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## Factors Associated with Adolescent Initiation of Injection Drug Use

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### S Y N O P S I S

**Objective.** The purpose of this study was to evaluate the extent to which demographic, sexual, and non-injection drug use practices predict adolescent initiation of injection drug use.

**Methods.** Street recruited injection drug users 15–30 years of age in Baltimore, Maryland, who initiated injection within five years of study enrollment, completed a questionnaire that included a year-by-year history regarding the five years prior to initiation of injection. Factors associated with initiation during adolescence ( $\leq 21$  years of age) versus young adulthood ( $> 21$ ) were determined using logistic regression.

**Results.** Of 226 participants, most were female (61%) and African American (64%). Median age of participants was 25; median age at initiation of injection was 23. Factors significantly associated with adolescent initiation in multivariate analysis included race other than African American, and practices prior to initiating injection including condom use, lack of cocaine use, exclusive crack smoking just prior to initiation, and smoking marijuana. Adolescent initiates also had shorter durations of illicit drug use prior to initiating injection.

**Conclusion.** Short-term non-injection drug use, particularly exclusive crack smoking, was associated with adolescent initiation of injection drug use. Early prevention efforts targeting this high-risk group of younger drug users are warranted in order to delay or prevent onset of injection drug use.

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Injection drug use continues to be a major risk factor for acquisition of human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV).<sup>1-9</sup> Cohort studies conducted among injection drug users (IDUs) have indicated that younger ( $\leq 21$  and  $\leq 35$  years of age) age and short-term injection drug use are risk factors for HIV infection.<sup>1,2,10,11</sup> Cross-sectional studies have consistently shown younger ages ( $\leq 21$  and  $\leq 35$  years of age) to be independently associated with HIV seroprevalence as well as high-risk injection practices.<sup>12-15</sup>

Among the few cross-sectional studies conducted among young or newly initiated IDUs, both high-risk sexual practices (such as trading sex for money or drugs, having multiple sex partners, men having sex with men) and injection practices (injecting cocaine or speedball or sharing injection equipment within a high-risk network, for example) have been found to be independently associated with HIV seroprevalence.<sup>19,20</sup> These studies have emphasized the need for more comprehensive research among young or newly initiated IDUs so that timely intervention and prevention programs may be implemented.<sup>3,16-18,21,22</sup>

Because transmission of HIV, and particularly HCV, occurs soon after initiation of injection (often within the first two years), only a brief window of opportunity exists to intervene and prevent infection.<sup>6,8,9</sup> Although IDUs typically initiate injection drug use during late adolescence, a sizable subgroup begins injecting during early and late adulthood.<sup>15,16,18,23</sup> With one exception,<sup>18</sup> among the few studies that have described the differences between younger and older initiates with respect to HIV risk behavior it is younger initiates who have reported higher levels of sexual and injection risk behaviors.<sup>15-17</sup> Previous researchers have noted that it is plausible that a strong association exists between initiation of injection drug use and early non-injection drug use or sexual behaviors prior to initiation.<sup>16</sup> Thus, specific risk behaviors found to be more common among adolescent initiates might be targeted for specific interventions that might decrease the acquisition of HIV, HBV, and HCV infection.

We recruited adolescent and young adult IDUs between the ages of 15 and 30 in Baltimore, Maryland, and collected year-by-year histories of sexual and drug use practices up to five years prior to initiation of injection to study entry. The purpose of this study was to evaluate the extent to which demographic, sexual, and non-injection drug use practices differentiate adolescent versus young adult initiation of injection drug use.

## METHODS

**Study population.** Between July 1997 and May 1999, 276 adolescent and young adult IDUs were recruited into a prospective study of HIV infection (Risk Evaluation and Assessment of Community Health—REACH II) through extensive community-based street outreach in Baltimore. Experienced outreach workers who engaged young drug users on the street served as the primary method of recruitment for this study. The outreach team posted flyers in various settings such as youth shelters, treatment centers, emergency rooms, public health clinics, the Baltimore City Needle Exchange Program, and neighborhoods with vacant buildings. Participants were also recruited through word of mouth. Since adolescent and young adult IDUs tend to be difficult to locate, a recreational vehicle (mobile clinic) was used to enhance accessibility to this hidden population. The REACH II van parked in various areas with high drug activity in the city and was used to recruit, enroll, and interview study participants. A stationary clinic site in East Baltimore also operated daily in conjunction with the mobile clinic. Participants were compensated \$15 for their time spent during the baseline study visit.

To be eligible for the study, participants had to be 15 to 30 years of age (verified by photo identification), to have injected drugs no more than 5 years before study entry, and to report injecting at least once in the 6 months prior to study entry. Injection status was verified by presence of "stigmata," or track marks. If without visible stigmata, participants were enrolled only if their reported injection history was less than one year and frequency of injection was less than one time per week. During this study, non-IDUs (crack smokers, and intranasal heroin or cocaine users) were enrolled simultaneously to reduce the incentive to fabricate an injection history simply to obtain study entry for the associated remuneration. Participants who reported a history of injection at the baseline visit and subsequently reported having no lifetime history of injection at a follow-up visit were excluded from the analysis. Of 276 screened IDUs, 226 (82%) were considered eligible and were included in the final analysis.

The Institutional Review Board of the Johns Hopkins School of Public Health (Committee on Human Research) approved this study. An active community advisory board (CAB) was established that consisted of community leaders from community-based organizations and social services agencies. The REACH II CAB facilitated development of referral protocols and recruitment strategies.

## Adolescent crack smokers transition relatively quickly from a short period of exclusive crack smoking to a brief period of other non-injection drug use (heroin or cocaine, for example), and subsequently to injection drug use.

**Data collection.** After participants were screened for eligibility (by the outreach worker during the recruitment phase and by the interviewer during the enrollment phase), informed consent was obtained and a structured interview was administered privately by a trained interviewer. The baseline interview covered topics that included demographics, drug use, injection, and sexual practices. In addition to characteristics measured as “ever” having occurred and those occurring during the six months preceding study entry, we obtained year-by-year histories of specific sexual (condom use and trading sex, for example) and drug use practices (such as frequency of marijuana, alcohol, heroin, cocaine, and crack use). The histories spanned the five years prior to initiation of injection use up to the study entry date, using an interviewer strategy described elsewhere.<sup>24,25</sup> In brief, these histories began with prevalence measures of behaviors occurring in the most remote period (five years prior to initiation) and moved forward in time to the most recent period (one year prior study entry).

Due to the event of unequal time periods among participants from initiation of injection drug use to study entry, duration of injection use was controlled in the final analysis.

**Data analysis.** Variables explored as potential correlates of adolescent initiation ( $\leq 21$  years of age) of injection drug use compared with initiation among young adults ( $> 21$  years of age) included demographic characteristics such as sex, race or ethnicity, duration of injection drug use, source of income, and juvenile arrest. Most of the study sample was comprised of either African American (64%) or white (31.4%) participants, which also reflects the racial make-up of the general population of Baltimore. The fewer than 5% reporting Hispanic or other ethnicity were combined with the white category to create an African American versus non-African American variable so that similar comparisons across previous studies can be made. We examined current sexual practices, including sex with an IDU and multiple sex partners

(three or more sex partners within the six months prior to study entry).

Pre-initiation sexual practices included age at first sexual experience, having been raped or sexually assaulted, trading sex for drugs or money, and lack of condom use during the year prior to initiation of injection. A lifetime measure of having had sex with an injection drug user and having had current multiple sex partners (in past six months) were also explored. Pre-initiation drug use practices included use of alcohol, marijuana, inhalants, hallucinogens, heroin, crack, and cocaine. With the exception of hallucinogens and inhalants, each drug was measured using the year-by-year history described above. Although alcohol use was measured through the year-by-year history, a lifetime alcohol variable was not measured.

Each drug use practice was subdivided into three variables of differing time periods: (a) a broad time period defined as having “ever used prior to initiation of injection”; (b) a more refined time period defined as “used any time in the two years prior to initiation of injection”; and (c) a refined and specific time period defined as “used during year one or year two prior to initiation of injection.” To be conservative, we did not consider those who reported first use of a specific drug type during the same year of initiation as having used that particular drug type *prior* to initiation. For example, participants reporting both first use of crack cocaine and first injection at age 18 were not considered as having used crack prior to initiation since it was uncertain whether the crack use actually preceded the first injection during that year. Thus, non-injection drug use practices preceding initiation may be slightly underestimated in this analysis. This approach was also employed when considering sexual practices.

To compare factors associated with initiation of injection among adolescents versus young adults, we performed simple descriptive statistical tests for all variables of interest. Where continuous data were skewed, medians and ranges rather than variable means were used. Continuous data were dichotomized, when appropriate, using natural cut-points unless the data suggested more

meaningful cut-points. For example, although the median age of initiation was 23, age 21 was used as the cut-point to distinguish adolescence from young adulthood, as defined by the American Medical Association and the American Academy of Pediatrics. We conducted bivariate analyses of contingency tables of exposure variables by adolescent initiation using chi-square tests and Mantel-Haenszel odds ratios to test the strength of the association. We conducted t-tests for differences between sample means. Variables that were significant at the 5% level in bivariate analyses were entered into multivariate models to determine the independent effect of each variable of interest on the initiation of drug use during adolescence. Formal tests of interactions were performed.

**RESULTS**

Of the 226 IDUs enrolled in the REACH II Study, the median age at study entry was 25 (range 15–30 years of age) and at initiation of injection was 23 (range 10–30

years of age), with 91 (40%) IDUs initiating drug use during adolescence. More than half the study sample was African American (64%), female (61%), and had been injecting for two years or less at study entry (61%) (Table 1). Adolescent initiates were less likely than young adult initiates to be female (odds ratio = 0.58), African American (odds ratio = 0.19), and to have reported injecting for two years or less (odds ratio = 0.19). Adolescent initiates were more likely than young adults to report spending time in juvenile arrests (odds ratio = 2.44) and more likely to report “street survival” (defined as trading sex, selling drugs, theft, or panhandling) as their primary source of income in the past six months (odds ratio = 2.13).

In terms of sexual practices (Table 2), adolescent initiates were significantly more likely than young adults to report having their first sexual experience prior to age 14 (odds ratio = 2.18) and to having multiple sex partners in the six months prior to study entry (odds ratio = 1.88). Although a lower proportion of adolescent initiates (31.3%) than young adults (43.8%) reported ever having

**Table 1. Demographic characteristics associated with adolescent initiation of injection drug use among recently initiated IDUs in Baltimore, using logistic regression, 1997–1999 (N = 226)**

Characteristic	Number	Percent	Initiated at age	Odds ratio	95% CI
			≤21 years (n = 91) Percent		
Duration of injection prior to enrollment?					
≤2 years	138	61	31.2	0.19	0.10, 0.34
3–5 years	88	39	54.6	1.00	
Race/Ethnicity					
African American	145	64	26.2	0.19	0.10, 0.34
White or Other <sup>a</sup>	81	36	65.4	1.00	
Sex					
Female	137	61	35.0	0.58	0.34, 0.99
Male	89	39	48.3	1.00	
Juvenile arrest					
Yes	45	20	57.8	2.44	1.27, 4.75
No	181	80	35.9	1.00	
Source of income <sup>b</sup>					
Street survival <sup>c</sup>	104	46	50.0	2.13	1.24, 3.66
Public assistance/job/none	122	54	32.0	1.00	

<sup>a</sup>Includes White (31.4%), Hispanic (1.8%), Native American (1.8%), and Other race/ethnicity (0.9%)

<sup>b</sup>In the six months prior to study enrollment

<sup>c</sup>Includes trading sex for money or drugs, selling drugs, theft, or pan handling

CI = confidence interval

**Table 2. Current and pre-initiation sexual practices associated with adolescent initiation of injection drug use among recently initiated IDUs in Baltimore, using logistic regression, 1997–1999 (N = 226)**

Characteristic	Number	Percent	Initiated at	Odds ratio	95% CI
			≤21 years of age (n = 91) Percent		
<b>Age at first sex</b>					
<14 years . . . . .	96	42	51.1	2.18	1.27, 3.76
≥14 years . . . . .	130	58	32.3	1.00	
<b>Sex with an injection drug user</b>					
Ever . . . . .	64	28	31.3	0.58	0.32, 1.08
Never . . . . .	162	72	43.8	1.00	
<b>Multiple sex partners<sup>a</sup></b>					
≥3 sex partners . . . . .	82	36	50.0	1.88	1.08, 3.28
<3 sex partners . . . . .	144	64	34.7	1.00	
<b>Rape or sexual assault prior to initiation</b>					
Yes . . . . .	29	13	32.4	0.67	0.32, 1.41
No . . . . .	197	87	41.8	1.00	
<b>Traded sex one year prior to initiation</b>					
Yes . . . . .	48	21	37.5	0.86	0.45, 1.66
No . . . . .	178	79	41.0	1.00	
<b>Condom use one year prior to initiation</b>					
Yes . . . . .	149	66	45.6	1.97	1.10, 3.54
No . . . . .	77	34	29.9	1.00	

<sup>a</sup>In the six months prior to study enrollment

CI = confidence interval

sex with an injection drug user, these differences were not statistically significant. For pre-initiation sexual practices, adolescent initiates were more likely than young adults to report condom use within one year prior to initiation (odds ratio = 1.97). There was no significant difference between adolescent and young adult initiates in proportions of those who reported trading sex one year prior to initiation or those who had experienced forced sex.

Regarding average length of time from first use of non-injection drugs to initiation of injection, adolescent initiates had significantly shorter durations (5.2 years) than young adult initiates (10.6 years) for smoking marijuana, inhalant use (4.7 years among adolescents, 9.8 years among young adults), snorting heroin (2.7 years among adolescents, 6.4 years among young adults), snorting cocaine (2.3 years among adolescents, 7.2 years among young adults), and smoking crack (1.9 among adolescents, 5.2 years among young adults).

When drug use prior to initiation was examined (Table 3), adolescent initiates were more likely than

young adult initiates to report using inhalants (odds ratio = 2.29) and hallucinogens (odds ratio = 2.56). Although the majority of IDUs in this study had used heroin, cocaine, or crack cocaine at some point prior to initiation, adolescent initiates were less likely than young adults to have used heroin (odds ratio = 0.51), cocaine (odds ratio = 0.42), or crack (odds ratio = 0.41). The two groups did not differ significantly in ever having used marijuana prior to initiation.

New associations emerged during examination of non-injection drug use specifically during the one or two years prior to initiation of injection. During this period, adolescent initiates were more likely than young adults to have smoked marijuana (odds ratio = 3.20). Although there were no significant differences between adolescent and young adult initiates when “Only snorting heroin” and “Only snorting cocaine” were examined, adolescent initiates were more likely to have exclusively smoked crack (odds ratio = 2.65), and were less likely to have exclusively snorted heroin and cocaine (odds ratio =

**Table 3. Pre-initiation drug use practices associated with adolescent initiation of injection drug use among recent IDUs in Baltimore, 1997–1999 (N = 226)**

<i>Characteristic</i>	<i>Number</i>	<i>Percent</i>	<i>Initiated at ≤21 years of age (n = 91) Percent</i>	<i>Odds ratio</i>	<i>95% CI</i>
<i>Any time prior to initiation</i>					
<i>Used marijuana</i>					
Ever . . . . .	202	89	42.1	2.18	0.83, 5.72
Never . . . . .	24	11	25.0	1.00	
<i>Used inhalants</i>					
Ever . . . . .	48	21	56.3	2.29	1.20, 4.38
Never . . . . .	178	79	36.0	1.00	
<i>Used hallucinogenics</i>					
Ever . . . . .	48	21	58.3	2.56	1.34, 4.90
Never . . . . .	178	79	35.4	1.00	
<i>Snorted heroin</i>					
Ever . . . . .	179	79	36.9	0.51	0.27, 0.89
Never . . . . .	47	21	53.2	1.00	
<i>Snorted cocaine</i>					
Ever . . . . .	135	60	52.8	0.42	0.24, 0.72
Never . . . . .	91	40	31.9	1.00	
<i>Smoked crack</i>					
Ever . . . . .	124	55	52.0	0.41	0.24, 0.70
Never . . . . .	102	45	30.7	1.00	
<i>During year 1 or 2 prior to initiation</i>					
<i>Snorted heroin only</i>					
Yes . . . . .	57	25	35.1	0.75	0.40, 1.39
No . . . . .	169	75	42.0	1.00	
<i>Snorted cocaine only</i>					
Yes . . . . .	6	3	33.3	0.74	0.13, 4.10
No . . . . .	220	97	40.5	1.00	
<i>Smoked crack only</i>					
Yes . . . . .	16	7	62.5	2.65	0.93, 7.58
No . . . . .	210	93	38.6	1.00	
<i>Snorted heroin and cocaine only</i>					
Yes . . . . .	27	12	22.2	0.38	0.15, 0.99
No . . . . .	199	88	42.7	1.00	
<i>Drank alcohol daily</i>					
Yes . . . . .	25	11	48.0	1.43	0.62, 3.28
No . . . . .	201	89	39.3	1.00	
<i>Smoked marijuana</i>					
Yes . . . . .	142	63	50.0	3.20	1.76, 5.83
No . . . . .	84	37	23.8	1.00	

CI = confidence interval

**Table 4. Multivariate analysis of the relation between adolescent initiation of injection drug use and high-risk pre-initiation and post-initiation correlates among recently initiated IDUs in Baltimore, 1997–1999 (N = 226)**

Variable	Initiation at age $\leq 21$ years		
	Unadjusted odds ratio	Adjusted <sup>a</sup> odds ratio	Adjusted 95% CI
African American . . . . .	0.19	0.15	0.07, 0.33
Duration of injection use $\leq 2$ years . . . . .	0.19	0.40	0.19, 0.81
First sex at age $< 14$ years . . . . .	2.18	2.38	1.20, 4.71
No condom use within one year prior to initiation . . . . .	1.97	2.51	1.21, 5.39
Smoked crack within one year prior to initiation . . . . .	0.22	0.23	0.08, 0.65
Smoked crack only during year 1 or year 2 prior to initiation . . . . .	2.65	5.14	1.22, 21.61
Smoked marijuana during year 1 or year 2 prior to initiation . . . . .	3.20	3.11	1.51, 6.41
Snorted cocaine prior to initiation . . . . .	0.42	0.44	0.21, 0.95

<sup>a</sup>Adjusted for all variables listed in the logistic regression model. All unadjusted early behaviors significantly associated with adolescent initiation prior to adjustment were entered into the regression model.

CI = confidence interval

0.38). Daily alcohol drinking did not differ between the two groups during this period.

Multiple logistic regression was used to determine factors that were independently associated with adolescent initiation of injection drug use (Table 4). Compared with young adult initiates, IDUs who initiated injection drug use during adolescence were less likely to be African American (odds ratio = 0.15) or to have had an injection history of ( $\leq 2$  years (odds ratio = 0.40). However, adolescent initiates were more likely to have had their first sexual experience at less than 14 years of age (odds ratio = 2.38) and to have reported condom use one year prior to initiation (odds ratio = 2.51). While adjusting for any crack cocaine use within one year prior to initiation (alone or in combination with other illicit drugs), adolescent initiates were more likely than young adults to have exclusively smoked crack (odds ratio = 5.14) during the two years prior to initiation. They were less likely, however, to have ever snorted cocaine prior to initiation (odds ratio = 0.44). The final model also showed adolescent initiates to be three times more likely than older initiates to have smoked marijuana during the two years preceding initiation.

## DISCUSSION

Our major finding in this study was that age of initiation into injection drug use appears to be associated with different risk behaviors preceding initiation. Adolescent ini-

tiates had a briefer but more intense risk interval before starting to inject drugs. This observation might reflect several factors, but the implication is that the adolescent initiators who are also at the highest risk for HIV and HCV infections can be observed as having high-risk, pre-initiation behaviors that can be distinguished and identified for public health intervention.

Previous published reports have identified several factors associated with younger initiation of substance abuse (during early and late adolescence) that may explain a faster acceleration into injection compared with individuals reporting an older initiation of substance abuse (young adulthood).<sup>26-29</sup> Specifically, our findings are consistent with an earlier study<sup>26</sup> of adolescent substance abuse, which noted an association between developmental test results of participants and age of onset and intensity of drug used. For example, compared with older adolescent drug users (15–18 years of age), younger (12–14 years of age) adolescents who exhibited increased levels of substance abuse were more likely to exhibit psychological distress, which the authors posited might explain a faster progression into heavier drug use.<sup>26</sup> Although we did not have measures of psychological distress in this study, these earlier studies provide some evidence that the initiation and practice for risk behavior may vary by age of initiation into injection drug use; if so, age of initiation into injection would be important to consider when developing public health interventions. The differences seen in



## Adolescent initiates were more likely than young adults to be other than African American, suggest[ing] possible sociocultural differences at the individual and group levels with respect to perceptions of illicit drug use and the transition into heavier use.

the early onset of illicit drug use are important to consider given the potential for early initiation of injection in this group, and the negative health consequences associated with early initiation.

Although adolescent initiates were less likely than young adult initiates to have ever smoked crack, exclusive crack smoking one or two years prior to initiation demonstrated the strongest relationship with adolescent initiation of injection. Surprisingly, we observed that smoking crack in combination with use of other drugs one year prior to initiation was inversely associated with adolescent initiation of injection. These findings may suggest that adolescent crack smokers transition relatively quickly from a short period of exclusive crack smoking to a brief period of other non-injection drug use (heroin or cocaine, for example), and subsequently to injection drug use. It should be noted that the association between adolescent initiation and crack use was probably not explained by a period effect that reflects the crack epidemic, as we studied the same calendar time for the two groups. No other significant associations were observed during the year prior to initiation; however, adolescent initiates were more likely than young adults to report smoking marijuana within the two years prior to initiation, but young adults were more likely to report a history of cocaine use any time prior to initiation. Our findings, especially when coupled with an earlier study that noted early adolescence ( $\leq 20$  years of age) to be associated with increased levels of substance abuse when compared with late adolescence (20–30 years of age),<sup>27</sup> emphasize the need for interventions aimed not only at delaying the onset of illicit drug use during adolescence, but also at reducing levels of use among young adult non-injection drug users, to help prevent transition into injection.

Given that the median age at study entry was 25 years, it is not surprising that adolescent initiates in this study sample had a longer duration of injection than adults, since most participants initiated injection over the age of 21 (median age at initiation was 23 years) and the

median length of injection was two years. These findings provide evidence that the typical age of initiation into injection drug use may be moving more into young adulthood as opposed to late adolescence, which has been suggested in a recent report.<sup>18</sup>

We also found that adolescent initiates were more likely than young adults to be other than African American, in contrast to a recent study of IDUs in New York.<sup>18</sup> These findings support earlier studies which found white males to have higher rates of mental illness, polydrug abuse, and early initiation of non-injected drugs (that is, tobacco, alcohol and marijuana) compared with African American males.<sup>30–32</sup> These ethnic differences could suggest possible sociocultural differences at the individual and group levels with respect to perceptions of illicit drug use and the transition into heavier use (social networks and social cohesion, for example) that were unexplored in the current study. However, it is important to acknowledge the potential for selection bias. For example, younger African American initiates who had injected drugs longer may have been more difficult to recruit than older African American initiates; however, reasons for this occurring more often within certain ethnic groups warrant further ethnographic evaluation. Conversely, older white initiates who injected for shorter durations may also have been more difficult to recruit. This could be due to the fact that adolescent initiates in this study were more likely to report street survival as their primary source of income; it is plausible that older white initiates with more stable sources of income may not have been as accessible and, thus, their opportunity for enrollment may have been minimized compared to the younger white initiates. On the other hand, since the majority of IDUs in Baltimore are African American, mirroring the city's population, it is unclear why younger and long-term drug-using African Americans would be under-represented in our study. A previous study of recently initiated IDUs conducted in Baltimore found similar results with respect to age of initiation, race, and length of injection drug use.<sup>33</sup> In each of these Baltimore studies, different

## Adolescent initiates had a briefer but more intense risk interval before starting to inject drugs.

methods of recruitment were used, which suggests that selection bias may not fully explain our results.

Our examination of early sexual behaviors found that adolescent initiates were more likely to report their first sexual experience at age 14 or younger compared with older initiates, which is consistent with previous studies.<sup>21,34,35</sup> We found no association between pre-initiation, high-risk sexual practices (such as trading sex for drugs or money) and adolescent initiation of injection. In fact, adolescent initiates were more likely to report condom use compared with young adult initiates. This could indicate that younger people are more receptive to safer-sex prevention messages than older initiates. It is possible, however, that adolescents may have been more likely to provide socially desirable responses for condom use, especially since they had more sexual partners than older initiates.

**Limitations.** Since sampling was based upon self-referral, certain subgroups may have been under-represented, as discussed above. These results may not be generalizable to other populations of recently initiated injectors. To reduce potential selection bias, we used a mobile clinic to broaden recruitment.

In cross-sectional studies, misclassification of exposure can occur due to biased recall or difficulty recalling events. In this study, older initiates may have had more difficulty than younger initiates remembering pre-initiation behaviors. To minimize recall bias, we attempted to assist recall of the chronological sequence of events by referring to other memorable biographical landmarks (for example, pregnancy, childbirth, time spent incarcerated, last high school grade attended). By combining periods across pre-initiation years during the analysis, the potential for misclassification was reduced. In spite of these measures, non-differential misclassification could have occurred if a participant could not accurately remember

behavioral events during the year-by-year history (by “telescoping” or “distancing”),<sup>25</sup> which would tend to bias associations towards the null. It should also be noted that without a non-injection drug using comparison group, our findings must be interpreted with caution. Further studies including a comparison group of non-IDUs who remain non-IDUs into adulthood are required to further validate these findings.

### CONCLUSION

Despite these limitations, our data suggest that adolescent initiation of injection drug use is likely to be associated with non-injection drug use practices, particularly exclusive crack smoking just prior to initiation. Since adolescents who are newly initiated to injection drug use are at high risk for infection with HIV and hepatitis, these findings are important for targeting appropriate interventions, such as enhanced treatment options for adolescents and young adults. Additional studies investigating adolescent initiation that include changing social networks and predisposing mental health factors may provide useful information for planning programs to prevent early onset of illicit drug use and initiation of injection drug use, and subsequent blood-borne infections.

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