

Acceptance and completion of hepatitis B vaccination among drug users in New York City

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Summary: Hepatitis B (HBV) vaccination rates remain low among drug users. We examined correlates of vaccine acceptance and completion in two ongoing prospective studies of young injecting and non-injecting drug users in New York City. Street recruited drug users were enrolled at one of two neighbourhood locations (Harlem and the Bronx) between 2000 and 2004 and completed risk behaviour questionnaires and HBV testing. Free HBV vaccination was offered. Among 1117 participants, 26.1% (275) had a previous HBV infection, 57.9% (610) were susceptible to HBV, and 16.0% (169) had serological evidence of previous vaccination. Of the 610 participants susceptible to HBV, 466 (76.4%) returned for their results and were offered vaccination; 53.9% (251) received at least one dose of the vaccine (acceptors). Correlates of vaccine acceptance included older age, public assistance as main income source, and being recruited in the Bronx. Daily crack users were significantly less likely to initiate the vaccine series. Among 240 vaccine acceptors, 98 (40.8%) completed all three doses. Daily injectors, Hispanics, and those recruited in Harlem were less likely to complete the vaccination series. HBV vaccination acceptance among drug users seems likely in programmes that are convenient and offer remuneration; however, extended efforts are needed to improve series completion.

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Hepatitis B virus (HBV) infection continues to be a major public health concern, with an estimated two billion people with serological evidence of current or past infection and 350 million people chronically infected worldwide¹. The prevalence of HBV infection (prevalence of HBV core antigen) among injecting drug users (IDUs) is high, ranging between 20% and 81%²⁻⁷. In the United States (US), high-risk heterosexual activity accounts for 38.8% of acute HBV cases, and parenteral transmission through injecting drug use practices accounts for 13.8%⁸.

Non-injecting drug users (NIDUs) also have been shown to have higher rates of HBV infection than the general population^{4,9}.

In the US, HBV vaccine has been recommended for IDUs since 1982. Although the prevalence of HBV infection is high among drug users, and IDUs in particular, studies show that only between 4% and 29% of IDUs are vaccinated¹⁰⁻¹². With the introduction of the HBV vaccine to the US childhood immunisation schedule in 1991^{13,14} and the World Health Organization Expanded Programme on Immunisation in 1992¹⁵, it is anticipated that vaccination coverage among drug users will improve as cohorts of immunised adolescents mature. However, those who were missed and continue to be missed by national vaccination programmes and various catch-up initiatives remain susceptible to HBV. Furthermore, adult NIDUs, who are at risk of becoming IDUs^{16,17}, are not included in HBV vaccination recommendations and may be at particular risk for HBV infection if they progress to injecting drug use.

Previous studies have documented low HBV vaccine acceptance rates among susceptible IDUs¹⁸⁻²⁰. A few studies have shown that needle exchange¹⁹ and drug treatment programmes²¹ can increase HBV vaccination among IDUs, but few studies are reported in the literature. The success of needle exchange and drug treatment programmes may be attributed, at least in part, to the convenience of the vaccination services they

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provide. However, few evaluations of the effectiveness of vaccination programme are reported in the literature.

Improving vaccination rates among drug users is an important step towards reducing the societal burden of HBV. To that end, it is important to understand the factors that are associated with acceptance and completion of vaccination in targeted programmes. However, the descriptions of vaccination efforts among these groups have been limited to overall vaccination completion rates^{11,19,21-24} and immune response to the vaccine²²⁻²⁵, with few data available that distinguish the characteristics of those who accept and complete HBV vaccination from those who do not. As we move closer to an HIV vaccine, drug users will be an important target population. HBV vaccination programmes will provide important lessons for HIV vaccination programmes among this high-risk subgroup.

Here we report on findings from two on-going cohort studies, where HBV vaccination was offered to young injecting and non-injecting heroin, crack, and cocaine users in two geographic areas in New York City: Harlem and the South Bronx. Participants who wanted to be vaccinated were given a referral and escorted to a nearby health clinic for the first vaccination. We examined the sociodemographic and behavioral correlates of HBV vaccine acceptance and completion among these young IDUs and NIDUs in Harlem and the South Bronx.

Methods

Recruitment of participants

Participants from two ongoing studies of NIDUs and IDUs were offered HBV vaccination. Potential participants were recruited by using street outreach techniques, as described elsewhere^{26,27}. Briefly, at places in the community where drugs were bought and/or used outreach workers engaged drug users in conversations about ongoing research being conducted by our centre. Interested participants were brought into one of two research stations in Harlem and the South Bronx. Both IDUs and NIDUs were recruited between August 2000 and January 2004. Potential participants completed a screening demographic interview. The IDU study was aimed at studying correlates and predictors of hepatitis C (HCV) infection and therefore targeted young, recently initiated IDUs at risk for HCV. Participants were eligible for the IDU part of the study if they were age 15-40 years and reported injecting drug use of heroin or cocaine at least once in the preceding two months but for no longer than five years. The NIDU study was aimed at investigating correlates and predictors of transition to injecting drug use, and therefore recruited young NIDUs. Participants were eligible for the NIDU part of the study if they were age 15 to 40 years and reported non-injecting drug use of heroin or cocaine at least two to three times in the preceding two months but for no longer than 10 years, and had never injected drugs. Participants were reimbursed \$20 for their participation. The study was approved by the institutional review boards of the New York Academy of Medicine and the New York Blood Center. Informed consent was obtained from all study participants, and guidelines for human experimentation

of the US Department of Health and Human Services and the authors' institutions were followed in the conduct of this research protocol.

Data collection

After giving informed consent, eligible participants completed a standardised, detailed risk behaviour questionnaire administered by trained interviewers. Interviews were administered in either English or Spanish. We asked about the type, frequency, and duration of their drug use, and, for recent users, we asked about the use of drug equipment and sharing of drug equipment. We also asked participants about their vaccination and medical histories. Prior drug use by injection was confirmed during the comprehensive interviewing process and by phlebotomists' observations during venipuncture.

Demographic characteristics considered included age, race, sex, socioeconomic status (SES), and ever being homeless. Variables used to assess SES were education and main income source (employed, illegal, or public assistance). In terms of risk behaviors, our analysis focused on drug use and potential opportunities for exposure to HBV through drug use behaviours (injection drug use) and sexual partners (i.e., DUs, homosexual sex partners, and hepatitis infected sex partners).

Counselling and vaccination referrals

After completing the interview, all participants were counseled about hepatitis B, hepatitis C, and HIV infection and had a blood specimen drawn for serological testing. Serology samples were tested for HBV. HBV testing consisted of detection of hepatitis B surface antigen (HBsAg: Abbott Laboratories, Abbott Park, IL), antibodies to hepatitis B surface antigen (anti-HBs: Ortho Clinical Diagnostics, Inc, Raritan, NJ), and antibodies to hepatitis B core antigen (anti-HBc: Ortho Clinical Diagnostics Inc, Raritan, NJ). Participants returned three weeks later to learn their test results and receive referrals for medical care and other health and social services. Participants who were immune to HBV by previous infection or vaccination were informed of their serostatus. Participants who were found to be HBV susceptible were informed that they were HBV negative and encouraged to receive vaccination.

Participants who wanted to be vaccinated were given a referral to a nearby health clinic (across the street in Harlem and five blocks away in the Bronx). Participants were escorted for the first vaccination by study staff with a vaccination card to the health clinic, where the study staff arranged for an appointment with the health clinic staff. For each subsequent vaccination, participants were not escorted by study staff to appointments, but calls were made by study staff to facilitate vaccination appointments. Participants were compensated (\$5) for returning a vaccination card, signed by the staff of the health clinic, back to the study site after each dose of the vaccine. Participants were encouraged to adhere to a zero-month, one-month and six-month schedule; compensation was not contingent on suggested spacing of vaccine doses.

Statistical methods

Two sets of analyses were conducted to deal with the questions of vaccination acceptance and completion using SAS 8.0²⁸. Firstly, we assessed correlates of vaccine acceptance. Vaccine acceptance was defined as receiving at least one dose of the vaccine and returning the vaccination card to study personnel among those who were susceptible to HBV. Among those susceptible to HBV at baseline and who came back for their result visit, we compared those who received at least one dose of HBV vaccine with those who did not receive any doses to assess correlates of vaccine acceptance. Secondly, among drug users who received at least one dose of vaccine (acceptors) we compared those who completed the HBV vaccine series (three doses) with those who did not complete (one to two doses) but were due to be vaccinated, to determine correlates of vaccination completion.

For each analysis, we used bivariable analysis to compare demographic, drug use, and sexual behaviors between the groups of acceptors (*vs* not) and completers (*vs* not) using the chi-square statistic for categorical variables and *t*-tests for continuous variables. Covariates that were associated with vaccination status in bivariable analyses ($p < 0.2$) were included for consideration in logistic models. Variables were retained in the final model if they were significant at the $\alpha = 0.05$ level.

Results

Among the 1117 subjects enrolled in the two ongoing studies, 63 were missing HBV serology results. Of the remaining 1054, 26.1% (275) had been previously infected, 57.9% (610) were susceptible to HBV at baseline, and 16.0% (169) had serological evidence of previous vaccination. IDUs were significantly more likely to show serological evidence of a previous infection than NIDUs (36.1% *vs.* 21.6%, $p < 0.01$).

Of the 610 participants susceptible to HBV, 466 (76.4%) returned for their result visit and were available for this analysis. Those who returned for the results were more likely to be under 25 years of age (73.9% *vs* 60.9%, $p < 0.01$) and Hispanic (32.9% *vs* 23.8%, $p = 0.06$) and less likely to be Black (57.3% *vs* 61.6%, $p = 0.06$) or White/Other (9.8% *vs* 14.6%, $p = 0.06$) than those who did not return for their results (data not shown). Table 1 describes the sociodemographic characteristics of IDUs and NIDUs susceptible to HBV. The sample was predominantly male (75.1%) and Hispanic (57.3%). The mean age at enrolment was 29.2 (SD: 6.1) years. Some 11.4% self-identified as lesbian, gay, or bisexual. Almost 43% had at least a high school diploma or equivalent. Most (42.7%) reported an illegal main income source. About 80.3% had been homeless in their lifetime.

Of the 466 HBV-susceptible drug users in this study, 251 (53.9%) completed at least one dose of the vaccine. There were no significant differences in terms of sociodemographic variables between vaccine receivers and non-receivers. Those who received at least one vaccine dose were more likely to have been recruited at the Bronx study site (table 1, $p < 0.01$). We next examined sexual and drug use behaviour correlates of vaccine

acceptance (table 2). About 22.2% had injected drugs in the preceding two months; NIDUs were significantly more likely to accept vaccination than IDUs. Those who received at least one vaccine dose were significantly less likely to use crack daily or inject daily than those who did not receive any doses. Vaccine acceptors were also less likely to be daily users of alcohol, cocaine, and heroin, although these associations did not reach significance.

In multivariable logistic regression (table 3), receiving public assistance was significantly associated with acceptance of the HBV vaccine. In addition, participants recruited from the Bronx study site were more likely (odds ratio = 1.66; 95% confidence interval: 1.06, 2.61) to receive at least one vaccine dose than participants recruited in Harlem. Those who were under age 25 and smoked crack daily were less likely to accept vaccination.

Of the 251 who had received at least one vaccine dose, 11 were not due to complete their vaccine series at the time of this analysis. Among the 240 remaining, 98 (40.8%) received all three doses. We next investigated the correlates of vaccination series completion (tables 1 and 2). Vaccination completion rates were higher in the Bronx than in the Harlem study site (49.6% *vs* 30.6%, $p < 0.01$) and higher among women compared to men (53.0% *vs* 36.1%, $p = 0.02$). Hispanics were less likely to complete the series, although this association was not statistically significant in bivariable analysis. NIDUs were significantly more likely to complete the vaccination series as compared to IDUs (44.4% *vs* 24.4%, $p = 0.02$). Daily heroin users and daily injectors were significantly less likely to complete the series. In multivariable logistic regression modelling (table 4) daily injectors, Hispanics, and those recruited at the Harlem storefront were significantly less likely to complete the HBV vaccination series.

Discussion

In this cohort of heroin, crack, and cocaine users in northern New York City, 57.9% (610) were susceptible to HBV. IDUs were more likely to have been HBV infected than NIDUs, as previous studies have shown^{4,9,29}. However, HBV infection among NIDUs was not negligible, with 21.6% having serological evidence of previous infection. In terms of vaccine acceptance, NIDUs were more likely to complete the HBV vaccination series.

Among drug users susceptible to HBV in this study, 53.9% (251) received at least one dose of the HBV vaccine when referred, and escorted to, a nearby health clinic. Studies have reported first dose acceptance rates 23-80% among sexually transmitted disease (STD) clinic attendees^{30,31}, 82.8% among sex workers,³² and 24-60% among IDUs¹⁸⁻²⁰. Our acceptance rates were markedly different from a study in Seattle that reported that only 24% of study subjects received at least one HBV vaccine dose¹⁸. However, there are two important differences between the study in Seattle and our study: the Seattle study did not include NIDUs and participants did not receive a monetary incentive. In Alaska, investigators provided monetary incentives and transportation for their IDU study participants and were able to vaccinate more than 60% with at least one dose of anti-HBV vaccine¹⁹.

TABLE 1 Demographic characteristics of 466 drug users susceptible to HBV in Harlem and the South Bronx, by acceptance and completion of HBV vaccination. Values are numbers (percentages) of participants unless otherwise indicated.

	Total (n=466) (%)	Vaccine receivers [†] (n=251) (%)	p value	Vaccine completers [‡] (n=98) (%)	p value
Age in years					
>25	124 (26.6)	69/124 (55.7)		24/64 (37.5)	
≥25	342 (73.4)	182/342 (43.2)	0.64	74/176 (42.1)	0.53
Sex					
Male	346 (75.1)	182/346 (52.6)		62/172 (36.1)	
Female	115 (24.9)	67/115 (55.3)	0.29	35/66 (53.0)	0.02
Race					
Hispanic	267 (57.3)	137/267 (51.3)		46/131 (35.1)	
Black	154 (33.1)	88/154 (57.1)		40/83 (48.2)	0.14
White/Other	45 (9.7)	26/45 (57.8)	0.44	12/26 (46.2)	
Sexual orientation					
Straight	404 (88.6)	216/404 (53.5)		84/205 (41.0)	
Lesbian/gay/bisexual	52 (11.4)	29/52 (55.8)	0.75	11/29 (37.9)	0.75
Education					
<High school	265 (57.1)	137/265 (51.7)		52/129 (40.3)	
High school	199 (42.9)	112/199 (50.5)	0.33	46/109 (42.2)	0.77
Homeless					
Never	92 (19.7)	48/111 (43.2)		23/47 (48.9)	
Ever	374 (80.3)	203/400 (50.8)	0.72	75/193 (38.9)	0.21
Main source income					
Employed	99 (20.7)	44/94 (46.8)		14/41 (34.2)	
Illegal	194 (42.7)	109/194 (56.2)		36/102 (35.3)	0.34
Public assistance	98 (21.6)	55/98 (56.1)	0.42	24/54 (44.4)	
Other	68 (15.0)	34/68 (50.0)		17/34 (50.0)	
Recruitment site					
Bronx	217 (46.6)	140/217 (64.5)		64/129 (49.6)	
Harlem	249 (53.4)	111/249 (44.6)	<0.01	34/111 (30.6)	<0.01

* Categories do not add to 466 because of missing values.

† Among total sample, those who received at least one vaccine dose.

‡ Among 240 vaccine receivers who were eligible to receive all three doses, those who completed all three doses.

Previous findings from these data have show that young drug users are more likely to have a history of previous vaccination³³. In our study, older drug users and those receiving public assistance were more likely to initiate the HBV vaccine series. This association may reflect differences in treatment and/or service seeking behaviours as opposed to actual differences in income. Regardless of the reason, it is important to note that older drug users who may have been missed by other vaccination programmes were willing to initiate the

vaccine series when encouraged to do so. These findings are similar to a study of a street involved population in Winnipeg, which reported that people aged 25 and older were more likely to complete the HBV vaccination series³⁴.

About 40% of study participants who received at least one dose of the HBV vaccine completed the three-dose vaccine series. A significant predictor of both initiating and completing the vaccine series was study site. Participants recruited at the storefront in the South Bronx

TABLE 2 Sexual and drug use behaviours of 466 drug users susceptible to HBV in Harlem and the South Bronx, by acceptance of HBV vaccination. Values are numbers (percentages) of participants unless otherwise indicated.

	Total (n=466) (%)	Vaccine receivers* (n=251) (%)	p value	Vaccine completers† (n=98) (%)	p value
Injecting drug use					
Never (NIDU)	361 (77.8)	206/361 (57.1)		88/198 (44.4)	
Ever (IDU)	103 (22.2)	44/103 (42.7)	0.01	10/41 (24.4)	0.02
Age at 1st injection in years					
<25	59 (57.8)	25/59 (42.4)		6/23 (26.1)	
≥25	43 (42.2)	19/43 (44.2)	0.86	4/18 (22.2)	0.77
Injection frequency in preceding 6 months					
Daily	62 (13.4)	26/62 (41.9)		4/25 (16.0)	
<Daily	38 (8.2)	16/38 (42.1)		5/14 (35.7)	
None	364 (78.5)	208/364 (57.1)	0.03	89/200 (44.5)	0.02
Drug or alcohol treatment					
Never	157 (34.1)	85/157 (54.1)		32/85 (39.2)	
Ever	304 (65.9)	163/304 (53.6)	0.92	64/155 (41.3)	0.74
Alcohol use in preceding 6 months					
Daily	89 (19.1)	39/89 (43.8)		19/38 (50.0)	
<Daily	288 (61.8)	159/288 (55.2)		56/149 (37.6)	
None	89 (19.1)	53/89 (59.6)	0.08	23/53 (43.3)	0.35
Cocaine use in preceding 6 months					
Daily	52 (11.2)	24/52 (46.2)		8/23 (34.8)	
<Daily	285 (61.2)	160/285 (56.1)	0.36	63/153 (39.4)	0.82
None	129 (27.7)	67/129 (51.9)		27/64 (42.2)	
Crack use in preceding 6 months					
Daily	80 (17.2)	31/80 (38.8)		11/31 (35.5)	
<Daily	188 (40.3)	108/188 (57.5)	<0.01	42/104 (40.4)	0.76
None	198 (42.5)	112/198 (56.6)		45/105 (42.9)	
Heroin use in last 6 months					
Daily	142 (30.5)	68/142 (47.9)		19/67 (28.4)	
<Daily	167 (35.8)	91/167 (54.5)	0.18	38/87 (43.7)	0.04
None	157 (33.7)	92/157 (58.6)		41/86 (47.7)	
IDU sex partner					
Ever	56 (12.0)	32/56 (57.1)		11/29 (37.9)	
Never	410 (88.0)	219/410 (53.4)	0.60	87/211 (41.2)	0.73
Homosexual sex partner					
Ever	168 (36.1)	92/168 (54.8)		30/86 (34.8)	
Never	298 (63.9)	159/298 (53.4)	0.77	68/154 (44.2)	0.16
Hepatitis positive sex partner					
Ever	301 (93.2)	163/301 (54.2)		67/155 (43.2)	
Never	22 (6.8)	9/22 (40.9)	0.23	3/9 (33.3)	0.56

* Among total sample, those who received at least one vaccine dose.

† Among 240 vaccine receivers who were eligible to receive all three doses, those who completed all three doses.

were more likely to both initiate and complete the vaccination series than those recruited at the Harlem storefront. In terms of study protocol, there were no differences between the Bronx and Harlem. However, there were two important structural differences between the two sites in terms of vaccination: distance to the vaccination clinic and waiting time. The Harlem vaccination site was closer to the study site than

the Bronx vaccination site; however, the Bronx site was more convenient for participants. In Harlem, participants often had to wait several hours to get their vaccinations, whereas in the Bronx, the waiting time was considerably shorter. Convenience seems to have a role in acceptance of harm reduction opportunities and has been described in other situations. A recent study in Baltimore showed the role of convenience in harm

TABLE 3 Multivariable logistic regression models describing correlates of HBV vaccination acceptance among drug users in Harlem and the South Bronx

	HBV vaccination acceptance	
	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Age in years		
≥25	1.00	1.0
<25	0.65 (0.41 to 1.02)	0.57 (0.35 to 0.93)
Main income source		
Employed	1.00	1.0
Illegal	1.09 (0.64 to 1.63)	0.91 (0.57 to 1.48)
Public assistance	2.55 (1.35 to 4.81)	2.38 (1.24 to 4.56)
Site		
Harlem	1.00	1.0
Bronx	1.45 (0.96 to 2.23)	1.66 (1.06 to 2.61)
Crack used in preceding 6 months		
None	1.00	1.0
<Daily	1.19 (0.74 to 1.90)	1.17 (0.71 to 1.92)
Daily	0.41 (0.22 to 0.74)	0.35 (0.19 to 0.66)

reduction services, where those who lived less than three miles from a needle exchange were more likely to exchange needles than those who lived further away³⁵ where, as in Alaska, including HBV vaccination as an on-site service for a needle exchange programme resulted in high completion rates¹⁹.

Participants who used crack daily were less likely to initiate HBV vaccination and those who injected daily were less likely to complete the HBV vaccination, series once initiated. It is likely that participants who use drugs more often spend more time getting money to buy drugs, and thus will not get vaccinated if services are not convenient and immediate. Innovative approaches are needed to meet the needs of these vulnerable populations, including continued integration with needle exchange programmes, outreach using mobile vans, and direct outreach in areas of high drug traffic.

We also observed that Hispanics were less likely to complete the vaccination series than Blacks and Whites. In an effort further to understand this finding, we evaluated whether or not the questionnaires were administered in English or Spanish, as a crude proxy for acculturation. We also examined the potential interaction between language and site, as the South Bronx is a predominately Hispanic neighbourhood compared with Harlem. However, language was not associated with vaccine completion, nor was the interaction between site and language significant. One potential barrier to vaccination completion may be racial/ethnic discrimination, whether actual or

perceived. Further research is needed to determine whether this association is observed in other Hispanic populations and the extent to which discrimination is associated with vaccination rates.

These results must be considered in the context of our study's limitations. The extent to which these findings are generalisable to other situations, or other cities, is unclear. However, in light of the lack of published data on correlates of HBV vaccination acceptance and completion among drug users, these data provide valuable insight into the provision of HBV vaccine to this hard-to-reach population.

Data on vaccination acceptance and completion came from participants returning vaccination cards that were completed by the healthcare providers who administered the vaccine. It is possible that some participants who did not return the vaccination cards were vaccinated, thereby causing us to underestimate acceptance and completion rates. We cannot determine how many participants did not return the card but were vaccinated. However, since participants received a nominal reimbursement for bringing back their completed vaccination cards we do not believe this to be a large number.

In summary, we found that most of the street recruited drug users in this population were susceptible to HBV, and more than half accepted at least one dose of HBV vaccination when offered in the context of this study. These results may provide insight into and guide improved HBV vaccine coverage among drug users. HBV vaccination acceptance among drug users may rise if the vaccination services offered are convenient and individuals are nominally compensated to receive vaccination. Drug users will be an important target population when an HIV vaccine becomes available. Understanding some of the correlates of HBV vaccination acceptance can guide and inform strategies for HIV vaccination programmes among this high-risk subgroup.

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TABLE 4 Multivariable logistic regression models describing correlates of HBV vaccination completion among drug users in Harlem and the South Bronx

	HBV vaccination acceptance	
	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)
Hispanic	0.59 (0.35 to 1.00)	0.51 (0.28 to 0.92)
Daily injection	0.25 (0.08 to 0.74)	0.28 (0.09 to 0.88)
Site		
Bronx	1.0	1.0
Harlem	0.45 (0.26 to 0.76)	0.35 (0.19 to 0.62)

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