



Published in final edited form as:

AIDS Care. 2018 January ; 30(1): 59–64. doi:10.1080/09540121.2017.1363852.

HIV testing and awareness of HIV status among people who inject drugs in Greater Kuala Lumpur, Malaysia

Alexander R. Bazazi^{1,2}, Aishwarya Vijay¹, Forrest Crawford³, Robert Heimer², Adeeba Kamarulzaman^{1,4}, and Frederick L. Altice^{1,2,4}

¹Yale School of Medicine, Department of Medicine, Section of Infectious Diseases, AIDS Program, 135 College Street, New Haven, CT 06510, USA

²Yale School of Public Health, Department of Epidemiology of Microbial Diseases, New Haven, CT 06510, USA

³Yale School of Public Health, Department of Biostatistics, New Haven, CT 06510, USA

⁴Centre of Excellence for Research in AIDS (CERiA), University of Malaya, Kuala Lumpur, Malaysia

Abstract

HIV testing services are the gateway into HIV treatment and are critical for monitoring the epidemic. HIV testing is recommended at least annually in high-risk populations, including people who inject drugs (PWID). In Malaysia, the HIV epidemic is concentrated among PWID, but their adherence to testing recommendations and the proportion of HIV-positive PWID who are aware of their status remain unknown. We recruited 460 PWID in Greater Kuala Lumpur using respondent-driven sampling and conducted HIV testing. We examined past testing behaviors, estimating testing frequency, correlates of testing in the past 12 months, and the proportion of those living with HIV who were aware of their status. Results showed that most PWID living with HIV (90.4%, 95% CI: 83.6-95.9%) were aware of their status. Among those never previously diagnosed with HIV, few had accessed HIV testing in the past 12 months (14.3%, 95% CI: 11.1-18.0%). Prison (57.0%) and compulsory drug detention centers (36.1%) were the primary locations where PWID reported ever being HIV tested, and the main correlate of recent testing in regression was recent criminal justice involvement. Although awareness of HIV status may be high among PWID living with HIV in Kuala Lumpur, testing occurs primarily in prisons and compulsory drug detention centers, where it is involuntary and linkage to care is limited. A shift in HIV testing policy is needed to align health and human rights objectives, replacing mandatory testing with voluntary testing in settings where individuals can be rapidly linked to HIV care.

Keywords

HIV testing; people who inject drugs; Malaysia; HIV treatment cascade

Corresponding Author: Alexander R. Bazazi, Yale AIDS Program, 135 College Street, Suite 323, New Haven, CT 06511. alexander.bazazi@yale.edu.

Geolocation information

This study was conducted in Greater Kuala Lumpur, Malaysia.

1. Introduction

People who use drugs are disproportionately affected by HIV and face unique challenges in accessing HIV testing and care (Altice, Kamarulzaman, Soriano, Schechter, & Friedland, 2010; Degenhardt et al., 2014; Mathers et al., 2008; WHO, 2015). In Malaysia, people who inject drugs (PWID) account for a majority of existing cases and a significant proportion of new infections of HIV (Degenhardt et al., 2014; Kamarulzaman, 2009; Mathers et al., 2008; Ministry of Health Malaysia, 2015). HIV treatment and prevention services in Malaysia are inadequately scaled to need (Degenhardt et al., 2014), and AIDS-related mortality has increased by 20% in the past decade (UNAIDS, 2014b). Increasing the flow of people living with HIV (PLH) through the HIV treatment cascade is critical for reducing morbidity, mortality, and ongoing HIV transmission (Cohen et al., 2011; Nakagawa et al., 2012; UNAIDS, 2014a).

In Malaysia, prisoners and detainees in jail or compulsory drug detention centers (CDDC) are subjected to mandatory HIV testing, as are Malay couples before marriage (Fu, Bazazi, Altice, Mohamed, & Kamarulzaman, 2012; Khebir, Adam, Daud, & Shahrom, 2007). However, little is known about the use of voluntary HIV testing services in the community. We analyzed data from a study of PWID in Greater Kuala Lumpur to examine HIV testing behaviors and the proportion of PWID living with HIV who were aware of their HIV status.

2. Methods

2.1. Study design

Data were from a 2010 sample of 460 adults recruited using respondent-driven sampling in three neighborhoods in Greater Kuala Lumpur who reported injecting drugs in the prior 30 days. All participants completed HIV testing and a 60-minute, interviewer-administered questionnaire. Details of the study design are described elsewhere (Bazazi, Crawford, et al., 2015; Bazazi, Zelenev, et al., 2015; Vijay, Bazazi, Yee, Kamarulzaman, & Altice, 2015).

2.2. Outcome and analytic sample

Our primary outcome was whether participants had been tested for HIV in the past 12 months (“recent” HIV testing), which is the minimum frequency recommended and a performance indicator suggested by the World Health Organization (WHO, 2010; WHO & UNODC, 2009; WHO, UNODC, & UNAIDS, 2012). We excluded 69 people who reported previously receiving an HIV diagnosis (including three who mistakenly believed they were infected), leaving a subsample of 391 people never previously diagnosed with HIV.

For the secondary outcome of whether PLH were aware of their status, we used a subsample of 73 participants with reactive HIV test results.

2.3. Statistical analysis

2.3.1. Correlates of HIV testing—Based on a literature review of predictors of HIV testing and *a priori* knowledge about PWID in Malaysia, we selected 35 covariates to screen for association (See Online Supplemental Appendix for details about covariates). Given the large number of covariates for the sample size, we used penalized regression for variable

selection. Results are presented from the least absolute shrinkage and selection operator (lasso) and the adaptive lasso (Tibshirani, 1996; Zou, 2006). For each of these types of regression, we fit a less-restricted (more covariates selected) and more-restricted (less covariates selected) model. We used the standard method of 10-fold cross-validation to select two values of the penalty parameter for these models (λ_{\min} and λ_{1se} , respectively) (Hastie, Tibshirani, & Friedman, 2013). Penalized regressions were implemented with the *glmnet* package in *R* (Jerome Friedman, 2010; R Core Team, 2016). For reference, we also present results from a commonly used bidirectional stepwise regression algorithm using AIC, but we focus our interpretation on results of the penalized regressions. More details about our model-building strategy are in the Online Supplemental Appendix.

2.3.2. Uncertainty estimation—For the penalized regressions, we estimated uncertainty using the non-parametric bootstrap with fixed values of the penalty parameters (Fan & Li, 2001; Harrell, 2001; Morozova, Levina, Uuskula, & Heimer, 2015; Rothman, Greenland, & Lash, 2008; Tibshirani, 1996). Uncertainty around sample proportions was also estimated with the non-parametric bootstrap.

2.3.3. Missing data—Eighteen of 391 individuals were missing values for at least one covariate. They were removed from regression analysis after Little's test failed to reject the null hypothesis that the data were missing completely at random ($p=0.97$) (Beaujean, 2012; Little, 1988), leaving $n=373$ individuals. Summary statistics reflect the full analytic sample ($n=391$) unless otherwise noted.

2.4. Ethics

All data were collected anonymously after participants gave oral informed consent. This study was approved by institutional review boards at Yale University and University of Malaya.

3. Results

3.1. Sample characteristics

Summary statistics for all covariates used in the regressions are presented in Table 1 alongside unadjusted odds ratios for their association with recent HIV testing.

3.2. HIV testing

Overall, 79% of participants (309/391, 95% CI: 74.9-82.9%) had *ever* received an HIV test. Among those 309 who had previously been tested, the average time since their last HIV test was 5.6 years (95% CI: 5.1-6.1 years). Only 14.3% (56/391, 95% CI: 11.1-18.0%) had been tested for HIV in the past year. The majority of participants had been tested at some point for HIV in closed settings where HIV testing is compulsory: 57.0% (223/391) had been tested in a prison, 36.1% (141/391) in a CDDC, and 66.2% (259/391) in either of the two. HIV testing was less commonly reported at hospitals (23.0%, 90/391), non-governmental organizations (3.5%, 14/391), and private clinics (2.0%, 8/391). Among those who had ever been HIV tested, 93.5% (287/307 [n=2 missing], 95% CI: 90.6-96.1%) reported receiving the results of their last HIV test.

In the less-restricted lasso regression, all three criminal justice covariates (recent incarceration in jail, prison or a CDDC) were retained along with recruitment at the Kajang site and recent unprotected sex with a PWID; only recent prison incarceration and recruitment at the Kajang site were retained in the more-restricted model (Table 2). In the less-restricted adaptive lasso regression, all three criminal justice covariates were retained as well as recruitment at the Kajang site and the number of tuberculosis symptoms; in the more-restricted models only recent prison incarceration was retained (Table 3). A standard stepwise regression strategy selected twelve covariates, which included nearly all covariates selected by the penalized regressions, and more of the coefficients were statistically significant (Table 4).

The most robust correlate of recent HIV testing was prison incarceration in the prior six months. While 40.4% (21/52) of those recently incarcerated in prison had also been tested recently for HIV, only 10.3% (35/339) of those not recently incarcerated in prison had been tested. Recent prison incarceration was retained in all models, and the coefficient was significant in both of the less-restricted penalized regressions and in one of the two more-restricted versions. Recent jail incarceration and detention in a CDDC were also retained in the less-restricted regressions, but the coefficients were not statistically significant.

Participants' recruitment site was correlated with recent testing. While 22.5% (18/80) of those recruited in Kampung Baru and 16.9% (33/195) of those recruited in Shah Alam had been tested recently for HIV, only 4.3% (5/116) of those recruited in Kajang had. Compared to participants at the other two sites, participants at the Kajang site were significantly less likely to have tested recently in both less-restricted penalized regressions. This covariate was retained in only one of the more-restricted penalized regressions, where it was not statistically significant.

3.3. Awareness of HIV status

In our sample, 9.6% (7/73, 95% CI: 4.1-16.4%) of participants who tested positive for HIV were unaware of their status. Awareness of HIV status differed by recruitment site: only 1 of 47 participants living with HIV and recruited in Kampung Baru did not know their HIV status, while 4 of 13 in Kajang and 2 of 13 in Shah Alam did not know their status ($X^2=10.25$, $p=0.006$).

Three individuals reported previously testing positive for HIV but had non-reactive results on two different rapid tests.

4. Discussion

We find that PWID in Greater Kuala Lumpur are being tested for HIV infrequently and primarily in criminal justice settings where testing is not voluntary and linkage to HIV care is limited.

While the WHO recommends that PWID be tested at least yearly, only 14.3% of our sample had been tested in the past year (WHO, 2010). Despite infrequent testing, most PWID living with HIV (90.4%) were aware of their status. The UNAIDS 90-90-90 strategy seeks to

diagnose 90% of PLH by 2020 (UNAIDS, 2014a), and our findings suggest that Malaysia may be on track to meeting this target among PWID in Kuala Lumpur. The high rate of HIV diagnosis in PWID, however, has come at the expense of the rights of incarcerated people. HIV treatment is absent in most CDDCs and limited in the prison system, and programs for linking PLH to care in the community after release are practically non-existent (Fu et al., 2012; Margolis, Al-Darraj, Wickersham, Kamarulzaman, & Altice, 2013). Individuals in Malaysian prisons and CDDCs primarily are tested for HIV not to link them to care but rather to identify PLH in order to segregate them, thereby also compromising their confidentiality. International agencies universally recommend against segregation of PLH in closed settings (UNODC, ILO, UNDP, WHO, & UNAIDS, 2013). A rights-based approach to HIV testing involves assuring the voluntariness of testing, defining the purpose of testing with respect to individual benefits, and minimizing stigma and discrimination (Fu, Bazazi, & Altice, 2011; UNAIDS Global Reference Group on HIV/AIDS and Human Rights & WHO, 2004). Shifting from a policy of mandatory testing to opt-out testing of incoming prisoners and detainees could allow for continued high rates of diagnosis of this at-risk population without infringing on their rights. But if HIV testing is to be conducted at all in these settings, it should be paired with HIV treatment and linkage to care in the community (Springer, Spaulding, Meyer, & Altice, 2011).

In a community setting, it is easier to ensure that testing is voluntary, confidentiality preserved, and linkage to HIV care achieved. If Malaysia's priority is to diagnose and link to care as many PLH as possible, it should prioritize community-based rapid testing programs, such as those integrated within harm reduction organizations, that target individuals at elevated risk of HIV infection. A recent review of this form of task shifting by the WHO shows that outreach workers at harm reduction organizations can effectively provide HIV testing services (Kennedy & Fonner, 2015). In our study, only 3.5% had accessed testing from community-based organizations. Community-based organizations operating needle exchange programs or drop-in centers are well-positioned to offer rapid HIV testing to individuals at high risk of contracting HIV, but such organizations have received a modicum of total government spending on HIV testing. Instead, the government allocates funding for HIV testing to less cost-effective programs like mandatory pre-marital screening (Khebir et al., 2007; Ministry of Health Malaysia, 2012, 2015). For example, in 2011 only 219 HIV infections were identified from conducting mandatory premarital testing on nearly 250,000 individuals (Ministry of Health Malaysia, 2012). Even if all identified cases represented new diagnoses, this would translate to 1,142 tests needed to diagnose one new case of HIV. In comparison, we identified 7 new HIV diagnoses from 461 tests in our study, which is equivalent to administering 66 tests to diagnose one new case of HIV, roughly 17 times the yield of the premarital testing program.

Limitations

First, respondent-driven sampling introduces complex sampling dependencies and potential biases that are not remedied with standard estimators that adjust for network size. We present sample means and bootstrapped confidence intervals because they represent the least problematic and most transparent estimators available for use with our data. Second, the factors identified from exploratory regression analysis represent correlates of HIV testing;

causation cannot be inferred. Third, the associations we present are those of a large enough magnitude to be detected in a sample of this size. Failure to detect other associations with HIV testing may be due to low power and is not necessarily evidence of their absence.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: This work was supported by NIH career development (FLA: NIDA K24DA017072, FC: NCATS KL2 TR000140), research (FLA, AK: NIDA R01DA025943, FC: NIMH/CIRA P30MH062294, NICHD/BD2K 1DP2OD022614-01), and training (ARB: T32GM07205, NIDA F30DA039716) grants as well as University Malaya's High Impact Research Grant (AK: E-000001-20001) and the Yale Downs Fellowship (ARB). OraSure Technologies, Inc. provided discounted rapid HIV tests. Funders had no role in study design; in the collection, analysis and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

References

- Altice FL, Kamarulzaman A, Soriano VV, Schechter M, Friedland GH. Treatment of medical, psychiatric, and substance-use comorbidities in people infected with HIV who use drugs. *Lancet*. 2010; 376(9738):367–387. DOI: 10.1016/S0140-6736(10)60829-X [PubMed: 20650518]
- Bazazi AR, Crawford F, Zelenev A, Heimer R, Kamarulzaman A, Altice FL. HIV Prevalence Among People Who Inject Drugs in Greater Kuala Lumpur Recruited Using Respondent-Driven Sampling. *AIDS and behavior*. 2015; 19(12):2347–2357. DOI: 10.1007/s10461-015-1191-y [PubMed: 26358544]
- Bazazi AR, Zelenev A, Fu JJ, Yee I, Kamarulzaman A, Altice FL. High prevalence of non-fatal overdose among people who inject drugs in Malaysia: Correlates of overdose and implications for overdose prevention from a cross-sectional study. *Int J Drug Policy*. 2015; 26(7):675–681. DOI: 10.1016/j.drugpo.2014.11.010 [PubMed: 25532449]
- Beaujean, AA. *BaylorEdPsych: R Package for Baylor University Educational Psychology Quantitative Courses*. R package version 0.5. 2012. Retrieved from <http://cran.r-project.org/package=BaylorEdPsych>
- Cohen MS, Chen YQ, McCauley M, Gamble T, Hosseinipour MC, Kumarasamy N, Team HS. Prevention of HIV-1 infection with early antiretroviral therapy. *N Engl J Med*. 2011; 365(6):493–505. DOI: 10.1056/NEJMoa1105243 [PubMed: 21767103]
- Degenhardt L, Mathers BM, Wirtz AL, Wolfe D, Kamarulzaman A, Carrieri MP, Beyrer C. What has been achieved in HIV prevention, treatment and care for people who inject drugs, 2010–2012? A review of the six highest burden countries. *International Journal of Drug Policy*. 2014; 25(1):53–60. [PubMed: 24113623]
- Fan JQ, Li RZ. Variable selection via nonconcave penalized likelihood and its oracle properties. *Journal of the American Statistical Association*. 2001; 96(456):1348–1360. DOI: 10.1198/016214501753382273
- Fu JJ, Bazazi AR, Altice FL. Preserving human rights in the era of "test and treat" for HIV prevention. *Am J Public Health*. 2011; 101(2):198–199. author reply 199–200. DOI: 10.2105/AJPH.2010.300050 [PubMed: 21228278]
- Fu JJ, Bazazi AR, Altice FL, Mohamed MN, Kamarulzaman A. Absence of antiretroviral therapy and other risk factors for morbidity and mortality in Malaysian compulsory drug detention and rehabilitation centers. *PLoS ONE*. 2012; 7(9):e44249.doi: 10.1371/journal.pone.0044249 [PubMed: 23028508]
- Harrell, JFE. *Regression Modeling Strategies With Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis*. 2. 2001.
- Hastie, T., Tibshirani, R., Friedman, J. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Second. 2013.

- Jerome Friedman TH, Robert Tibshirani. Regularization Paths for Generalized Linear Models via Coordinate Descent. *Journal of Statistical Software*. 2010; 33(1):1–22. Retrieved from <http://www.jstatsoft.org/v33/i01/>. [PubMed: 20808728]
- Kamarulzaman A. Impact of HIV prevention programs on drug users in Malaysia. *J Acquir Immune Defic Syndr*. 2009; 52(Suppl 1):S17–19. DOI: 10.1097/QAI.0b013e3181bbc9af [PubMed: 19858930]
- Kennedy, C., Fonner, V. Consolidated guidelines on HIV testing services: 5Cs: consent, confidentiality, counselling, correct results and connection 2015. ANNEX 1: Should trained lay providers perform HIV testing and counselling services using HIV rapid diagnostic tests?: A systematic review. 2015. Retrieved from <https://www.ncbi.nlm.nih.gov/books/NBK316019/>
- Khebir BV, Adam MA, Daud AR, Shahrom CMD. Premarital HIV screening in Johor - (2002–2004). *Medical Journal of Malaysia*. 2007; 62(1):19–22. [PubMed: 17682564]
- Little RJA. A Test of Missing Completely at Random for Multivariate Data with Missing Values. *Journal of the American Statistical Association*. 1988; 83(404):1198–1202. DOI: 10.2307/2290157
- Margolis B, Al-Darraj HA, Wickersham JA, Kamarulzaman A, Altice FL. Prevalence of tuberculosis symptoms and latent tuberculous infection among prisoners in northeastern Malaysia. *Int J Tuberc Lung Dis*. 2013; 17(12):1538–1544. DOI: 10.5588/ijtld.13.0193 [PubMed: 24200265]
- Mathers BM, Degenhardt L, Phillips B, Wiessing L, Hickman M, Strathdee SA, Injecting Drug U. Global epidemiology of injecting drug use and HIV among people who inject drugs: a systematic review. *Lancet*. 2008; 372(9651):1733–1745. DOI: 10.1016/S0140-6736(08)61311-2 [PubMed: 18817968]
- Ministry of Health Malaysia. Malaysia 2012 Global AIDS Response Country Progress Report: Reporting period January 2010 to December 2011. 2012. Retrieved from http://files.unaids.org/en/dataanalysis/knowyourresponse/countryprogressreports/2012countries/ce_MY_Narrative_Report.pdf
- Ministry of Health Malaysia. Global AIDS Response Progress Report Malaysia 2015: Reporting period January 2014 to December 2014. 2015. Retrieved from http://www.unaids.org/sites/default/files/country/documents/MYS_narrative_report_2015.pdf
- Morozova O, Levina O, Uuskula A, Heimer R. Comparison of subset selection methods in linear regression in the context of health-related quality of life and substance abuse in Russia. *BMC Med Res Methodol*. 2015; 15:71.doi: 10.1186/s12874-015-0066-2 [PubMed: 26319135]
- Nakagawa F, Lodwick RK, Smith CJ, Smith R, Cambiano V, Lundgren JD, Phillips AN. Projected life expectancy of people with HIV according to timing of diagnosis. *AIDS*. 2012; 26(3):335–343. DOI: 10.1097/QAD.0b013e32834dcec9 [PubMed: 22089374]
- R Core Team. R: A Language and Environment for Statistical Computing. 2016. Retrieved from <http://www.r-project.org/>
- Rothman, KJ., Greenland, S., Lash, TL. *Modern epidemiology*. 3. Philadelphia: Wolters Kluwer Health / Lippincott Williams & Wilkins; 2008.
- Springer SA, Spaulding A, Meyer JP, Altice FL. Public Health Implications for Adequate Transitional Care for HIV-Infected Prisoners: Five Essential Components. *Clin Infect Dis*. 2011; 53(5):469–479. [PubMed: 21844030]
- Tibshirani R. Regression shrinkage and selection via the Lasso. *Journal of the Royal Statistical Society Series B-Methodological*. 1996; 58(1):267–288.
- UNAIDS. 90-90-90: An ambitious target to help end the AIDS epidemic. Geneva, Switzerland: 2014a. Retrieved from http://www.unaids.org/sites/default/files/media_asset/90-90-90_en_0.pdf
- UNAIDS. The Gap Report. (UNAIDS / JC2656). Geneva, Switzerland: 2014b. Retrieved from http://www.unaids.org/en/media/unaids/contentassets/documents/unaidspublication/2014/unaids_gap_report_en.pdf
- UNAIDS Global Reference Group on HIV/AIDS and Human Rights, & WHO. UNAIDS/WHO Policy Statement on HIV Testing. 2004. Retrieved from <http://www.who.int/hiv/pub/vct/en/hivtestingpolicy04.pdf>
- UNODC, ILO, UNDP, WHO, & UNAIDS. HIV prevention, treatment and care in prisons and other closed settings: a comprehensive package of interventions. 2013. Retrieved from Vienna, Austria:

https://www.unodc.org/documents/hiv-aids/HIV_comprehensive_package_prison_2013_eBook.pdf

Vijay A, Bazazi AR, Yee I, Kamarulzaman A, Altice FL. Treatment Readiness, Attitudes Toward, and Experiences with Methadone and Buprenorphine Maintenance Therapy Among People Who Inject Drugs in Malaysia. *Journal of Substance Abuse Treatment*. 2015; 54:29–36. DOI: 10.1016/j.jsat.2015.01.014 [PubMed: 25841703]

WHO. Delivering HIV test results and messages for re-testing and counselling in adults. 2010. Retrieved from http://apps.who.int/iris/bitstream/10665/44278/1/9789241599115_eng.pdf

WHO. Consolidated guidelines on HIV testing services: 5Cs: consent, confidentiality, counselling, correct results and connection. 2015. Retrieved from Geneva, Switzerland: <https://www.ncbi.nlm.nih.gov/books/NBK316021/>

WHO, & UNODC. Guidance on testing and counselling for HIV in settings attended by people who inject drugs: Improving access to treatment, care and prevention. 2009. Retrieved from http://www.who.int/entity/hiv/topics/idu/care/GuidanceTC_IDUsettings.pdf

WHO, UNODC, & UNAIDS. Technical guide for countries to set targets for universal access to HIV prevention, treatment and care for injecting drug users - 2012 revision. 2012. Retrieved from http://www.who.int/iris/bitstream/10665/77969/1/9789241504379_eng.pdf

Zou H. The adaptive lasso and its oracle properties. *Journal of the American Statistical Association*. 2006; 101(476):1418–1429. DOI: 10.1198/016214506000000735

Table 1

Participant characteristics and correlates of recent HIV testing.

Covariate	Entire Sample (N=391)	HIV testing, prior 12 mo.		Unadjusted Odds Ratio (95 % CI)
	N (%)	No (N=335) N (%)	Yes (N=56) N (%)	
<u>Social and demographic factors</u>				
Age, mean (SD)	38.6 (9.5)	38.7 (9.6)	38.1 (8.8)	1.0 (1.0 – 1.0)
Male gender	381 (97.4%)	328 (97.9%)	53 (94.6%)	0.4 (0.1 – 1.8)
Completed high school education	190 (48.6%)	161 (48.1%)	29 (51.8%)	1.2 (0.7 – 2.1)
Married	120 (30.7%)	101 (30.1%)	19 (33.9%)	1.2 (0.6 – 2.2)
Income below poverty line, 30 d.	84 (21.5%)	77 (23%)	7 (12.5%)	0.5 (0.2 – 1.0)
Ethnicity				
Malay	354 (90.5%)	296 (88.4%)	54 (96.4%)	Referent
Indian	28 (7.2%)	26 (7.8%)	2 (3.6%)	0.4 (0.1 – 1.5)
Chinese	8 (2.1%)	8 (2.4%)	0 (0%)	Undefined
Recruitment site				
Kampung Baru	80 (20.5%)	62 (18.5%)	18 (32.1%)	Referent
Kajang	116 (29.7%)	111 (33.1%)	5 (8.9%)	0.2 (0.1 – 0.5)
Shah Alam	195 (49.9%)	162 (48.4%)	33 (58.9%)	1.5 (0.9 – 2.8)
<u>Criminal justice and policing factors, prior 6 mo.</u>				
Jail incarceration	163 (41.7%)	130 (38.8%)	33 (58.9%)	2.3 (1.3 – 4.1)
Prison incarceration	52 (12.3%)	31 (9.3%)	21 (37.5%)	5.9 (3.0 – 11.3)
Detention in compulsory drug detention center	10 (2.6%)	6 (1.8%)	4 (7.1%)	4.2 (1.1 – 15.0)
Rushed injection from fear of police	192 (49.2%)	160 (47.9%)	32 (57.1%)	1.5 (0.8 – 2.6)
Avoided carrying injection equipment from fear of police	225 (57.7%)	195 (58.4%)	30 (53.6%)	0.8 (0.5 – 1.5)
<u>Medical and psychiatric factors</u>				
Anxiety symptom score (DASS-21), mean (SD)	10.9 (5.8)	10.8 (5.7)	11.3 (6.4)	1.0 (1.0 – 1.1)
Depression symptom score (DASS-21), mean (SD)	12.2 (7.4)	12.3 (7.5)	11.5 (7.0)	1.0 (1.0 – 1.0)
Stress symptom score (DASS-21), mean (SD)	14.8 (6.5)	14.8 (6.4)	14.8 (7.5)	1.0 (1.0 – 1.1)
Hospitalized, prior 6 mo.	42 (10.8%)	36 (10.8%)	6 (10.7%)	1.0 (0.4 – 2.3)
Tuberculosis symptom screening score, mean (SD)	1.1 (1.0)	1.1 (1.0)	1.0 (1.0)	0.9 (0.7 – 1.2)
<u>Drug use and risk behaviors</u>				
Years of drug injection, mean (SD)	14.4 (9.2)	14.7 (9.1)	12.7 (9.8)	1.0 (0.9 – 1.0)
Injected daily, prior 30 d.	356 (91.0%)	309 (92.2%)	47 (83.9%)	0.4 (0.2 – 1.0)
Injections per day, prior 30 d., mean (SD)	2.0 (1.0)	2.0 (0.9)	2.0 (1.0)	1.1 (0.8 – 1.5)
Addiction severity score (DAST-10), mean (SD)	7.4 (1.5)	7.4 (1.4)	7.4 (1.5)	1.0 (0.8 – 1.2)
Most injection equipment from a needle exchange program, prior 6 mo.	115 (29.4%)	96 (28.7%)	19 (33.9%)	1.3 (0.7 – 2.3)
Alcohol use, prior 6 mo.	93 (23.8%)	80 (23.9%)	13 (23.2%)	1.0 (0.5 – 1.8)
Heroin use, prior 6 mo.	375 (95.9%)	323 (96.4%)	52 (92.9%)	0.5 (0.2 – 1.8)
Methadone use, prior 6 mo.	179 (45.8%)	155 (46.3%)	24 (42.9%)	0.9 (0.5 – 1.5)
Buprenorphine use, prior 6 mo.	90 (23.0%)	74 (22.1%)	16 (28.6%)	1.4 (0.7 – 2.6)
Benzodiazepine use, prior 6 mo.	156 (39.9%)	132 (39.4%)	24 (42.9%)	1.2 (0.7 – 2.0)

Covariate	Entire Sample (N=391)	HIV testing, prior 12 mo.		Unadjusted Odds Ratio (95 % CI)
	N (%)	No (N=335) N (%)	Yes (N=56) N (%)	
Methamphetamine use, prior 6 mo.	172 (44.1%)	149 (44.6%)	23 (41.1%)	0.9 (0.5 – 1.5)
Any needle or syringe sharing episodes, prior 30 d.	182 (46.5%)	157 (46.9%)	25 (44.6%)	0.9 (0.5 – 1.6)
Any need or syringe sharing partners, prior 30 d.	101 (25.8%)	82 (24.5%)	19 (33.9%)	1.6 (0.9 – 2.9)
Any unprotected sex, prior 30 d.	126 (32.2%)	107 (31.9%)	19 (33.9%)	1.1 (0.6 – 2.0)
Any unprotected sex with a person who injects drugs, prior 30 d.	11 (2.8%)	7 (2.1%)	4 (7.1%)	3.6 (0.9 – 12.4)

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 2

Correlates of recent HIV testing, lasso.

Covariate	Less Restricted ($\lambda = \lambda_{\min}$)		More Restricted ($\lambda = \lambda_{1SE}$)	
	aOR*	95% CI	aOR*	95% CI
Jail incarceration, prior 6 mo.	1.2	0.8 – 1.8		
Prison incarceration, prior 6 mo.	3.5	1.7 – 7.3	2.1	1.0 – 4.6
Detention in compulsory drug detention center, prior 6 mo.	1.7	0.5 – 5.8		
Any unprotected sex with a person who inject drugs, prior 30 d.	1.1	0.4 – 3.5		
Kajang recruitment site	0.5	0.3 – 0.9	1.0	0.8 – 1.3

*aOR = adjusted odds ratio

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 3

Correlates of recent HIV testing, adaptive lasso.

Covariate	Less Restricted ($\lambda = \lambda_{\min}$)		More Restricted ($\lambda = \lambda_{1SE}$)	
	aOR*	95% CI	aOR*	95% CI
Jail incarceration, prior 6 mo.	1.4	0.8 – 2.3		
Prison incarceration, prior 6 mo.	4.5	2.2 – 9.1	2.3	1.1 – 4.8
Detention in compulsory drug detention center, prior 6 mo.	2.3	0.6 – 9.3		
Tuberculosis symptom screening score	1.0	0.8 – 1.2		
Kajang recruitment site	0.3	0.2 – 0.7		

*aOR = adjusted odds ratio

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4

Correlates of recent HIV testing, stepwise logistic regression.

Covariate	aOR*	95% CI
Jail incarceration, prior 6 mo.	2.1	1.1 – 4.3
Prison incarceration, prior 6 mo.	5.3	2.5 – 11.4
Detention in compulsory drug detention center, prior 6 mo.	6.7	1.3 – 30.3
Tuberculosis symptom screening score	0.7	0.1 – 0.5
Kajang recruitment site	0.2	0.1 – 0.5
Years of drug injection	1.0	0.9 – 1.0
Heroin use, prior 6 mo.	0.3	0.1 – 1.2
Completed high school education	1.8	0.9 – 3.6
Income below poverty line, 30 d.	0.5	0.2 – 1.2
Any needle or syringe sharing partners, prior 30 d.	2.0	0.9 – 4.3
Rushed injection from fear of police, prior 6 mo.	1.9	0.9 – 4.2
Avoided carrying injection equipment from fear of police, prior 6 mo.	0.6	0.3 – 1.2
Kajang recruitment site	0.2	0.1 – 2.3

*aOR = adjusted odds ratio