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Research article

KEY RISK FACTORS FOR POPULATIONS ESPECIALLY VULNERABLE TO HIV INFECTION

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Since 2012, no data can be found on any scientific research accomplished in correction facilities of the Russian Federal Penitentiary Service with its aim being to identify HIV risk factors and adherence to antiretroviral therapy (ART) among prisoners. In correction facilities of the Sverdlovsk oblast, each fifth prisoner is HIV-positive and in future this means a grave HIV burden for the regional population. Between 2020 and 2022, an anonymous survey was accomplished within an observational analytical cross-sectional study. Overall, 302 men participated in it; they were all former prisoners who applied for aid to a socially-oriented nonprofit organization during their social adaptation.

Injection drug use (IDU) was established to be the basic factor able to cause HIV in the analyzed group. Among HIV-positive respondents, 94.3 % had such experience prior to and during their service; among other prisoners, 55.6 % reported IDU ($p < 0.001$). Twenty-eight point nine percent of prisoners continued to use narcotics in prison. According to the survey results, 87.9 % of HIV-positive men only 'sometimes' used barrier protection during sexual intercourse or didn't use it at all. Seventy-three point five percent of them had more than 10 sexual partners during their lifetime and 29.3 % had sexually transmitted diseases in their case history. It is noteworthy that 82.9 % of the HIV-positive respondents had sexual contacts already during the first six months after being released from prison.

The study established a growing share of people who got antiretroviral therapy (ART) after release from the penitentiary system, from 63.1 % to 75.4 %; however, only 33.0 % of the patients who received ART were able to confirm they had never stopped doing it. Therefore, we have detected a high risk HIV spread among prisoners during their service with subsequent active HIV transmission into the general population.

Keywords: *HIV, injection drug users, prison, prisoners, risky behavior, risk factors, correction facilities, antiretroviral therapy, especially vulnerable population groups.*

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The UNAIDS reports that by the end of 2021 there were 38.4 million HIV-positive people among the whole global population of 7.9 billion[1]. This number has grown slightly over the last 10 years, only by 13 %; in general, this means that national programs implemented in some countries and aimed at slowing down the HIV pandemic have been quite successful. Preventive and anti-epidemic activities introduced in the most vulnerable population groups are the most effective means of fighting against HIV infection. Such groups include detained people, prisoners in holding cells who are under investigation, or those serving their sentence as incarceration in the penitentiary system establishments[2]. People who spent some time in prison and are prone to risky behavior can be a major reservoir for the onset and spread of HIV in the community [1].

According to some estimates, HIV infection prevalence was established to vary between 1.4 and 3.8 % among prisoners in 2016–2019 [2, 3]; it reached 13.9 % in Russia by July 01, 2021 [4]. HIV transmission in EECA was fuelled primarily by injection of opioids, with harsh criminalization of drug use that resulted in extraordinarily high levels of incarceration among people involved in illicit drug trade. Consequently, people who inject drugs, including those with HIV, hepatitis C virus, and tuberculosis, are concentrated within prisons [5].

More than 70 % of HIV cases are diagnosed when suspects enter the penitentiary system [6]. The disease is usually detected in the rest of them prior to criminal prosecution. Overall, between 3 and 6 % of people incarcerated in holding cells are already HIV infected[3]. Despite high relevance of the issue, since 2012, no data can be found on any scientific research accomplished in correction facilities of the Russian Federal Penitentiary Service with its aim being to identify and analyze HIV risk factors and adherence to antiretroviral therapy (ART) among prisoners.

Foreign studies have shown that prisoners tend to have some peculiar behaviors, which can result in HIV infection spread both inside penitentiary establishments and beyond them.

Injection drug use is the most widely spread way of HIV transmission among prisoners all over the world [3]. High levels of injection drug use make prisoners share syringes or needles much more often than it is done by those people who are not imprisoned [7]. Investigations accomplished between 2004 and 2013 show that from 20 to 45 % of people in Europe who had prison experience injected drugs during incarceration [8]. A study accomplished in Palestine revealed that 83.6 % of respondents who used injection drugs had spent some time in prison and almost half of them reported injection drug use while in prison [9], whereas both in Indonesia and Ukraine more than 70 % who used injection drugs reported sharing needles or syringes in prison [10, 11]. A study with its focus on various social groups of injection drug users in Iran established that among all participants who injected drugs, prisoners had the highest unsafe injecting behavior at the last injection (61 %) [12]. Injecting drug use during their current sentence was reported by 40 % of participants in a cohort study conducted in Victoria, Australia [13].

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[1] Fact sheet – Latest global and regional statistics on the status of the AIDS epidemic. *UNAIDS*, 2022. Available at: https://www.unaids.org/en/resources/documents/2022/UNAIDS_FactSheet (September 09, 2022).

[2] Gosudarstvennaya strategiya protivodeistviya rasprostraneniyu VICh-infektsii v Rossiiskoi Federatsii na period do 2030 goda; utv. rasporyazheniem Pravitel'stva Rossiiskoi Federatsii ot 21 dekabrya 2020 g. № 3468-r [The State Strategy for fighting against HIV infection spread in the Russian Federation for the period up to 2030; approved by the RF Government Order issued on December 21, 2020 No. 3468-r]. *Sudebnye i normativnye akty RF [RF juridical and regulatory documents]*. Available at: https://sudact.ru/law/rasporiazhenie-pravitelstva-rf-ot-21122020-n-3468-r/gosudarstvennaia-strategiia-protivodeistviia-rasprostraneniiu-vich-infektsii/ (July 16, 2023) (in Russian).

[3] Razvitie ugolovno-ispolnitel'noi sistemy (2018–2030 gody): Federal'naya tselevaya programma, utv. postanovleniem Pravitel'stva RF ot 06.04.2018 № 420 [The development of the penitentiary system (2018–2030): the Federal Target Program, approved by the RF Government Order issued on April 06, 2018 No. 420]. *GARANT: information and legal support*. Available at: https://base.garant.ru/71921634/ (July 16, 2023) (in Russian).

Unprotected sexual contacts hold the second rank place as a factor able to cause HIV transmission among prisoners. A study conducted among prisoners in Poland in 2016 established that men in prison faced various risky forms of sexual activities two times more often than men who did not have any prison experience. Prisoners did not use condoms in 83 % of cases when coercing their partner to have anal sex with them. Moreover, 3.3 % of the respondents provided sex services on the premises of the correctional facilities they were actually in [14]. In Australia, a survey was conducted with 2018 men participating in it who were imprisoned in New South Wales and Queensland; as a result, 7.1 % of the respondents reported sexual contacts with inmates in prison and 2.6 % had been sexually coerced [15].

In the USA, data about behaviors of HIV-positive people are collected by the National HIV Surveillance System within US Centers for Disease Control and Prevention; an analysis of such data established that risky behavior was more prevalent during the first year after release from the penitentiary system: condomless heterosexual contacts were 1.32 times more frequent and injection drug use was 3.75 times more frequent among former prisoners as compared with never-incarcerated men [16]. After release from prison, 17.9 % of African Americans had multiple parallel sexual contacts with several partners including female commercial sex workers [17]. A study was accomplished with 751 participants who were former prisoners and were released in 2013–2015; as a result, a share of the respondents who reported any illicit use of psychoactive drugs just after release was established to reach 18 %.

Effective antiretroviral therapy (ART) and high adherence to taking antiretroviral medications are key factors able to mitigate risks of HIV transmission.

A study accomplished in 2019–2020 in Southern Ethiopia among prisoners with HIV and free people living with HIV (PLWH) established that patients in prison get treated with antiretroviral drugs more often (83 % among prisoners against 81 % among free PLWH); however, they have lower adherence to a prescribed dosage and drug inefficacy is more common in them. Prisoners most often missed ART sessions due to lack of help from prison guards and / or due to forgetfulness. Some prisoners reported that they missed their ART appointment due to fear of social stigma, feeling hopeless and being disinterested in the therapy [18].

A systematic review and meta-analyses on initiation, adherence and outcomes of antiretroviral therapy in incarcerated people established several regularities. Lower odds of ART initiation was noticed among inmates with higher baseline CD4 count (CD4 $\geq$ 500 cells/mm^3), new HIV diagnosis, and in those who lacked belief in ART safety and efficacy. Non-adherence was high among inmates who lacked social support, had low self-efficiency score and those with depressive symptoms [19].

A study accomplished among prisoners LWH in a prison in Tehran established some other ART drug side effects, especially with Efavirenz, in addition to several widespread factors producing negative effects on ART adherence (social stigma, lack of social support, difficulties in getting access to ART drugs). These effects included Methadone and opioids effects resolution due to interaction with antiretroviral drugs, forgetfulness, fear of hangover due to the missed or delayed Methadone use, inappropriate nutrition and lack of access to food supplements and poverty; they were noted by the majority of participants [20].

In this study, our aim was to estimate significance of HIV risk factors among former prisoners.

Materials and methods. Between February 2020 and March 2022, an anonymous survey was accomplished within an observational analytical cross-sectional study. Overall, 302 men participated in it; they were all former prisoners who had served their sentence in the Sverdlovsk oblast. They all took part in the survey during their first year after release.

Former prisoners on their own applied for social support and healthcare to the ‘New Life’ Regional public fund for assistance to various

categories of the population of the Sverdlovsk region, a nonprofit organization (Ekaterinburg). Upon application, they were offered to take part in the survey. Additionally, HIV/AIDS positive people were provided with comprehensive information about peculiarities of HIV infection diagnostics and treatment and with relevant psychological aid; they were motivated to adhere to antiretroviral therapy (ART) and to give up risky behavior. The survey relied on using two questionnaires that were specifically developed for (a) people who had been incarcerated, and (b) people who had been incarcerated and lived with HIV (a questionnaire for PLWH). Both questionnaires covered common social parameters (marital status, family, social status, etc.) and some general information about some probable factors of HIV risks prior to incarceration and after it as well as some HIV awareness. The questionnaire for PLWH additionally included questions about a probable place and period of getting infected with HIV, ART adherence, actual intake of antiretroviral drugs prior to incarceration and after release and during the service as well.

The questionnaires can be found in free access on the web-site of the Federal Scientific Research Institute of Viral Infections 'Virome' of the Russian Sanitary Service (Rospotrebnadzor)[4].

HIV risk factors were divided into several groups as per an infection transmission mechanism. Frequency characteristics of the risk factors were described for the whole sample ($n_{max} = 302$).

We compared a group of HIV-positive people (PLWH, $n_{max} = 181$) with a group of HIV-negative people (the reference group, $n_{max} = 121$). Given that not all respondents agreed to answer some questions including those about duration and experience of drug use, the number of estimated survey results for several indicators was smaller than the number of people in the initial study groups. Two respondents from the PLWH group gave answers only to the first questionnaire (provided only some general information).

Statistical data analysis involved calculating confidence intervals as per the Wilson method for the level of a type I error 0.05[5]. Statistically significant differences between the groups were confirmed with non-parametric tests (Chi-square, Mann – Whitney test). Relationships between qualitative indicators were quantified by calculating odds ratio (*OR*) and its 95 % confidence interval.

All obtained data were analyzed using STATISTICA (data analysis software system), version 12 (StatSoft Inc), and PAST 4.0 application [21].

Results and discussion. ***A social profile of questioned prisoners.*** An average age of the respondents (302 people), who participated in the observational analytical cross-sectional study, was 38.85 ± 7.23 years. Of them, 45.7 % (95 % *CI* [40.2–51.3]) had never been married officially but 20.2 % of these respondents cohabitated with a partner (95 % *CI* [40.2–51.3]); 18.9 % (95 % *CI* [14.9–23.7]) were married; 15.2 % (95 % *CI* [11.6–19.7]) were divorced or widowed. Forty-eight point seven percent (95 % *CI* [43.1–54.3]) had children. Most respondents had secondary, vocational, or incomplete higher education, namely 64.2 % (95 % *CI* [58.7–69.4]); 7.0 % were HEI graduates (95 % *CI* [4.6–10.4]). Twenty-nine point six percent had worked in profit-making organizations prior to incarceration (95 % *CI* [24.7–35.1]); 11.8 % (95 % *CI* [8.6–15.9]) had worked in budgetary institutions. Fifty-eight point six % had been unemployed (95 % *CI* [52.9–64.0]). The number of convictions varied within a wide range between 1 and 10 and the median number of convictions identified for the entire sample was 3.

Therefore, a generalized social profile of a respondent was predominantly represented by

[4] Informatsionnye materialy [Information materials]. *Federal Scientific Research Institute of Viral Infections 'Virome' of the Russian Sanitary Service (Rospotrebnadzor).* Available at: http://eniivi.niivirom.ru/?page_id=1574 (July 02, 2023) (in Russian).

[5] Wilson E.B. Probable Inference, the Law of Succession, and Statistical Inference. *Journal of the American Statistical Association*, 1927, vol. 22, no. 158, pp. 209–212. DOI: 10.1080/01621459.1927.10502953

single unemployed men aged 39 years with secondary, vocational, or incomplete higher education; to put it shortly, a typical respondent was a single unemployed injection drug user and a relapsed criminal (three convictions).

Overall, HIV prevalence was 59.9 % in the analyzed sample (95 % *CI* [54.3–65.3]).

An average age was 38.74 ± 5.8 years in the test group made of PLWH (n_{max} = 181). Of them, 47 % were single, 18.8 % cohabitated with a partner, 19.3 % were married, and 15 % were divorced or widowed. Forty-six point four percent had children. People with secondary, vocational, or incomplete higher education accounted for 60.8 %; 4.4 % had higher education. Prior to imprisonment, 32.2 % had worked in profit-making organizations, 10.6 % had been employed by budgetary institutions, and 57.2 % had been unemployed. The number of convictions varied between 1 and 10, its median value being 3.

An average age was 39.02 ± 8.9 years in the reference group (n_{max} = 121). Of them, 43.8 % had never been married, 22.3 % cohabitated with a partner, and 18.2 % were married. Divorced and widowers accounted for 15.7 %. Fifty-two point one percent had children. People with secondary, vocational, or incomplete higher education accounted for 69.4 % and 10.7 % had higher education. Prior to incarceration, 25.6 % had worked in profit-making organizations; 13.7 % had been employed by budgetary institutions. The number of convictions varied between 1 and 10, its median value being 2.

The groups did not have any statistically significant differences as per age, marital status, or employment. Respondents with incomplete secondary education were more frequent in the group of PLWH (χ^2 = 11.93, d.f. = 1, $p < 0.001$).

A risk factor associated with injection drug use and making tattoos. Injection drug use is the most significant HIV risk factor. Out of 174 PLWH who gave an answer to the question about drug use, 164 (94.3 %; 95 % *CI* [89.7–96.8]) reported drug use prior to incarceration or they started doing it in prison; only 55 HIV-negative people (55.6 %; 95 % *CI* [45.7–65]) admitted they were injection drug users (IDUs). IDUs were HIV positive statistically significantly more frequently than those who had never used injection drugs (χ^2 = 59.55, d.f. = 1, $p < 0.001$). IDUs had 13 times higher HIV risks than people in the reference group (*OR* = 13.12; 95 % *CI* [6.19–27.82]). The median duration of injection drug use equaled 20 years in the group of PLWH and 7 years in the reference group (U = 1702.5, Z = 6.205, p = 0; n_1 = 137 (PLWH), n_2 = 57).

Only 273 respondents of the entire sample (302 people) agreed to give an answer about their experience of injection drug use; of them, 194 people were able to name the exact duration of such use. IDUs accounted for 80.2 % (219 out of 273; 95 % *CI* [71.7–82.0]), duration of injection drug use varied between 8 months and 31 years, the median duration being 15 years and interquartile year range varying between 7 and 21.

Fifty seven people of 197 respondents who had used injection drugs before incarceration continued their active use in prison as well (28.9 %; 95 % *CI* [23–35,6]). It is noteworthy that 3 people (1.5 %; 95 % *CI* [0.5–4.4]) first started to use injection drugs in prison. Therefore, according to the survey data, only 137 IDUs (69.5 %; 95 % *CI* [62.8–75.5]) quit using drugs in prison.

The question whether a respondent had seen any actual injection drug use in prison was answered by 243 respondents (80.5 %). Positive answers were given by 77 former prisoners who had been kept in penal colonies (31.7 %; 95 % *CI* [26.2–37.8]) and by 30 who had been kept in holding cells under investigation (12.4 %; 95 % *CI* [8.8–17.1]). Totally, 102 respondents (42.0 %; 95 % *CI* [35.9–48.3]) or each second prisoner had witnessed injection drug use in prison; out of them, 60 prisoners used such drugs themselves.

One hundred and eighty-three people out of 300 respondents (61.0 %; 95 % *CI* [55.4–66.3]) made tattoos in prison. This fact was mentioned 1.6 times more frequently by PLWH (*OR* = 1.61; 95 % *CI* [1.00–2.58]). However, none of them believed they had got infected with HIV due to this manipulation.

A risk factor associated with sexual transmission. A statistically significant difference was identified between the group of PLWH and the reference group as regards the number of sexual partners (χ^2 = 8.06, d.f. = 1, p = 0.005). Eighteen out of 181 PLWH (9.9 %; 95 % *CI* [6.4–15.2]) had more than 20 sexual partners whereas only 2 people in the reference group (1.7 %; 95 % *CI* [0.5–5.8]) reported the same.

Risky sexual behavior due to refusal to use barrier contraception (condoms) was more prevalent in the PLWH group than in the reference one: *OR* = 1.52 (95 % *CI* [0.79–2.9]). However, sexually transmitted infections (STIs) were reported more frequently by people from the reference group whereas a chance to transmit STIs was *OR* = 0.66 (95 % *CI* [0.39–1.13]) in the PLWH group.

One hundred and forty-two people from the PLWH group (79.3 %; 95 % *CI* [72.8–84.6]) reported sexual contacts with HIV-positive partners. Likelihood of such contacts was 15 times higher among PLWH (*OR* = 15.73; 95 % *CI* [8.85–27.94]) than in the reference group.

We established high HIV risks for people who had sexual contacts with IDUs, *OR* = 6.87 (95 % *CI* [3.79–12.46]), and with people who had parenteral viral hepatitis, *OR* = 3.48 (95 % *CI* [2.15–5.65]). While being aware that HIV infection is a sexually transmitted one, 89 respondents (30.4 %; 95 % *CI* [25.4–35.9]), including 46 PLWH, admitted they had never used barrier contraception; 167 people (55.3 %; 95 % *CI* [49.7–60.8]), including 112 PLWH, reported using condoms 'from time to time'. In the PLWH group, 159 people out of 181 (87.9 %; 95 % *CI* [82.3–91.8]) did not use condoms all the time; this answer was given by 100 people from the reference group (82.6 %; 95 % *CI* [74.9–88.4]).

Most respondents from the analyzed sample had sexual contacts after release from prison; 187 people (61.9 %; 95 % *CI* [56.3–67.2]) reported having such contacts over the last month and 56 people (18.5 %; 95 % *CI* [14.6–23.3]), over a period between one and six months. One hundred and fifty respondents (82.9 %; 95 % *CI* [76.7–87.7]) from the PLWH group reported having sexual contacts over the last six months and 41 of them (22.7 %; 95 % *CI* [17.2–29.3]) had not used barrier contraception.

Out of 179 PLWH, 41 respondents (22.9 %; 95 % *CI* [17.4–29.6]) believed they had gotten infected with HIV through sexual contacts; 25 of them (61.0 %; 95 % *CI* [45.7–74.3]) had used some drugs and 7 people (17.1 %; 95 % *CI* [8.5–31.3]) refused to disclose any information about drug use.

HIV identification and adherence to antiretroviral therapy. The penitentiary system makes a significant contribution to HIV identification in socially significant population groups. All former prisoners had been screened to identify HIV in the penitentiary system: in a holding cell, in a prison clinic, or in penal colonies when provided with various healthcare services in health units. One hundred and sixty-nine people (56.0 %; 95 % *CI* [50.3–61.4]) in the entire sample had never been examined to identify HIV and had not known their HIV status prior to incarceration. Out of them, 96 people (56.8 %; 95 % *CI* [49.3–64.0]) were identified as HIV positive in the penitentiary system.

People living with HIV more frequently had more than one conviction (*OR* = 1.8; 95 % *CI* [1.01–3.21]). The median number of convictions was 3 in the PLWH group whereas it was only 2 in the reference group (U = 9398, Z = 2.235, p = 0.0254; n_1 = 178 (PLWH group), n_2 = 124).

The survey established that the respondents were well aware of HIV transmission ways. Only 39 people out of 301 in the entire sample (13.0 %; 95 % *CI* [9.6–17.2]) were not able to give a correct answer to this question. Two hundred and ninety-nine people (99.3 %; 95 % *CI* [97.6 – 99.8]) knew it was possible to get HIV thought injection drug use and 293 (97.3 %; 95 % *CI* [94.8–98.6]) knew HIV to be a sexually transmitted infection.

In the PLWH group, an average period of living with HIV amounted to 9.7 ± 5.6 with the respondents' average age being 38.8 ± 5.8. A time gap between a possible infection and a

moment when HIV was identified was 1.5 years on average; however, it could reach 8 years in some cases.

ART use to treat all PLWH is the most important preventive activity aimed at stopping HIV spread. Twenty-nine people out of 179 PLWH (16.2 %; 95 % *CI* [11.5–22.3]) remained ART-naive at the moment this survey was accomplished. Out of them, 5 people (17.2 %; 95 % *CI* [7.6–34.5]) had been diagnosed with HIV less than one year ago; the rest had been living with HIV for 6.2 ± 4.6 years on average.

In general, HIV-positive prisoners had favorable attitudes towards ART: 134 respondents (74.9 %; 95 % *CI* [68.0–80.6]) were sure than only antiretroviral drugs (ARVDs) were able to help them. Only 8 people (4.5 %; 95 % *CI* [2.3–8.6]), all of them being ART-naïve, considered ARVDs extremely ineffective or believed such medications did not help them. One hundred and sixty-three patients were planning to use ARVDs throughout their lifetime (93.1 %; 95 % *CI* [88.4–96]).

Not all PLWH had been offered ART in prison: only 143 respondents out of 175 (81.7 %; 95 % *CI* [75.3–86.7]) confirmed it had been possible to start or continue the therapy on a doctor's initiate in prison. Overall, 66 PLWH out of 177 (36.9 %; 95 % *CI* [30.1–44.1]) had not been provided with ART in prison.

Overall, 63.1 % of prisoners had been provided with ART in prison (Table).

One hundred and thirty-five PLWH (75.4 %; 95 % *CI* [68.6–81.1]) took ARVDs after release at the moment this survey was conducted including 32 people (23.7 %; 95 % *CI* [17.3–31.5]), who had not been provided with ART in prison.

Ten people (22.7 %; 95 % *CI* [12.8–37]) out of 44 respondents who were not taking ARVDs after release had been provided with ART in prison. Likelihood of ART provision was 1.8 times higher after release than in the penitentiary system (*OR* = 1.79; 95 % *CI* [1.14–2.83]). At the same time, only 50 respondents (33.3 %; 95 % *CI* [26.3–41.2]) reported uninterrupted ARVDs use without any breaks.

According to a global systematic survey that covered the period between 2008 and 2017, the Russian Federation took the leading place as per the number of PWID (people who inject drugs) since more than half a million people were drug addicts and HIV prevalence reached 30.4 % (95 % *CI* [17.9–43.0]) among them [22]. Our study established that HIV prevalence was higher than 75 % (95 % *CI* [68.8–80.2]) among PWID included in a randomly created sample of people who had been released from prison. This level is the closest to the actual HIV prevalence among PWID since it is determined by the total and repeated HIV screening among PWID who are in prison. High HIV prevalence among PWID, who are released from prison, is primarily associated with HIV prevalence in a region where they have been imprisoned as well as highly active HIV circulation among PWID population. As of December 31, 2021 in the Sverdlovsk region, HIV prevalence was 1906.9 cases per 100 thousand people and this level was 2.5 times higher than the national average. HIV detection among PWID in the region was 2.93 positive immunoblots per 1000 serums taken from PWID and this

Table

ART coverage of prisoners

Conditions	Respondents No.	Provided with ART	ART Coverage, %	95 % *CI*
Holding cells	145	80	55.2	47.0– 63.0
Penal colonies	146	109	74.7	67.0–81.0
Prison clinics	78	62	79.5	69.2–87.0
Transported as prisoners for more than 1 day	112	64	57.1	47.9–65.9
During the service	179	113	63.1	55.9– 69.9
After release	179	135	75.4	68.6– 81.1
Uninterrupted ARVDs use	150	50	33.3	26.3– 41.2

levels was 2.2 times higher than the national average and 6.5 times higher than in the general population of the Sverdlovsk oblast [23].

Parenteral transmission associated with intravenous drug injection (*OR* = 13.1) and sexual transmission through unprotected sexual contacts with HIV-positive partners (*OR* = 15.7) are two rivals for the first rank place as the primary contagion in most HIV-positive prisoners. However, given the absence of any statistically significant difference between PLWH and the reference group as per STIs (χ^2 = 2.37, d.f. = 1, p = 0.124), parenteral transmission can be considered main and primary.

Injection drug use is a more significant HIV risk factor in prison than at large. As a rule, groups of drug addicted prisoners who are kept in one cell use the same needle and dilute a drug with a prisoner's blood, which is filtered through one common homemade filter [24]. These factors, both separately and collectively, create considerably elevated risks of HIV transmission.

Our study results confirm the hypothesis that parenteral HIV transmission associated with injection drug use prevails in the penitentiary system. In our survey, 29 % of the respondents reported that they had continued to use drugs in prison and 42 % had witnessed injection drug use by their inmates during their service. This level of IDU prevalence in prison is considered moderate [25]. Moderate levels of injection drug use in prison were also registered in France (24.2 %) [26], Serbia (38.2 %) [27], Iran (40.1 %) [28] and Indonesia (56 %) [29]. The highest IDU prevalence in prison was detected in Mexico (61 %) [30], Great Britain (64 %) [31], the USA (62.5 %) [32], Australia (82 %) [33] and Kyrgyzstan (82.6 %) [34].

Involvement into drug addiction is even more dangerous. In Great Britain, 4 % of injection drug users first took them in prison [31], and the same goes for 7 % of IDUs in Brazil [35]. In our survey, 1.5 % of the respondents started to use injection drugs in prison. The established facts of illicit drug trade and use in the penitentiary system not only should be subject to the law and criminal procedures but also should be a focus of attention within epidemiological studies that involve HIV screening among all prisoners who have used injection drugs but have not yet been defined as HIV-positive.

Statistically significantly higher frequency of making tattoos as a HIV risk factor in prison was identified in the PLWH group (χ^2 = 3.93, d.f. = 1, p = 0.048) against the reference one. This also indicates likely HIV transmission through it when serving the sentence in the penitentiary system.

In the analyzed sample, sexual transmission as a HIV infection factor was a secondary one; however, it still might play a much greater role due to multiple sexual contacts with different partners and failure to use barrier contraception. This creates a serious threat of further HIV spread throughout the general population.

Incarceration is one of many social forces that affect sexual decision-making, and incarceration rates may have substantial effects on community-level HIV and STD risks [36]. A study accomplished in the USA established that up to 55 % men lost their primary sexual partner during incarceration and this increased HIV risks due to multiple casual and unprotected sexual contacts [17]. According to our survey results, 83 % of PLWH had sexual contacts during the first 6 months after release and only 25 % of them received ART without any breaks; it is also noteworthy that 90 % of them did not use condoms. Most PLWH who took part in the survey (74.3 %; 95 % *CI* [67.4–80.1]) had more than 10 sexual partners.

A study conducted in Saint Petersburg in 2010 established that up to 50 % of HIV-positive prisoners did not apply for treatment after release and only 36 % of those who did were treated with ART [37]. According to our study results, ART coverage was 63.1 % in the penitentiary system and 75.4 % after release. Only reaching 95 % ART coverage is considered to be able to stop the infection spread (provided that 95 % know about their HIV status and the viral load is suppressed down to its undetectable levels in 95 % of PLWH treated with

ART) [38]. Any breaks in taking ARVDs mentioned by 77 % of the respondents treated with ART create favorable conditions for occurrence and spread of mutant HIV strains with higher drug resistance [39].

Conclusions. Parenteral transmission associated with injection drug use is the main and primary way to get infected with HIV in prison. Our study established that likelihood of injection drug use was 13 times higher among PLWH than in the reference group (*OR* = 13.12; 95 % *CI* [6.19–27.82]). Sexual transmission and parenteral transmission through making tattoos were secondary in the analyzed PLWH group; likelihood of risky sexual behavior due to refusal to use condoms was only 1.5 times higher in the PLWH group than in the reference one (*OR* = 1.69; 95 % *CI* [1.03–2.77]), and likelihood of PLWH transmitting STIs was 1.5 times lower than in the reference group (*OR* = 0.66; 95 % *CI* [0.39–1.13]).

HIV-positive prisoners create a heavy HIV burden for the general population as they represent potential infection sources due to sexual transmission: as established in this study, 82.3 % had sexual contacts during the first six months after release and 90 % of them did not use barrier contraception. Frequent change of sexual partners (73.5 % of PLWH reported having more than 10 sexual partners over their lifetime) and sexually transmitted infections (29.3 % of PLWH had them) also indicate high risks of HIV-spread in the general population.

ART coverage of PLWH equals 63.1 % in prison and 75.4 % after release; this does not correspond to the level able to stop HIV circulation.

The high share (16.2 %) of ART-naïve patients among people released from prison, low ART adherence of former prisoners involving breaks in treatment in three out of four patients, risky behavior, and refusal to use barrier contraception create favorable conditions both for HIV spread among prisoners and for active HIV transmission into the general population.

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