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Addressing Police Occupational Safety During an Opioid Crisis: The Syringe Threat and Injury Correlates (STIC) Score

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Abstract

Objective: To develop and validate Syringe Threat and Injury Correlates (STIC) score to measure police vulnerability to NSI.

Methods: Tijuana police officers (N=1,788) received NSI training (2015-2016). STIC score incorporates five self-reported behaviors: syringe confiscation, transportation, breaking, discarding, and arrest for syringe possession. Multivariable logistic regression was used to evaluate the association between STIC score and recent NSI.

Results: Twenty-three (1.5%) officers reported NSI; higher among females than males (3.8% vs. 1.2%; p=0.007). STIC variables had high internal consistency, a distribution of 4.0, a mode of 1.0, a mean (sd) of 2.0 (0.8), and a median (IQR) of 2.0 (1.2-2.6). STIC was associated with recent NSI; odds of NSI being 2.4 times higher for each point increase (p-value<0.0001).

Conclusions: STIC score is a novel tool for assessing NSI risk and prevention program success among police.

Keywords

Needle stick injury; Police; Occupational Safety; Law Enforcement

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INTRODUCTION

North America's opioid crisis has spurred rising prevalence of injection substance use, with direct impact on the occupational risk environment for police. Officers regularly encounter injection equipment through their interactions with people who inject drugs (PWID). As a result, they face elevated risk of accidental needlestick injury (NSI) in the line of duty. Such NSI exposures carry significant risk of infection by bloodborne pathogens such as HIV (0.2-0.5% risk of infection per NSI), hepatitis C (3-10%) and hepatitis B (2-40%).[1] Introducing additional risk to police is the fact that HIV seropositivity of discarded needles from PWID may range from 5% to 20%[2] and among PWID taken into police custody, HIV and Hepatitis B prevalence are estimated to be 4% and 26%, respectively.[3] Aside from the physical risk of acquiring bloodborne diseases, NSI experiences and their perceived occupational safety threat can negatively impact recruitment, retention, occupational stress, financial and human resources as well as police-community relations.[4-7]

Occupational risk of NSI among police officers is a global phenomenon;[8-10] police have among the highest rates of exposure among all professions. While thought to be broadly underreported, data from police departments in the U.S. have estimated that lifetime prevalence of reported occupational NSI may range from 4% in North Carolina to nearly 30% in San Diego, California.[4,11-13] Our prior work in Mexico uncovered that nearly one in six officers reported ever having an occupational NSI, of whom a similar proportion reported having an NSI in the past year.[14] Officers' partial knowledge of syringe possession laws was significantly associated with the odds of reporting a higher frequency of self-reported syringe confiscation.[15] We also identified risky syringe-handling practices (i.e., breaking syringes) in Tijuana, where HIV and HCV rates are localized among vulnerable populations like PWID.[14]

Despite the urgent concern about NSI among police, evidence on this element of occupational health and safety is sparse. With injection drug use rapidly expanding across North America, Eastern Europe, Central Asia, and East Africa, this issue is rising in salience worldwide.[16] There is especially limited understanding of its NSI risk behaviors and protective factors. For example, little is known how officer behaviors like confiscating syringes or frisking suspects may affect their risk of NSIs. Demographic factors like gender and power dynamics in the department may also impact NSI risk as they relate to expected roles and responsibilities during police work. Relatedly, correct knowledge of the laws, positive attitudes towards PWID and correct implementation of safety procedures may play a protective role.

Establishing such factors, and devising standardized instrumentation for their measurement, is critical for effective prevention, monitoring, and response to this occupational safety challenge. Validated scales and instrumentation have been effectively implemented to measure occupational risk for other workplace health concerns such as safety at construction sites, noise exposure, and occupational stress.[17-19] However, to our knowledge, no such tool exists to measure or assess occupational risk of NSI among police. In addition to standardized scales there is a paucity of research elucidating factors that either heighten or attenuate risk of NSI among police officers. To address these gaps in the literature, we formulated a set of risk and protective factors that may shape police occupational NSI using data from a large police training and clinical trial in Tijuana. These factors were devised based on previous research[4-6] and input from police personnel. Our goal was to develop and validate a measure of officer vulnerability to occupational NSI, the Syringe Threat and Injury Correlates (STIC) score, to aid in prevention, monitoring, and response.

METHODS

Tijuana, Mexico, is a major border city where migration, drug trafficking, injection drug use, a localized HIV epidemic among PWID and intensified policing converge. These factors make the risk of occupational NSI a significant public health concern for police in Tijuana. With more than 2,000 active officers, the Tijuana Municipal police force is among the largest in Mexico. It consists mostly of men (80%) with a mean age of 38 years old and a median of 11 years of experience working in law enforcement. In 2014, approximately 17% of active-duty officers reported ever experiencing an occupational NSI.[14]

To reduce occupational NSI incidence and align street policing practices with public health, we implemented a department wide police education program in Tijuana using the Safety and Health Integration in Enforcement of laws on drugs (SHIELD) model. We have described the conceptual framework and design of the SHIELD model (*Escudo*, in Spanish) in detail elsewhere.[20] The SHIELD model is a collaborative occupational training that was integrated into the annual in-service training schedule of the municipal police academy from February 2015 to May 2016. Over 38 weeks, 1,806 officers of all ranks received the training in classes of 20 to 96 participants. The training covered four key topics: (1) occupational safety training for the prevention of NSIs; (2) information on bloodborne pathogen epidemiology, prevention, and treatment; (3) provisions of federal, state, and municipal drug and syringe possession laws; and (4) occupational safety and population health benefits of harm reduction measures. For the occupational safety component, officers received comprehensive information on policies and procedures for preventing and responding to NSIs in the field and either a video training or interactive role-play exercise to reinforce safe frisking techniques.

We administered pre- and post-training surveys to all participants and a randomized subset was followed for 24 months. All survey items that inform the STIC score were measured at all study visits, but this analysis is a cross-sectional analysis based on the baseline (pre-training) data only. In addition to detailed questions related to syringe-handling practices, the baseline survey also collected sociodemographic characteristics, knowledge of syringe/drug law, self-reported police behavior data and police assignment details (e.g. rank [officer vs. chief/deputy/supervisor] and precinct assignment [assigned to patrol a precinct with high drug use vs. low drug use]). We developed all measures based on prior studies[6], formative research with Tijuana police officers[14], and discussions with leadership as part of the collaborative planning process. The study protocol and consent documentation were approved by the Human Research Protections Program of the University of California, San Diego, and by the institutional review board at Universidad Xochicalco, Tijuana. All participants provided informed consent before participating in the study.

We created the STIC score by averaging the responses to five syringe handling items. These self-reported items addressed frequency of confiscating syringes from suspects, transporting syringes, breaking syringes, discarding syringes in the trash, and arresting a suspect for syringe possession. We coded response options on a Likert scale as: 1=all the time, 2=sometimes, 3=rarely, 4=never. To create a score that is directly proportional to NSI risk, rather than inversely proportional, we reversed the coding for each item (i.e., 1=never, ... , 4=all the time) and then averaged. Measures of central tendency (e.g., means, medians) and dispersion (e.g., standard deviations, interquartile ranges) along with histograms and normality tests, overall and by gender, were generated to assess and describe the distribution of the score. Cronbach alpha assessed internal consistency of the score.

The main outcome of interest and its association with the score was whether an officer reported sustaining a recent NSI (previous 6 months). We limited the analytical sample to those officers who reported exposure to syringes/needles. Descriptive statistics of the sample characteristics included means, standard errors, proportions and numbers for the overall sample and stratified by whether the officer indicated on the survey that they had sustained an NSI, or not, in the past 6 months. Univariate and multivariable logistic regression, via Generalized Estimating Equations was used to measure the association between the STIC score and the NSI outcome. We considered the data to be nested by training class, since officers received the training on different days. Therefore, we controlled for within training class correlation in the multivariable modeling by using class as a cluster variable with an exchangeable correlation structure.

Demographic variables associated in univariate logistic regression models with the outcome at a $P \leq 0.10$ were considered for inclusion as covariates in the multivariable model. Only variables that yielded a 5% significance level in the multivariate model were retained. To ensure the integrity of the model, we assessed and ruled out all possible interactions between the variables included in the model. Also, multi-collinearity was ruled out by assessing appropriate values of the variance inflation factors and condition indices. To account for the fact that the officers were not randomly assigned to training class and given that classes may have differed in terms of size, instructor, length and training date, we controlled the model for class. To assess the predictive performance of the STIC score for NSIs, we conducted Receiver Operating Characteristic (ROC) analysis of our logistic model (i.e., STIC score as a predictor and gender as a covariate). Additionally, to evaluate the model's generalization we conducted a ROC comparison analysis using the leave-one-out cross-validation principle (LOOCV).[21, 22] We conducted all statistical analyses using SAS version 9.4.

RESULTS

Out of 1,751 officers who completed the pre-training, the subsample for this analysis consisted of 1,524 officers who indicated their exposure to syringes while working in law enforcement either frequently or sometimes. Among the 1524 officers included in this analysis, mean age was 38.3 (range: 20-79) years; 87.9% were male; 79.6% had completed high school education or above; and had an average of 11.2 mean years of service in law enforcement. Overall, the prevalence of reporting a recent NSI was 1.5%. Descriptive statistics, stratified by whether or not one sustained an NSI in the 6-months prior to pre-training, are presented in Table 1, along with results from univariate logistic regression models. The odds of reporting a recent nsi were significantly higher among female officers (OR=3.44; P=0.022) as compared to male officers and among officers who reported having engaged all the times or sometimes (vs. rarely/never) in physical altercations with drug users (OR=2.26; P=0.035) (Table 1). The corresponding odds were lower among officers with a high school education or above (OR=0.43; P=0.036).

Based on our coding framework, the STIC score had a minimum value of 1 and a maximum value of 4, with a higher score indicating higher risk. The distribution of the score was skewed to the right, mostly because a large percentage of participants (20%) had a STIC score of 1 (Figure 1). The overall score had equal measures of central tendency (Table 2), with a mean (SD) of 2.0 (0.8) and a median (IQR) of 2 (1.2-2.6) (Supplementary Table 1]. The mode of the distribution was equal to 1, which is also the minimum value of the score. The STIC score differed significantly by gender and recent NSI, with male officers having a higher (P<0.001) median score (2.0, Interquartile range [IQR]:1.4-2.6) as compared to female officers (1.80 [IQR]:1.0-2.4) and those who reported a recent NSI (2.4, Interquartile range [IQR]:2.2-2.8) having a higher score (P<0.05) than those who did not report an NSI (2.0, IQR: 1.2-2.6). The Cronbach alpha coefficient for the five items included in the score was 0.84.

As reflected by the multivariable model (Table 3), the STIC score was a significant predictor of recent NSI. The adjusted odds of experiencing an NSI were 2.4 times higher for every one-point increase in the score (P<0.001). Female officers had approximately 3.5 times higher adjusted odds of reporting a recent NSI as compared to males (P<0.05), whereas officers with a high-school education or above had about one third the adjusted odds of reporting a recent NSI when compared to officers who had less than a high-school education (P<0.05).

According to the ROC analysis, the model based on the entire data set was a significant predictor of an NSI (Likelihood Ratio (LR) Chi-square=15.50, P<0.001, AUC=0.73). The model based on cross-validated probabilities yielded an AUC=0.70 and a test of the difference between the two areas indicated that the AUCs did not differ significantly from each other (Chi-square=0.232, NS). Figure 2 shows the ROC curve based on the logistic model fit to our data set and the curve based on cross-validated predicted probabilities (i.e., ROC1), respectively. We provide predictive probabilities of an NSI for STIC score values 1 to 4 by gender in Table 4. Among males, predicted probabilities for NSI ranged from 0.41 (STIC score=1.0) to 4.97 (STIC score=4.0). Among females, predicted probabilities for NSI ranged from 1.55 (STIC score=1.0) to 16.88 (STIC score=4.0). For each value of the STIC score, females demonstrate a higher predicted probability for NSI and wider confidence intervals.

DISCUSSION

This study developed a valid and reliable scale to assess NSI risk among police officers in Tijuana. The STIC score is a continuous measure with a range of values between one and four and a midpoint (median and mean) of 2.0. The Cronbach alpha coefficient for the five items constituting the STIC score (0.84) was high, demonstrating internal consistency of the items. [23] The odds of reporting an NSI increase by 2.4 times for each one-point increase in the STIC score, after adjusting for gender and level of education. Given the robust fit of the model to the cross-validated data, we conclude that the STIC score provides a relatively accurate prediction of NSIs for this sample population.

Females were almost 3 times more likely to report an NSI and the predicted probabilities for the STIC score for females are approximately fourfold that of males for each point increase in the STIC score. This is consistent with previous findings in this context which suggest that female police officers may be at higher risk for occupational NSI. Preliminary research within this cohort has suggested that while males are more confident in their ability to safely handle syringes, female officers were less likely to report policing behaviors that are inconsistent with public health and occupational safety standards such as confiscating syringes and extrajudicial arrests for syringe possession.[24] It could also be the case that females are equally likely to get an NSI while on duty but are simply more likely to report the NSI after the fact. This may be supported by the fact that female officers demonstrated a much higher predictive probability for the STIC score than males in our sample.

Level of education was a significant factor related to NSI risk, as officers with less than high a school level of education were more likely to report occupational NSI. This is consistent with policing literature that has suggested more education is protective for certain policing behaviors such as use of force, regardless of their supervisor's level of education.[25, 26] This reinforces the idea that education in general, not just in the context of police education programs, is an important consideration for aligning policing with public health and occupational safety priorities.

Arresting someone for syringe possession, in addition to confiscating, transporting, breaking, or throwing syringes in the trash; comprised a reliable indicator of NSI risks. Several of these items that form the STIC score, syringe confiscation and arrest for syringe possession in particular, may also shape the risk environment for disease transmission among PWID worldwide. Such policing behaviors are significant drivers of HIV and bloodborne pathogen risk among police officers and those they are charged to serve (including PWID), making them an issue of utmost importance for public health and occupational safety alike. For example, among PWID, arrest for syringe possession has been associated with HIV infection, receptive syringe sharing and shooting gallery attendance. [27-29] Similarly, among PWID, syringe confiscations have been associated with HIV infection, syringe sharing and the likelihood that PWID utilize syringe exchange program interventions.[28, 30-31]

Variables dealing with frequency of contact with syringes, number of years on the force, patrol assignment and location (areas of high drug use vs low drug use) were not significant factors in creating the STIC score. This suggests that the STIC score may be a highly useful tool for police officers with a wide range of experience, responsibilities and assignments; including those with low contact with needles. Furthermore, the syringe handling behaviors that constitute the STIC score have implications beyond police occupational safety. For example, sanitation workers, emergency medical service personnel and other community members could potentially be harmed by improper syringe disposal resulting from police activities.

Given the relatively low incidence of NSI, the STIC score also represents a critical surrogate endpoint for studies seeking to evaluate the impact of risk reduction interventions. For example, in situations where clinical data or other measures of NSI prevalence are unavailable, the STIC score may serve as an important tool for measuring NSI risk. A future direction for this line of research will be to apply the STIC score in the impact evaluation of the SHIELD cohort study. The STIC score may also be suitable for measure police officer NSI risk in other contexts and for the evaluation of other interventions to reduce the risk of occupational NSI.

There are several limitations to this study. First, self-reported data potentiates underreporting of NSI prevalence which tempers generalizability of study findings. However, surveys were self-administered to minimize the effects of underreporting due to social stigma. Second, participants were not randomized to training class as the intervention was conducted in concert with police academy training schedules. This was mitigated by controlling for training class in the multivariable analysis. Third, these findings represent one police force in Mexico and the STIC score or its components may not be generalizable to other settings with different resources and drug/paraphernalia policies. A fourth limitation is the cross-sectional nature of this analysis, precluding causal inference of associations between the STIC score and risk of NSI. Future longitudinal research is warranted to examine the stability of the scale over time. Finally, the confidence interval for predicted probability of NSI among women with a STIC score of 4.0 is wide (5.88, 39.78). This is likely due to a smaller sample of women in the study.

Limitations notwithstanding, this study has notable strengths. First, the study developed a novel, reliable score to measure risks of NSI of police who come into frequent contact with PWID. This key metric may be used to inform prevention, monitoring, training, and other interventions to address NSI risk. Future research must validate NSI risk scales with police in other parts of the world to establish external validity. The dual nature of the risk behaviors, threatening both police and PWID, adds a community health imperative to address risky practices like syringe confiscation and improper discarding of syringes. Additionally, the sample size was large and included female police officers who remain an understudied subpopulation of law enforcement officers in occupational health and safety research. The STIC score is an important tool in assessing occupational NSI risk among police and informing occupational safety trainings to address the risk environment for HIV and other bloodborne pathogens among law enforcement officers in Mexico.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Relevance: Prior to this analysis, there has been no instrumentation available to measure occupational needlestick injury (NSI) risk among police officers. The STIC score, which we have developed and validated, provides a useful tool for predicting occupational NSI risk among police in situations where prevalence data is unavailable or unreliable. Further, this analysis highlights a number of police behaviors (syringe confiscation, transportation, breaking, discarding and arrest for syringe possession) that are associated with previous (last 6 months) self-reported NSI.

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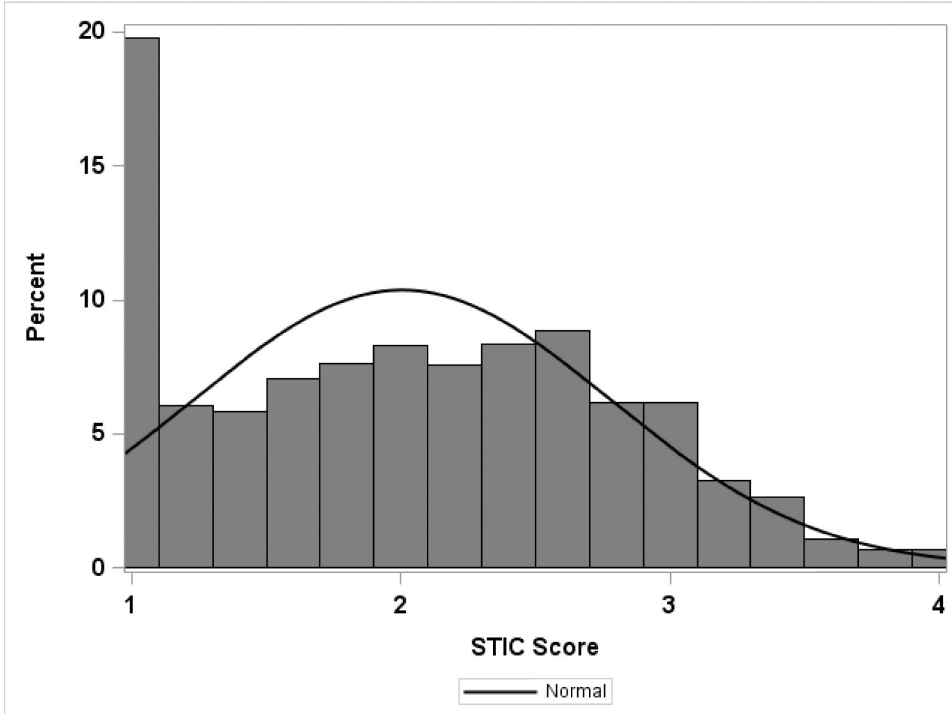
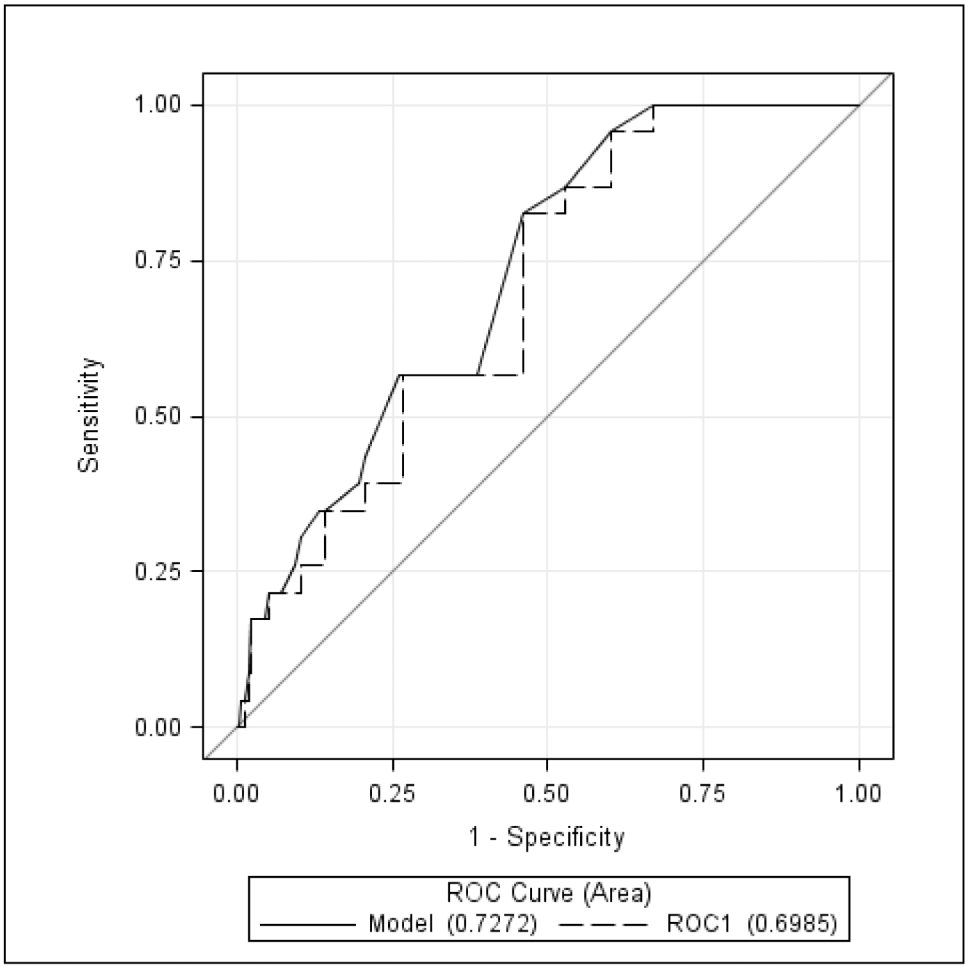


Figure 1.
Distribution of the STIC Score



	Area	Standard Error	95% Wald Confidence Limits	
Model	0.73	0.043	0.643	0.812
ROC1	0.70	0.045	0.610	0.787

Figure 2.
ROC comparison, Model using entire data set vs. Model using cross-validation (ROC1)

Table 1

. Police officer characteristics by whether one reported an NSI (past 6 months) and univariate regressions examining associations between these characteristics and the probability of reporting an NSI

Variable		NSI (N=23)	No NSI (N=1501)	Total (N=1524)	OR	95% CI	P-value
Gender	Female	7(30.4%)	178(11.9%)	185(12.1%)	3.24	(1.19, 8.88)	.022
	Male	16(69.6%)	1323(88.1%)	1339(87.9%)			
Age	Median(IQR)	36.0(30.0,41.0)	38.0(33.0,43.0)	38.0(33.0,43.0)	0.98	(0.94, 1.03)	.461
	Mean(SD)	37.3(7.9)	38.3(8.7)	38.3(8.7)			
Education Attainment *1	>=High School	12(63.2%)	1099(79.8%)	1111(79.6%)	0.43	(0.20, 0.95)	.036
	<High School	7(36.8%)	278(20.2%)	285(20.4%)			
Married *2	Yes	13(72.2%)	969(78.5%)	982(78.4%)	0.72	(0.21, 2.42)	.590
	No	5(27.8%)	266(21.5%)	271(21.6%)			
Rank	Officer or lower rank	3(13.0%)	161(10.7%)	164(10.8%)	0.80	(0.49, 1.31)	.385
	District	3(13.0%)	161(10.7%)	164(10.8%)			
Current Assignment	Chief/Deputy/Supervisor Patrol	21(91.3%)	1295(86.6%)	1316(86.6%)	1.58	(0.44, 5.74)	.486
	Administrative	2(8.7%)	201(13.4%)	203(13.4%)			
Current Work District *3	High Drug Use Area	9(39.1%)	469(31.6%)	478(31.7%)	1.50	(0.64, 3.52)	.354
	Low Drug Use Area	14(60.9%)	1017(68.4%)	1031(68.3%)			
# Years in Law Enforcement *4	Median (IQR)	11.3(5.3,17.2)	11.2(8.0,18.0)	11.2(8.0,18.0)	0.97	(0.92, 1.02)	.231
	Mean(SD)	11.3(7.0)	12.9(8.0)	12.9(8.0)			
Frequency of Physical Altercations with Drug Users	All the time/sometimes vs. rarely/never	14(60.9%)	605(40.5%)	619(40.8%)	2.26	(1.06, 4.80)	.035
	Rarely/never	9(39.1%)	888(59.5%)	897(59.2%)			
Contact with Needles/Syringes	Frequently	11 47.8%)	506(33.7%)	517(33.9%)	1.89	(0.77, 4.63)	.162
	Sometimes	12(52.2%)	995(66.3%)	1007(66.1%)			

*Missing observations (*1n=128; *2n=271;*3n=15;*4n=98)

Table 2.

STIC score distribution and descriptive statistics (overall, by gender, and by NSI status)

STIC Score	n	Min	Max	Mean	Standard Deviation	Median	Lower Quartile (Q1)	Upper Quartile (Q3)
Entire Sample	1541	1.00	4.00	2.00	0.77	2.00	1.20	2.60
Males	1348	1.00	4.00	2.03	0.77	2.00	1.40	2.60
Females	188	1.00	4.00	1.83	0.77	1.80	1.00	2.40
Had an NSI *	23	1.40	3.40	2.48	0.49	2.40	2.20	2.80
Did not have an NSI *	1505	1.00	4.00	2.00	0.77	2.00	1.20	2.60

* Past 6 months

Table 3.

Association between STIC score and having reported at least one NSI in the past 6 months

Variable	Adjusted Odds Ratio	95% Confidence Interval	Chi-Square	P-value
Score (per one-point increase)	2.43	(1.61, 3.67)	17.94	<.0001
Gender (Female vs. Male)	3.45	(1.14, 10.39)	4.84	.028
Education (High School or above vs. less)	0.31	(0.17, 0.88)	5.21	.023

Table 4.

Predicted probabilities (%) of an NSI for selected STIC values by gender

STIC Score	Predicted Probabilities (95% CI)	
	Males	Females
1.0	.41 (0.16, 1.05)	1.55 (0.55, 4.30)
2.0	.94 (0.54, 1.66)	3.57 (1.66, 7.49)
3.0	2.19 (1.26, 3.75)	7.98 (3.59, 16.79)
4.0	4.97 (2.10, 11.76)	16.88 (5.88, 39.78)