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ОСНОВНЫЕ ФАКТОРЫ РИСКА И ИХ ВЛИЯНИЕ НА РАСПРОСТРАНЕНИЕ ДВОЙНОЙ ИНФЕКЦИИ ВИЧ/ТУБЕРКУЛЕЗ

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На фоне прогрессирования эпидемии ВИЧ-инфекции рост распространения сочетанной инфекции ВИЧ/туберкулез, обусловленный рядом взаимосвязанных факторов риска, становится актуальным повсеместно. ***Целью*** настоящего описательно-аналитического исследования является комплексная и междисциплинарная оценка факторов риска, усиливающих или снижающих распространение двойной инфекции ВИЧ/туберкулез на современном этапе на примере Северо-Запада России. ***Материалы и методы.*** Методы исследования включали социально-демографический, экономический и эпидемиологический анализ, ранжирование, корреляционную и экспертную оценку. Основой социально-демографического и экономического анализа стали сведения из Федеральной государственной статистики по субъектам округа, эпидемиологического – отчетные формы Росстата по туберкулезу, ВИЧ-инфекции и их сочетанию, включая сведения по материально-техническому и кадровому обеспечению фтизиатрической службы, информация из аналитических справок при курационных выездах в регионы Северо-Запада за период 2007-2017 гг. Корреляционная зависимость между изучаемыми параметрами определялась по коэффициенту Спирмена на платформе SPSS 21. ***Результаты.*** На Северо-Западе России наблюдается статистически значимая зависимость между распространением сочетанной инфекции ВИЧ/туберкулез и эпидемиологическим фактором в целом (0,627, $p<0,039$) и развитием эпидемии ВИЧ-инфекции как монозаболевания (0,731, $p<0,011$). Распространение туберкулеза не играет существенной роли в комплексе эпидемиологических факторов (0,332, $p>0,319$) и не вносит статистически значимую лепту в эпидемическую обстановку по ВИЧ/туберкулезу (0,127, $p>0,710$). Пенитенциарная система также не имеет статистически значимой связи с распространением сочетанной инфекции ВИЧ/туберкулез (0,233, $p>0,490$), однако с местами лишения свободы достоверно связаны распространение туберкулеза как моноинфекции (0,619, $p<0,042$). ***Заключение.*** Для улучшения эпидемической ситуации по коинфекции ВИЧ/туберкулез необходимо усиление мер борьбы с распространением ВИЧ-инфекции, особенно в пенитенциарной системе и укрепление материально-технических и людских ресурсов фтизиатрической службы.

Ключевые слова*: ВИЧ/туберкулез; факторы риска; ВИЧ-инфекция; туберкулез; противотуберкулезные мероприятия; Северо-Западный Федеральный округ России.*

THE MAIN RISK FACTORS AND THEIR IMPACT ON THE HIV/TUBERCULOSIS EPIDEMIC

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With the HIV epidemic progression, an increase of HIV/tuberculosis co-infection in relation to a number of interrelated risk factors is becoming actual everywhere. ***The aim*** of the descriptive

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analytical study is a comprehensive and interdisciplinary assessment of risk factors that increase or decrease the spread of the dual HIV/tuberculosis infection at the current stage in the North-West of Russia, as a pilot region. ***Materials and Methods.*** Research methods included socio-demographic, economic and epidemiological analysis, ranking, correlation and expert assessment. The basis of the socio-demographic and economic analysis was information from the state statistics on the regions of North-West of Russia, of the epidemiological analysis – reporting forms of Rosstat on tuberculosis, HIV-infection and HIV/tuberculosis coinfection, including data on the economic and human resources of the tuberculosis control system, information from analytical reports on supervising activities in the regions of the North-West of Russia during 2007-2017. The correlation dependence between the studied parameters was determined by the Spearman coefficient. ***Results.*** In the North-West of Russia, there is a statistically significant relationship between the spread of HIV/tuberculosis co-infection and the epidemiological factor in general (0.627, $p<0.039$) and the HIV epidemic, as a mono-disease in particular (0.731, $p<0.011$). The tuberculosis epidemic does not play a significant role in the complex of epidemiological factors (0.332, $p>0.319$) and does not make a statistically significant contribution to the HIV/tuberculosis epidemic (0.127, $p>0.710$). The penitentiary system also has no statistically significant relation with the HIV/tuberculosis epidemic (0.233, $p>0.490$), however, the tuberculosis epidemic, as monoinfection (0.619, $p<0.042$) is significantly associated with the correctional system. ***Conclusion.*** To improve the HIV/tuberculosis epidemic situation, it is necessary to strengthen of HIV tackling measures, especially in the penitentiary system and strengthen the economic and human resources of the tuberculosis control system.

Keywords: *HIV/tuberculosis; risk factors; HIV-infection; tuberculosis; anti-tuberculosis measures; North-West Federal District of Russia.*

The main causes of an adverse tuberculosis (TB) situation in all countries are the HIV pandemic progression and the spread of multidrug-resistant (MDR) TB [1-6]. The complex of socio-economic factors influencing the epidemic process of infectious diseases, including TB and HIV infection, has also been studied quite thoroughly [7-10]. Drug using is one of the main causes of the HIV epidemic [11,12]. Currently, in our country, the heterosexual rout of HIV infection is becoming increasingly important, posing a threat of the HIV epidemic generalization through marginalized groups to the general population [13]. The relevance of the TB, HIV infection and HIV/TB in the penitentiary system, which encompasses almost all representatives of marginal groups, does not cause objections [14,15].

Demographic indicators of the country, the economy and the health care system, including medical care for socially determined diseases, are inevitably interrelated [16]. The HIV pandemic in terms of its impact on the population is equal to world wars, and in more than 30 years, it has taken 35-40 million lives in the world [17].

The country level of economic development determines its social policy, including the health care system [18]. Foreign researchers to study the impact of the economy on health care use a set of criteria: an indicator of market relations in the country, a balance between consumption and production, monetized income, unemployment, etc. [19]. E.N. Bogdanova, et al. to assess the well-being of patients with TB have introduced the concept of a regional subsistence minimum [20]. According to N.V. Mekhonoshina, et al. on the HIV incidence affect: the average per capita cash income of the population, migration rate and the number of medical specialists [21].

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Today, medical and economic aspects and the management of health care resources have received much attention [22]. The persistence of the TB situation in regions of the Russian Federation (RF) is associated with the unsatisfactory state of the economic and technical and the human resources in TB facilities [23,24].

Improving the effectiveness of TB control measures among people living with HIV (PLWH) requires knowledge in the epidemic process patterns, risk factors, their monitoring and monitoring of providing measures [2].

Thus, the *aim of the study* is a comprehensive assessment influence of risk factors on the dual HIV/tuberculosis epidemic development in the North-West Federal Region (NWFR) of Russia, as a pilot territory.

Materials and Methods

Research methods included epidemiological, sociological and demographic analysis, ranking, correlation and expert assessment. The basis of the epidemiological analysis were the reporting forms of Rosstat: №61 «Information on contingents of patients with HIV infection», №33 «Information on patients with tuberculosis», №8 «Information on patients with active tuberculosis», №4 «Information on contingents tested for HIV», №30 «Information of the medical organization» and reporting forms of the penitentiary sector: № Tub-4 «Report on patients with tuberculosis» and FSIN-6 «Information of socially significant diseases in persons held in the penitentiary system». Sociological and demographic indicators of the regions were obtained from the site of Federal state statistics [25].

The ranking of regions by factors affecting the HIV/TB situation was carried out using blocks with homogeneous averaged information, with a minimum value of one. A smaller amount of points scored corresponded to the best epidemic situation in the region and vice versa, with a high amount of points, the situation in the territory was considered tense. The same approach was applied to all other (economic, socio-demographic and other factors). The received information was divided into three blocks: epidemiological, socio-demographic and economic.

The ranking of the region by *epidemiological factors* was estimated by the growth rates of incidence, prevalence and mortality of patients with TB, HIV and HIV/TB coinfection for the review period, including the penitentiary sector and HIV transmission routes, where the heterosexual rout was chosen as a main one. TB mortality of people living with HIV and the impact of the epidemic situation in the penitentiary sector on the general population, the region's rank was estimated by the share of the whole population indicators. Some of characteristics of Nenets Autonomous Okrug (NAO) was not included in the analysis due to the acquisition of independence in a later period than the beginning of the analyzed period of the study. Due to the administrative association of penitentiary system (PS) of St. Petersburg (SPb) and the Leningrad Region (Len), epidemiological data in the penitentiary system of these regions were summarized.

Rank evaluation by the *socio-demographic factors* was estimated according to the natural population growth for 2017.

The economic block reflected the region's ranking in terms of gross domestic product per capita, per capita monthly income and unemployment. In the economic unit were included the data of economic and human resources (doctors) of the TB facilities in regions, which contained information on: depreciation of fixed assets (buildings, equipment, vehicles), modern equipment and the number of bacteriological laboratories, staffing, part-time ratio and number of doctors phthisiatricians per 10,000 population. The

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regions ranking by the listed criteria was estimated according to the data of 2015-2017.

In terms of socio-demographic and economic units, only the final ranks of the regions are presented due to the limitation of the publishing article size.

Results and Discussion

Epidemiological block. According to the HIV/TB incidence and prevalence growth rates and the proportion of patients dying of TB among all of dying subjects with HIV and HIV/TB in the NWFR, the first ranking position was taken by NAO, where for the review period was not identified a single case of coinfection (Table 1). The second and third places belong to Vologda (Vol) and Kaliningrad (Kal) regions, where a more prosperous epidemic situation are indicating. Kaliningrad region was the only region where the growth rate of HIV/TB incidence was negative for the review period (-58.2%). The fourth position is reserved by Murmansk region (Murm), the 5th place is divided between Novgorod (Nov) and Pskov (Pskov) regions, the 6th place – between St. Petersburg and the Komi Republic (Komi). The last three ranked places, from seventh to ninth, are occupied by Leningrad Region, Karelia Republic (Kar) and Arkhangelsk Region (Arch), reflecting the intensity of the HIV/TB epidemic situation in the regions.

Table 1

Ranked positions according to the main HIV/TB epidemiological indicators in regions of North-West of Russia (per 100 000 population and %, form № 61)

Indicator/rank/region	Arch	Vol	Kal	Kar	Komi	Len	Murm	Nov	Pskov	SPb	NAO
HIV/TB incidence (2007)	0.2	1.1	12.9	0.9*	1.2	4.9	2.3	2.4	1.0	5.4	0.0
Growth rate to 2017 (%)	474.2	13.1	-58.2	106.7	248.1	208.7	280.0	465.0	72.3	61.5	0.0
Ranking position	11	3	2	6	8	7	9	10	5	4	1
HIV/TB prevalence (2007)	0.4	1.1	20.6	26.6	2.6	12.2	3.4	2.4	2.0	12.6	0.0
Growth rate to 2017 (%)	231.8	83.8	112.2	29.0	323.5	126.0	203.3	465.0	584.0	30.6	0.0
Ranking position	8	4	5	2	9	6	7	10	11	3	1
% of dying of TB among all of dying PLWH in 2007-2016	25.2	15.5	20.1	46.4	16.4	23.0	14.0	8.4	22.2	30.3	0.0
Ranking position	9	4	6	11	5	8	3	2	7	10	1
% of dying of TB among all of dying with HIV/TB in 2007-2016	78.8	72.6	74.5	91.2	68.4	78.6	64.9	63.8	58.8	84.7	0.0
Ranking position	9	6	7	11	5	8	4	3	2	10	1
The sum of points	**37**	**17**	**20**	**30**	**27**	**29**	**23**	**25**	**25**	**27**	**4**
Final Rank for HIV/TB	**9**	**2**	**3**	**8**	**6**	**7**	**4**	**5**	**5**	**6**	**1**

Note: ***** – 2008

The growth rates of the TB main indicators (Table 2) in the all NWFR regions have been negative, expressing the general trend to improve the situation in the whole country, except of NAO, where the TB prevalence growth rate has become positive (95.0%).

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Table 2

Ranked positions according to the main HIV and TB epidemiological indicators in regions of North-West of Russia (per 100 000 population and %, forms №8, 33, 61, 4)

Indicator/rank/region	Arch	Vol	Kal	Kar	Komi	Len	Murm	Nov	Pskov	SPb	NAO
TB incidence (2007)	59.2	46.9	134.0	71.0	95.3	69.3	58.2	67.8	90.5	37.3	40.5
Growth rate to 2017 (%)	-62.0	-54.4	-71.1	-57.3	-56.2	-46.3	-58.8	-36.3	-57.7	-21.7	-21.5
Ranking position	2	7	1	5	6	8	3	9	4	10	11
TB prevalence (2007)	99.6	101.3	261.2	150.8	167.3	126.5	129.5	179.7	188.0	107.2	14.0**
Growth rate to 2017 (%)	-79.4	-60.4	-71.3	-46.8	-56.4	-32.6	-47.4	-58.8	-44.0	-49.8	95.0
Ranking position	1	3	2	8	5	10	7	4	9	6	11
TB mortality (2007)	12.7	10.0	18.3	21.7	14.2	4.2	10.0	8.2	15.4	13.1	-
Growth rate to 2017 (%)	-81.1	-72.0	-82.5	-80.2	-63.4	-14.3	-52.0	-50.0	-62.3	-69.5	-
Ranking position	2	4	1	3	6	10	8	9	7	5	-
Sum of points	**5**	**14**	**4**	**16**	**17**	**28**	**18**	**22**	**20**	**21**	**22**
Final ranking position for TB	**2**	**3**	**1**	**4**	**5**	**10**	**6**	**9**	**7**	**8**	**9**
HIV incidence (2007)	4.5	11.4	53.4	12.9	13.8	71.2	48.7	20.5	6.2	101.4	**11.9**
Growth rate to 2017 (%)	520.0	195.6	-28.7	190.7	248.6	-39.5	1.6	150.7	172.6	-57.1	-4.2
Ranking position	11	9	3	8	10	2	5	6	7	1	4
HIV prevalence (2007)	18.3	83.9	444.3	70.1	95.9	602.8	247.0	139.2	42.9	764.5	31.0
Growth rate to 2017 (%)	444.8	94.3	18.4	187.9	144.0	13.6	81.5	155.4	222.1	-21.3	281.3
Ranking position	11	5	3	8	6	2	4	7	9	1	10
HIV mortality (2007)	0.6	2.5	32.3	1.2	2.5	19.5	5.0	4.7	1.0	8.9	0.0
Growth rate to 2017 (%)	219.0	30.4	-62.6	124.9	29.5	7.7	31.1	164.1	376.3	29.1	-
Ranking position	9	5	1	7	4	2	6	8	10	3	-
Heterosexual route (%, 2017)	43.9	44.0	70.2	54.1	46.2	57.3	67.2	83.3	79.0	32.8	80.0
Ranking position	2	3	8	5	4	6	7	11	9	1	10
Sum of points	**33**	**22**	**15**	**28**	**24**	**12**	**22**	**32**	**35**	**6**	**24**
Final ranking position for HIV	**8**	**4**	**3**	**6**	**5**	**2**	**4**	**7**	**9**	**1**	**5**
Total sum	**38**	**36**	**19**	**44**	**41**	**40**	**40**	**54**	**55**	**27**	**46**
Total ranking position for epidemiological factor	**4**	**3**	**1**	**7**	**6**	**5**	**5**	**9**	**10**	**2**	**8**

Note: ** – 2009

For the total amount of points expressing the prevalence of TB and HIV infections, as a separate epidemiological factors, affecting the HIV/TB epidemic, the first three ranking positions are occupied by Kaliningrad region, St. Petersburg and Vologda region. At the 4th place is Arkhangelsk region, at the 5th place – Leningrad and Murmansk regions. From sixth to eighth positions consistently belong to Komi and Karelia republics and

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NAO, the last two places (ninth and tenth) are assigned to Novgorod and Pskov regions.

In the *penitentiary system* of the North-West of Russia, HIV-infection is mostly detected in five regions (Table 3): St. Petersburg with Leningrad region (34.4%), Komi Republic (24.5%), Murmansk (23.4%) and Arkhangelsk (20.1%) regions, the rarely – in Kaliningrad region (10.3%). The TB cases are mostly found in penitentiary facilities of: Komi Republic (20.3%), St. Petersburg with Leningrad region (17.2%) and Arkhangelsk region (16.9%), the least cases are detected in the penitentiary sector of Kaliningrad region (6.5%).

Table 3

Ranked positions by the penitentiary sector impact on the general TB, HIV and HIV/TB epidemic situation in 2007-2017 in regions of North West of Russia (%, forms TUB-4, FSIN-6 and № 8, 33, 61)

Indicator/rank/region	Arch	Vol	Kal	Rar	Komi	Len	Murm	Nov	Pskov	SPb+ Len	NAO
Summarized share of new HIV cases in penitentiary system among general HIV incidence (%)	20.1	16.3	10.3	18.5	24.5	-	23.4	15.1	16.8	34.4	-
Ranking position	6	3	1	5	8	-	7	2	4	9	-
Summarized share of new TB cases in penitentiary system among general HIV incidence (%)	16.9	12.8	6.5	9.9	20.3	-	12.8	11.1	13.3	17.2	-
Ranking position	6	4	1	2	8	-	4	3	5	7	-
Summarized share of all HIV cases in penitentiary system among general HIV prevalence (%)	40.2	24.0	8.5	35.2	32.6	-	26.2	11.0	42.1	8.8 -	
Ranking position	8	4	1	7	6	-	5	3	9	2	-
Summarized share of TB mortality in penitentiary system among general TB mortality (%)	22.2	8.5	3.1	11.9	20.5	-	5.8	20.8	3.0	6.5	-
Ranking position	9	5	2	6	7	-	3	8	1	4	-
Summarized share of new HIV/TB cases in penitentiary system among general HIV/TB incidence (%)	60.9	53.8	9.7	15.5	56.1	-	35.0	14.9	47.5	23.9	-
Ranking position	9	7	1	3	8	-	5	2	6	4	-
Summarized share of all HIV/TB cases in penitentiary system among general HIV/TB prevalence (%)	59.9	45.7	11.5	84.5	93.9	-	29.6	34.9	28.7	9.3	-
Ranking position	7	6	2	8	9	-	4	5	3	1	-
Summarized share of TB mortality among PLWH in penitentiary system of the general TB mortality in PLWH (%)	19.5	36.4	3.2	74.8	47.7	-	16.0	26.3	35.0	14.7	-
Ranking position	4	7	1	9	8	-	3	5	6	2	-
Sum of points	**49**	**36**	**11**	**40**	**54**	**-**	**31**	**28**	**34**	**29**	**-**
Final ranking position	**8**	**6**	**1**	**7**	**9**	**-**	**4**	**2**	**5**	**3**	**-**

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In Pskov (42.1%) and Arkhangelsk (40.2%) regions – more than 2/5, in republics of Karelia (35.2%) and Komi (32.6%) – more than 1/3 of the HIV-positive contingent stay in prisons. The proportion of HIV-positive people in correctional sector is also high in Murmansk (26.2%) and Vologda (24.0%) oblasts. Least of all, HIV-positive people are staying in penitentiary facilities of Kaliningrad region (8.5%), St. Petersburg with Leningrad region (8.8%) and the Novgorod region (11.0%).

In Arkhangelsk (22.2%), Novgorod (20.8%) regions and Komi Republic (20.5%) almost every fourth case of TB deaths are registered in prisons. In Pskov (3.0%), Kaliningrad (3.1%) and Murmansk (5.8%) regions, TB deaths in penitentiary sector are much less than in other territories.

In general the proportion of HIV/TB coinfection in prisons is highest in three regions of the North-West: in Arkhangelsk region, Komi Republic and Vologda region. In Arkhangelsk region, 60.9% of newly diagnosed and 59.9% of all HIV/TB cases are registered in correctional system, in Komi Republic, respectively – 56.1% and 93.9%, in Vologda region – 53.8% and 45.7% of cases. The smallest role of the penitentiary sector in the general HIV/TB incidence and prevalence was observed in Kaliningrad region (9.7% and 11.5% respectively). In Novgorod region (14.9%) and Karelia Republic (15.5%) with a low proportion of new HIV/TB cases in penitentiary facilities, the HIV/TB prevalence was 34.9 and 84.5%, respectively, due to the presence of anti-tuberculosis medical organizations in the penitentiary sector of these regions.

In an integrated, ranked assessment of the prisons role, the smallest impact of correctional facilities on the overall HIV, TB and HIV/TB situation was marked in Kaliningrad region (11) – the first ranking place, in the second place – Novgorod region (28), in the third position – Saint-Petersburg with Leningrad region (29). In the fourth place is Murmansk region (31), in the fifth – Pskov region (34) and in the sixth place – Vologda region (36). Karelia Republic (40), Arkhangelsk Region (49) and Komi Republic (54) are located on the last three ranking places.

According to an integrated assessment of economic and socio-demographic factors, the most prosperous regions of the North-West are St. Petersburg, NAO and Komi Republic, which took the first three ranking places (Table 4). The fourth place belongs to Murmansk region, the 5th position is divided between Arkhangelsk and Leningrad regions. The sixth place is reserved for Vologda region, the 7th place – for Kaliningrad region. The least prosperous territories in economic and socio-demographic development are Novgorod region, Karelia Republic and Pskov region, which took the last three positions (8-10 places).

According to the scores obtained in assessing the economic and human recourses of TB control system, the most favorable region is Leningrad Region, which took the 1st ranking place, then – St. Petersburg, NAO and Komi Republic, which divided the 2nd position, on the 3rd place – Murmansk region. From 4th to 6th places consistently belong to Novgorod region, Karelia Republic and Arkhangelsk region. Seventh place is divided between Pskov and Vologda regions. The lowest economic and human resources of TB control system are in Kaliningrad region, with the eighth ranked position.

In relation to the final summarized points of economic, socio-demographic factors complex, and economic and human resources of TB control system, the first three ranks belong to St. Petersburg (18), NAO (23) and Komi Republic (27), reflecting the economic well-being of the regions. Leningrad (32) and Murmansk (32) regions, with

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Table 4

Ranked positions in the economic, socio-demographic factors and economic and human recourses of TB control system in regions of North-West of Russia

Indicator/rank/region	Arch	Vol	Kal	Kar	Komi	Len	Murm	Nov	Pskov	SPb	NAO
Gross product per capita (ranking position)	6	7	9	10	2	5	4	8	11	3	1
The average annual per capita income of population (ranking position)	5	6	8	9	4	7	3	10	11	2	1
Unemployment Rate (ranking position)	7	5	4	11	8	3	9	2	6	1	10
Natural population growth (ranking position	6	7	5	8	3	9	4	10	11	2	1
Sum of points	**24**	**25**	**26**	**38**	**17**	**24**	**20**	**30**	**39**	**8**	**13**
Ranking position	**5**	**6**	**7**	**9**	**3**	**5**	**4**	**8**	**10**	**1**	**2**
TB lab network (ranking position)	4	5	5	5	3	1	4	5	5	2	4
Amortisation of fixed assets of TB control system (ranking position)	4	8	7	2	6	3	1	5	9	3	4
Human recourses of TB control system (ranking position)	8	6	9	8	1	4	7	3	5	5	2
Sum of points	**16**	**19**	**21**	**15**	**10**	**8**	**12**	**13**	**19**	**10**	**10**
Ranking position	**6**	**7**	**8**	**5**	**2**	**1**	**3**	**4**	**7**	**2**	**2**
Total points sum	**40**	**44**	**47**	**53**	**27**	**32**	**32**	**43**	**58**	**18**	**23**
Final ranking position	**5**	**7**	**8**	**9**	**3**	**4**	**4**	**6**	**10**	**1**	**2**

an equal level of evaluated criteria, occupy the fourth place.

The most unfavorable socio-demographic and economic conditions, as well as the lowest economic and human resources of TB control system in the North-West of Russia, are Karelia Republic (53) and Pskov region (58), which occupied the last (ninth and tenth) ranking places. In other regions, the differences in scores of the studied factors are insignificant, which indicates an equivalent level of economic capacity of the regions, including the TB control system recourses.

In the study using the multivariate analysis, an interdependence between estimated parameters consisting of the scores of epidemiological, economic, socio-demographic factors and the level of economic and human recourses development of TB control system was established in the regions of North-West of Russia (Table 5).

The figure shows that in general the epidemiological factor (0.722, $p<0.012$) and the economic and socio-demographic development of the region (0.828, $p<0.002$) are decisive in the complex of assessed factors affecting the HIV/TB epidemic in the North-West of Russia. In turn, the decisive parameter of the general epidemiological factor is the HIV, as monoinfection (0.856, $p<0.001$).

There is a statistically significant relation between the HIV/TB coinfection and epidemiological factor in general (0.627,

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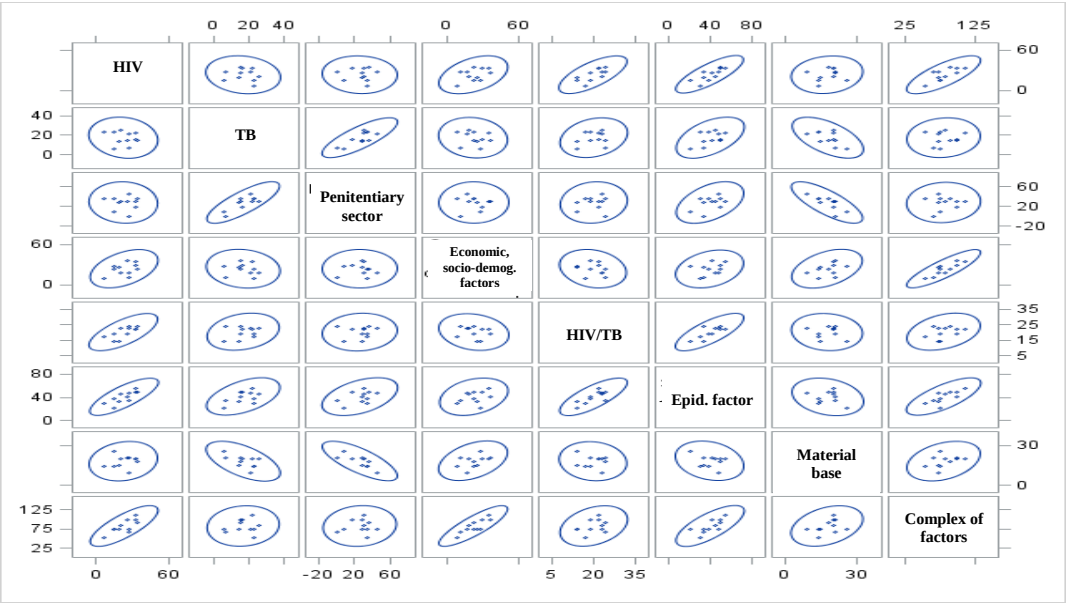
Table 5

The value and structure of factors potentially influencing the HIV/TB situation in North-West of Russia

Region/factor (Points sum)	YIV/ TB	HIV	TB	Penitentiary system	Epidemiological factors (3+4+5)	Economic and socio-demographic factors	Economic and human recourses in TB	Factors complex (6+7+8)
Arch	37	33	5	49	87	24	16	127
Vol	17	22	14	36	72	25	19	116
Kal	20	15	4	11	30	26	21	77
Kar	30	28	16	40	84	38	15	137
Komi	27	24	17	54	95	17	10	122
Len	29	12	28	29	69	24	8	101
Murm	23	22	18	31	71	20	12	103
Nov	25	32	22	28	82	30	13	125
Pskov	25	35	20	34	89	39	19	147
SPb	27	6	21	29	56	8	10	74
NAO	4	24	22	-	46	13	10	69

p<0.039), particularly with HIV epidemic, as monoinfection (0.731, p<0.011). The TB situation does not play a significant role in the complex of epidemiological factors (0.332, p>0.319) and does not make a statistically significant contribution to the HIV/TB epidemiological situation in general in the North-West regions (0.127, p>0.710).

The statistical significance of the listed factors relations with HIV/TB epidemic is shown in Figure 1 with a tabular display of mathematical values expressing the results reliability.



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	HIV/TB	HIV	TB	Penitentiary sector	Epid. factors	Economic, socio-demographic factors	Economic, human recourses in TB	Factors complex
HIV/TB	1.0	0.731	0.127	0.233	0.627	-0.318	-0.007	0.144
p		0.011	0.710	0.490	0.039	0.341	0.984	0.674
HIV	0.731	1.000	-0.149	0.069	0.856	0.287	0.139	0.576
p	0.011		0.661	0.840	0.001	0.393	0.683	0.064
TB	0.127	-0.149	1.000	0.619	0.332	-0.256	-0.549	0.101
p	0.710	0.661		0.042	0.319	0.447	0.081	0.767
Penitentiary sector	0.233	0.069	0.619	1.000	0.366	-0.309	-0.792	-0.021
p	0.490	0.840	0.042		0.268	0.355	0.004	0.952
Epid. factors	0.627	0.856	0.332	0.366	1.000	0.331	-0.115	0.722
p	0.039	0.001	0.319	0.268		0.320	0.735	0.012
Economic, socio-demographic factors	-0.318	0.287	-0.256	-0.309	0.331	1.000	0.473	0.828
p	0.341	0.393	0.447	0.355	0.320		0.141	0.002
Economic, human recourses in TB	-0.007	0.139	-0.549	-0.792	-0.115	0.473	1.000	0.371
p	0.984	0.683	0.081	0.004	0.735	0.141		0.261
Factors comple	0.144	0.576	0.101	-0.021	0.722	0.828	0.371	1.000
p	0.674	0.064	0.767	0.952	0.012	0.002	0.261	

Fig. 1. Correlation between estimated factors with a tabular display of the Spearman coefficient and P-value values

The penitentiary system also has no statistically significant association with HIV/TB epidemic (0.233, $p>0.490$), however prison system reliably related to the TB epidemic, as monoinfection (0.619, $p<0.042$) and inversely related to the economic and human recourses in TB control system (-0.792, $p<0.004$).

The economic and human resources of TB control system have not significant relation in the studied factors (0.371, $p>0.261$), in other words, they do not influence on the HIV/TB situation in the North-West of Russia.

Conclusion

The leading role in HIV/tuberculosis epidemic in the North West of Russia belongs to the epidemiological factor caused by the HIV-infection. The penitentiary sector mainly affects the tuberculosis situation, as monoinfection. To improve the HIV/tuberculosis epidemic situation it is necessary to strengthen measures tackling of HIV progression, especially in the penitentiary system and strengthen the economic and human resources in tuberculosis facilities.

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