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ESTIMATION OF THE NUMBER OF INJECTION DRUG USERS IN ST. PETERSBURG, RUSSIA

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Abstract

The conjoined epidemics of HIV and injection drug abuse have progressed rapidly in many parts of the Russian Federation, including the City of St. Petersburg, which now has more cases of HIV than any other region in the country. Official estimates of the number of injection drug users (IDUs), which rely on official registration of IDUs, greatly underestimate their number. We have combined official statistics that register HIV cases and attribute risk to causes including injection drug use with data from a study that collected data from IDUs about their HIV serostatus and their history of HIV testing to estimate the number of IDUs in the city. We conclude that there are $83,118 \pm 5,799$ total IDUs. Since many IDUs have not been tested and even some who have been officially tested do not know their serostatus, a first step in countering the growing HIV epidemic among IDUs in St. Petersburg must be expanded access to HIV testing, prevention, and treatment that is targeted to IDUs.

Keywords

Injection drug use; HIV; Russia; population estimation

1. INTRODUCTION

The HIV epidemic in Russia that began in the mid 1990's is embedded in a parallel epidemic of drug abuse. According to official statistics, the number of registered HIV-positive individuals nationwide has increased from just over 1,000 at the beginning of 1996 to nearly 450,000 by the end of 2008 and the number of newly registered infections from 2005 through 2008 exceeded 35,000 annually, increasing the cumulative incidence by 10% annually (Pokrovsky et al., 2008). It was estimated that true prevalence – 940,000 in 2007 -- was more than double the official count of 417,715 (UNAIDS, 2008). To date, the epidemic remains concentrated among injection drug users (IDUs) who comprise more than 80% of the infections with attributable risk (Goliusov et al., 2008).

The City of St. Petersburg is the regional jurisdiction in the Russian Federation with the most registered HIV cases, and there is little evidence that the epidemic is slowing. Large increases in HIV began in 1998, and with an additional 5,200 cases added between February 2007 and July 2008, the most recent available data place the number at 38,080 (AFEW, 2008). IDUs

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remain at the core of the epidemic in St. Petersburg. Heroin injection predominates; it was injected by 97% of 900 drug users surveyed in 2002 and 95% of drug users surveyed in 2005–08 (Niccolai et al., 2009a; Shaboltas et al., 2006). To date, 77.7% of the HIV cases registered in St. Petersburg have been attributed to injection drug use and there has been little evidence for a sustained decrease in this percentage over the past decade (Rakhmanova et al., 2007). Our studies of IDUs have revealed that prevalence among IDUs has increased from 11% in 2000 (Abdala et al., 2003) to 30% in 2002 (Shaboltas et al., 2006) and 43% among IDUs sampled in 2005–08 (Niccolai et al., 2009a).

In order to estimate the scope of what is needed to provide care to individuals suffering from addiction and HIV infection, it would be useful to have a reasonable estimate of the number of IDUs in St. Petersburg. Official statistics are compiled of all individuals identified with drug abuse problems; they are registered and remain on the City registry for at least five years. The number of registered drug injectors in St. Petersburg is slightly more than 10,000 (personal communication (Apalikova, 2008; Krupitsky, 2009). Given that nearly 30,000 cases of HIV have been diagnosed in drug injectors and just over 1,600 deaths among people living with HIV/ AIDS were reported as of July 2008 (AFEW, 2008), the number of registered drug users clearly underestimates the extent of the problem. The need for a more reliable measure of the number of drug users is apparent.

Several approaches have been used to estimate hidden populations of individuals involved with drugs. Capture-recapture methods have been used in several studies: in a New York neighborhood to estimate the number of cocaine and heroin users and sellers and in Austria to estimate the number of problematic opioid users (Davis et al., 2003; Uhl and Seidler, 2001). Averaging estimates collected from interviews with experts has been used for 96 metropolitan regions in the US (Friedman et al., 2004). Multiplier methods have been used in Australia, Great Britain, Italy and New Haven (Hall et al., 2000; Hartnoll, 1997; Kaplan and Soloshatz, 1993; Rossi, 1999).

Capture-recapture studies have long been used to estimate the size of populations. For the estimate to be accurate, four assumptions must be met: (1) that the population is closed, (2) that there is no loss of markings, i.e., unique identifiers given to individuals in a population such as bands on animals or, for humans, social security numbers, unique personal identifiers, or biometrics, (3) that each individual has the same likelihood of recapture, and (4) that samples are independent (International Working Group for Disease Monitoring and Forecasting, 1995). None of these assumptions can be reliably met in attempts to use capture recapture to estimate the size of hidden populations and this is especially so for drug users. Individuals enter and leave the population frequently as they try to stop using drugs, are arrested, and for other reasons. Because injectors seek to remain hidden, visible evidence (markers) for their drug user are concealed. Many studies have revealed that there can be great variations in the likelihood of identifying drug users (Brady et al., 2008; Friedman et al., 2004; Pompidou Group, 1997). Finally, capture-recapture studies of drug users often rely on lists of individuals who interact non-independently with drug treatment, the police, the courts, and social service agencies. This is especially true in a place such as St. Petersburg where the government's reporting systems link people who register as drug users, who are imprisoned following drug related arrests, and who are tested for HIV making each register non-independent.

Relying on experts to provide valid estimates for the size of hidden populations requires that the experts have access to valid information. A frequently employed method is the Delphi analysis in which the question of interest is addressed to a panel of experts who provide answers independently, and differences in the estimates are resolved through iterations of the question of interest that increasingly seek to encourage the panel to reach consensus (Adler and Ziglio, 1996; Akins et al., 2005). To identify an adequate panel of experts, all of them need access to

valid information. Based on what experts in St. Petersburg have been able to report (see above), it seems obvious that access to valid information is lacking.

This leaves the multiplier method as the best option for attempting to determine the size of the IDU population in St. Petersburg. In this manuscript, we will provide a set of simple equations that allow us to estimate the number of IDUs in St. Petersburg using data on HIV diagnoses among IDUs. This number will be put in the context of the adult population of St. Petersburg

2. METHODS

2.1 Necessary Information

Several pieces of information are needed to make an estimate of the number of drug users if we know about HIV diagnoses. To make the calculation we need to know benchmark data -- the number of HIV positive individuals living in St. Petersburg and the percentage of these cases among IDUs -- and multiplier data -- the percentage of IDUs who have been tested and the prevalence of HIV among a representative sample of IDUs.

2.2 Data Sources

All HIV infections identified by testing at healthcare facilities (hospitals, health clinics, drug treatment programs) and non-healthcare situations in which testing is mandatory (upon incarceration, entry into the military, to qualify for certain forms of employment) are reported to the City AIDS Center which is responsible for maintaining the count of cases and for attributing these among several risk categories including injection drug use. These data are compiled, reported to the Federal AIDS Center in Moscow, and published in an annual report from the chief infectious disease specialist in the city (Rakhmanova et al., 2007). Thus, the benchmark data come from the City AIDS Center.

Multiplier data -- HIV prevalence and HIV testing rates -- come from the NIDA-funded Sexual Acquisition and Transmission (SATH-CAP) study that planned two discrete waves of respondent driven sampling (RDS), which is a variant of chain referral sampling. RDS uses a dual incentive system and data collection about the social networks of drug users that can be assessed to estimate the extent that the sample varies from the hidden population from which the sample was drawn (Heckathorn, 2002; Salganik and Heckathorn, 2004). We used a dual core recruitment scheme to recruit both drug users and men who have sex with men; individuals who enrolled in the study could, in turn, recruit up to five other individuals who met eligibility criteria for drug use. Further details of the SATH-CAP recruitment scheme and preliminary analyses of the study population -- have been previously reported (Iguchi et al., 2009; Niccolai et al., 2009a; Niccolai et al., 2009b). This study focuses on those individuals who reported injection drug use; of the 715 drug users who met eligibility criteria and were enrolled in the study, 691 (96.6%) reported a history of injection drug use. Of these 691, 677 provided sufficient information about testing to be included in this report. The first wave was conducted from November 2005 through December 2006. The second wave was conducted from May 2007 through December 2008. Participants in wave one were excluded from wave two. All study procedures, instruments, and consent materials were approved by IRBs at all participating institutions. Participants were tested for HIV using a primary enzyme immunoassay test (Genscreen HIV 1 / 2; BioRad, France and/ or Vironostika HIV Uni-Form II plus 0; Biomérieux, The Netherlands) and all positive results were confirmed using Western blot (New Lav Blot HIV-1; BioRad, France). Study participants were also asked if they had been tested for HIV at any time before they were tested as part of their involvement in this study.

2.3 Equations

The first equation calculates the number of HIV-positive IDUs alive in St. Petersburg who have come to the attention of the testing system:

$$(\text{\#knownlivingHIV+people}) \times (\text{\%ofcasesamongIDUs}) = (\text{\#knownHIV+IDUs}) \quad (1)$$

This estimate of the number cases is among those IDUs who have ever been tested, since those who have not been tested cannot have come to the attention of the system and been counted among the registered HIV positives. To estimate the true number of HIV positive IDUs we need to adjust for those people who have never been tested. Therefore, the second equation uses data on the percentage of IDUs enrolled in our study who were HIV infected but had never been tested before:

$$(\text{\#ofknownIDUsivingwithHIV+IDUs}) / (\text{\%ofIDUstested}) = (\text{\#IDUsivingwithHIV}) \quad (2)$$

To estimate the total number of IDUs, we need to divide the number of HIV cases among IDUs by the prevalence of HIV in the population

$$(\text{\#IDUsivingwithHIV}) / (\text{HIVprevalence}) = (\text{\#IDUs}) \quad (3)$$

2.4 Analysis of the sample of IDUs

Equation 1 relies on data from the City AIDS Center; equations (2) and (3), use estimates that come from the SATH-CAP study. To analyze the extent to which our sample met criteria indicating that the sample reached an equilibrium, we applied the RDS analysis tool (RDSAT software, version 5.6). We determined weights based on recruitment patterns for variables focusing on demographic variables of sex, age, educational level, and employment status and on the variable of HIV serostatus.

We calculated standard 95% confidence intervals around the percentages of HIV seropositive IDUs and IDUs who had previously been tested in our sample. Comparisons of the proportion of HIV-positive and HIV-negative IDUs who had been tested and who had received their test results employed the chi-square statistic with Yates correction.

3. RESULTS

Data on registered infection have been maintained since the late 1980's by the City AIDS Center in St. Petersburg. The cumulative prevalence reported in the most recently available report was 38,080 as of 31 July 2008. To that date there had been 1,673 deaths among the HIV positive population, leaving 36,407 living with HIV. The data from the City AIDS Center revealed that 77.7% of all infections could be attributed to injection drug use. Thus:

$$36,407 \text{ registered cases} \times 0.777 \text{ who were IDUs} = 28,288 \text{ registered HIV-positive IDUs}$$

This number under-represented the number of HIV infected IDUs in proportion to the rate that HIV-positive IDUs have failed to be tested. In our recent study of 677 IDUs who provided data on HIV testing, 532 (78.6%) reported having been previously tested; among the 293 HIV-positive individuals in the study 222 (75.8%) reported having been previously tested (Table 1). The percentages that had been tested among HIV-positive and HIV-negative IDUs -- 75.8%

and 80.7%, respectively -- were not statistically different ($p=0.109$). We therefore estimated that the actual number of HIV-infected IDUs was:

$$28,288/0.786=35,990 \pm 1,116 \text{ total HIV infected IDUs}$$

If we used our estimate for HIV prevalence among these 677 IDUs from Table 1, then the 35,990 HIV infected IDUs were only 43.3% ($\pm 3.8\%$) of the total population of IDUs. Thus, the total number of IDUs was:

$$35,990/0.433=83,118 \pm 5,799 \text{ total IDUs.}$$

Applying standard confidence intervals to the estimates of the proportion of IDUs tested for HIV and the HIV prevalence, we estimated 95% confidence intervals between 74,381 and 92,296 IDUs in St. Petersburg.

The estimate was based on the assumption that our sample of 677 IDUs is representative of all IDUs in St. Petersburg. An advantage of RDS is that data collected as part of recruitment can be used to estimate the extent to which the sample recruitment pattern is consistent with the accrual of a representative sample. Such estimates are based on weighting individual observed variables to determine the extent of sampling imbalance across the categories within each variable. We determined the weighted estimates for sex, age, educational level, employment status, and HIV serostatus (Table 2). The similarity in the observed and weighted percentages suggested that a representative sample may have been obtained and that there was little if any reason to recalculate our estimates using the weighted prevalence.

4. DISCUSSION

This simple multiplier method to estimate the number of injection drug users in St. Petersburg yielded a number that is far greater than official estimates. Given that almost all IDUs in St. Petersburg were between 20 and 45 years of age, and that the size of this age group in St. Petersburg is approximately 1.5 million, we estimate that 5.54% of people aged 20 to 45 was likely to be an IDU. For the total population of the City of St. Petersburg, which is 4.6 million, the proportion that were IDUs was estimated to be 1.81%. By way of comparison to estimates from U.S. metropolitan statistical areas range from 0.19% for Ann Arbor, MI to 1.73% for Fresno, CA (Friedman et al., 2004). The scope of the epidemic of injection drug use in St. Petersburg clearly indicates that it is a major health problem among young adults.

This report is subject to several limitations. There are two factors that could lead us to underestimate the number of IDUs. First, the percentage of HIV diagnoses attributed to injection drug use may be inaccurate. It is possible that IDUs will conceal their drug use and, as a result, the infection may be attributed to unsafe sex or reported as cause unknown. This underestimation of the fraction of cases attributed to injection drug use would result in a higher estimate for the number of IDUs in the city. A second source of bias would be unofficial or anonymous testing that does not get reported to the City AIDS registry. If this were widespread among IDUs, many people who report being tested might have been tested in a manner not entered into the system. This would again lead to under-estimating the IDU population. However, we did inquire about the circumstances of testing and we found that testing was strongly associated with circumstances -- entering drug treatment, imprisonment, hospitalization -- that would lead to registration (Niccolai et al., 2009b). Therefore, we do not believe that this type of underestimation will be large. In summary, the limitations appear to either have no imbalanced effect on the estimate or lead to underestimation. Thus, it seems that our estimate is, if anything, a lower bound for the number of IDUs in the city of St. Petersburg.

A limitation that would lead to overestimation is that our analysis assumed that all IDUs captured by the HIV surveillance system were still active IDUs. While it is certain that some IDUs ceased injection, the number is likely to be small. First, deaths among IDUs were taken into account since the cases we used as input from the City HIV registry was people living with HIV/ AIDS. Second, the Russian residence system inhibits free movement of residents, especially those who are registered as social deviants (i.e., IDUs) who would need special dispensation to change residence. Third, given the ineffective system of treatment for drug addiction, relapse is all but universal even when the process is completed. This system is based on a 7–10 day period of in-patient detoxification and subsequent post-detoxification stabilization that is generally limited to a month followed by release to the community for which discharge planning is absent or haphazard and where community-based ongoing rehabilitation consists of, at best, intermittent, low-intensity psychotherapy and 12-step programs. A recent survey of forty narcologists – the Russian term for addiction treatment specialists – from ten regions in Russia revealed a surprising gap between expectations for treatment and outcomes (Krupitsky et al., 2009). Half believed that detoxification and 17 (42.5%) believed that post-detoxification rehabilitation was effective treatment. On the other hand, these narcologists also estimated that only 39% of patients remained drug free one month after completing treatment and by six months this estimate fell to 19%. And these percentages are for the patients who **complete** the detoxification and stabilization period. Conversations with narcologists in five Russian regions have revealed that the majority of patients admitted to in-patient narcology services leave against medical advice before the 21-day treatment is completed.

There is another limitation: the estimation of the percentage of IDUs who have been tested comes from self-report and is therefore susceptible to recall and socially desirable response biases. We do not know the extent of misreporting for this variable, but we have no reason to believe that it should systematically under- or over-estimate the percentage of IDUs who have been tested.

Given the size of the IDU population and the failure of current drug treatment, it is imperative that active steps be taken to reduce the burden of injection drug use. Given the weak structure of civil society in Russia and with its increasing emphasis on government to control all aspects of social policy (Howard, 2003; Marinova, 2008; Proskuryakova, 2005), government will have to be the key actor in establishing and expanding any kind of coordinated public health response to addiction. In short, the government of St. Petersburg will need to become more actively engaged in addiction prevention and treatment activities and will need to find ways to expand HIV testing that reaches IDUs.

In 2007, the city officially recognized the need to organize primary drug abuse prevention. The Committee on the Rule of Law, Order and Security prepared a report that identified the city agencies that need to become involved and specified policies that need to be implemented (Комитет по вопросам законности, 2007). This document focused both on identifying individuals involved in drug abuse and trafficking to “...work with people, programs and techniques aimed at law-abiding behavior, prevention and suppression of drug addiction among the population” and on increasing educational efforts to deter school-age youth from beginning to use illicit drugs. It is unclear whether the agencies have been coordinated, what if any steps have been taken to implement the recommendations of the report, and if implemented whether the plans outlined in the document have had any impact.

At the level of treating those who are already addicted, the government will have to take steps to go beyond what is currently available. Treatment is hampered since the most effective treatment for heroin addiction – opioid substitution therapy – is prohibited throughout Russia. Instead, detoxification is the standard treatment for addiction in Russia (Krupitsky et al.,

2009). At present in St. Petersburg, the standard for in-patient care is 21 days for detoxification and stabilization and all in -patient care is centralized at one in-patient facility with a capacity of less than 600 beds. If the calculation in this report is correct, then the supply of places can handle less than 1% of the patient burden at any time.

To improve the outcome of detoxification, greater efforts must be made to support post-detoxification care that can reduce the rates of relapse. Proper planning for post-detoxification care must begin during the time that the patient is hospitalized. Transition to supportive care upon release must become better coordinated.

The enfolding epidemic of injection drug use in St. Petersburg has been studied extensively insofar as it is related to the transmission of HIV and hepatitis C (Abdala et al., 2003; Gore-Felton et al., 2003; Heimer et al., 2008; Kozlov et al., 2006; Krupitsky, 2004; Ksobiech et al., 2005; Niccolai et al., 2009b; Shaboltas et al., 2006; Smolskaya et al., 2000; Somlai et al., 2002), but not enough emphasis has been placed on finding meaningful responses to injection drug use itself as the primary driver for the transmission of these blood -borne viruses. We hope that this report can serve to direct the focus of the scientific and policy-making communities to pay closer attention to the problems of drug abuse and addiction in Russia's second largest city.

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Table 1

HIV Seroprevalence and Prior Testing of IDUs Recruited by RDS, 2005–2008

	N	Previously Tested	Obtained Previous Test Results
All IDUs	677	532 of 677 (78.6 ± 3.1%)	440 of 532 (82.7 ± 3.2%)
HIV Positive at Enrollment	293 (43.3 ± 3.8%)	222 of 293 (75.8 ± 5.0%)	180 of 222 (81.1 ± 5.2%)
HIV Negative at Enrollment	384 (56.7 ± 3.8%)	310 of 384 (80.7 ± 3.9%)	260 of 310 (83.9 ± 4.1%)
p-value		0.119	0.401

Percentages in second column “N” refer to the proportion of IDUs who were HIV-positive or HIV-negative. Percentages in the third column refer to proportion of HIV-positive or HIV-negative individuals who reported having been tested at some point prior to entry into our study. Percentages in the fourth column refer to proportion of HIV-positive or HIV-negative individuals who, having been tested at some point prior to entry into our study, had been informed of their test results. We applied the χ^2 statistic to test if the probability of having been tested or of obtaining the results differed between HIV-positive and HIV-negative IDUs

Table 2

Observed and Weighted Proportions for Demographic Characteristics am HIV Prevalence of the Sample of IDUs
Accrued by RDS

		Observed	Weighted
Sex	Male	74%	77%
	Female	26%	23%
Age	≤26	37%	32%
	>26	63%	68%
Educational Level	Incomplete high school	17%	18%
	Completed high school	73%	73%
	Some university	10%	10%
Employed for Pay	Yes	33%	35%
	No	67%	65%
HIV Serostatus	Negative	56%	62%
	Positive	44.%	38%

None of the differences between the observed and weighted proportions were statistically significant at $p < 0.05$.