born communities. J Hepatol **2013**; 58:890–7.
37. Joint United Nations Programme on HIV/AIDS. UNAIDS report on the global AIDS epidemic, **2013**. Available at: http://www.unaids.org/sites/default/files/media_asset/UNAIDS_Global_Report_2013_en_1.pdf. Accessed 5 March 2016.
38. Sriphanlop P, Jandorf L, Kairouz C, Thelemaque L, Shankar H, Perumalswami P. Factors related to hepatitis B screening among Africans in New York City. Am J Health Behav **2014**; 38:745–54.