DOI: 10.29326/2304-196X-2020-3-34-162-169
UDC 619:616.98:578.824.11:616-036.22(470)

Evaluation of rabies control measure effectiveness in the Russian Federation

S. V. Shcherbinin[1], T. V. Vadopalas[2], F. I. Korennoy[3], K. A. Blokhina[4], A. K. Karaulov[5]
FGBI "Federal Centre for Animal Health" (FGBI "ARRIAH"), Vladimir, Russia
[1] *ORCID 0000-0002-6434-0683, e-mail: sherbinin@arriah.ru*
[2] *ORCID 0000-0002-6681-9364, e-mail: vadopalas@arriah.ru*
[3] *ORCID 0000-0002-7378-3531, e-mail: korennoy@arriah.ru*
[4] *ORCID 0000-0001-6498-5257, e-mail: blohina@arriah.ru*
[5] *ORCID 0000-0002-5731-5762, e-mail: karaulov@arriah.ru*

SUMMARY
Rabies is a zooanthroponotic disease, causing significant economic damage, resulting from losses due to livestock deaths, costs of preventive measures and diagnostic tests. The disease is transmitted through biting or licking of damaged skin or mucosa. The disease is absolutely fatal and practically all warm-blooded animals are susceptible to it. The paper presents the analysis of statistical data on rabies morbidity and mortality among humans and animals; the assessment of epidemic situation in the Russian Federation, including the target population vaccination coverage and effectiveness evaluation of measures, taken in Russia to prevent rabies spread. The major causes of human mortality are considered. The recommendations on decreasing the disease spread risks are given. It was established that about 60 thousand human deaths and 45 thousand animal deaths from rabies have been reported in the Russian Federation within the past 10 years (from 2010 to 2019). Moreover cases of licking/scratching/biting of humans (397,248 cases in 2019, out of them 10,232 by wild animals) are reported every year. The sources of human infection within the mentioned period were dogs (39%), foxes (18%), cats (14%), raccoon dogs (14%), wolves (4%), polar foxes (4%), ferrets (4%), unknown sources (3%). The analysis of data from veterinary reports showed that the most rabies-infected regions are the Central and Volga Federal Districts. Using the mathematical modeling of the epidemic process the results of preventive measures, taken by the Veterinary Service in case of rabies in the region, were evaluated.

Key words: rabies, analysis, epidemic situation, vaccination, regionalization, anti-epidemic measures.

Acknowledgements: The study was funded by the FGBI "ARRIAH" within the framework of "Veterinary Welfare" research work.

For citation: Shcherbinin S. V., Vadopalas T. V., Korennoy F. I., Blokhina K. A., Karaulov A. K. Evaluation of rabies control measure effectiveness in the Russian Federation. *Veterinary Science Today*. 2020; 3 (34): 162–169. DOI: 10.29326/2304-196X-2020-3-34-162-169.

Conflict of interest. The authors declare no conflict of interest.

For correspondence: Sergey V. Shcherbinin, Leading Veterinarian, Information and Analysis Centre, FGBI "ARRIAH", 600901, Russia, Vladimir, Yur'evets, *e-mail: sherbinin@arriah.ru.*

УДК 619:616.98:578.824.11:616-036.22(470)

Оценка эффективности противоэпизоотических мероприятий против бешенства, осуществляемых в Российской Федерации

С. В. Щербинин[1], Т. В. Вадопалас[2], Ф. И. Коренной[3], К. А. Блохина[4], А. К. Караулов[5]
ФГБУ «Федеральный центр охраны здоровья животных» (ФГБУ «ВНИИЗЖ»), г. Владимир, Россия
[1] *ORCID 0000-0002-6434-0683, e-mail: sherbinin@arriah.ru*
[2] *ORCID 0000-0002-6681-9364, e-mail: vadopalas@arriah.ru*
[3] *ORCID 0000-0002-7378-3531, e-mail: korennoy@arriah.ru*
[4] *ORCID 0000-0001-6498-5257, e-mail: blohina@arriah.ru*
[5] *ORCID 0000-0002-5731-5762, e-mail: karaulov@arriah.ru*

РЕЗЮМЕ
Бешенство – зооантропонозное заболевание, наносящее значительный экономический ущерб, складывающийся из потерь в результате падежа животных, затрат на проведение профилактических мероприятий и диагностических исследований. Болезнь передается при укусе или ослюнении поврежденных поверхностей кожи, слизистых оболочек. Заболевание характеризуется абсолютной летальностью, ему подвержены практически все теплокровные животные. В работе проведен анализ статистических данных по заболеваемости и смертности людей и животных от бешенства, проведена оценка эпизоотической ситуации в Российской Федерации, включающая охват вакцинацией целевых популяций, а также оценка эффективности мер,

применяемых в России для предотвращения распространения бешенства. Рассмотрены основные причины смертности людей. Даны рекомендации по снижению риска распространения заболевания. Было выявлено, что за последние 10 лет (с 2010 по 2019 г.) на территории Российской Федерации зарегистрировано 60 случаев гибели людей от бешенства и около 45 тысяч случаев падежа животных. Кроме этого, ежегодно фиксируются случаи ослюнений/оцарапываний/покусов людей (397 248 случаев за 2019 г., из них 10 232 – дикими животными). Источниками заражения людей за указанный период являлись: собака (39%), лисица (18%), кошка (14%), енотовидная собака (14%), волк (4%), песец (4%), хорек (4%), неизвестный источник (3%). В результате анализа данных ветеринарных форм отчетности выявили, что самыми неблагополучными по бешенству являются Центральный и Приволжский федеральные округа. В представленной работе с помощью математического моделирования эпизоотического процесса оценены результаты профилактической работы, проводимой ветеринарной службой при возникновении бешенства в регионе.

Ключевые слова: бешенство, анализ, эпизоотическая ситуация, вакцинация, регионализация, противоэпизоотические мероприятия.

Благодарность: Работа выполнена за счет средств ФГБУ «ВНИИЗЖ» в рамках научно-исследовательских работ по теме «Ветеринарное благополучие».

Для цитирования: Щербинин С. В., Вадопалас Т. В., Коренной Ф. И., Блохина К. А., Караулов А. К. Оценка эффективности противоэпизоотических мероприятий против бешенства, осуществляемых в Российской Федерации. *Ветеринария сегодня*. 2020; 3 (34): 162–169. DOI: 10.29326/2304-196X-2020-3-34-162-169.

Конфликт интересов. Авторы заявляют об отсутствии конфликта интересов.

Для корреспонденции: Щербинин Сергей Владимирович, ведущий ветеринарный врач ИАЦ ФГБУ «ВНИИЗЖ», 600901, Россия, г. Владимир, мкр. Юрьевец, *e-mail: sherbinin@arriah.ru.*

INTRODUCTION

Rabies (or hydrophobia) is one of zoonotic diseases, which occurs in the whole world, except for Antarctica. This is the fatal disease, presenting a significant threat for public health. Notwithstanding the fact, that human cases can be prevented by modern post-exposure prophylaxis tools, control and eradication are possible only in reservoir populations, for example in foxes and domestic dogs [1].

Taking into account the nature of rabies agent reservoir the epidemics can be natural (the disease is spread by wild carnivores) and urban (the virus sources and vectors are stray dogs and cats, the number of which defines the epidemic proportions) [2].

According to the researchers' assessments about 60 thousand people die from rabies and about 29 million people seek for post-exposure medical assistance after contact with a suspected animal [3].

Every year considerable financial resources are dedicated to rabies prevention in animals and reducing the probability of human infections. The vaccination of domestic and wild susceptible animals, post-exposure prophylaxis in humans and control of carnivore movements (regionalization requirements) are carried out in the territory of the Russian Federation.

The purpose of this work was the analysis of statistical data on rabies morbidity and mortality in humans and animals in the Russian Federation in 2010–2019, as well as the evaluation of control measure effectiveness and recommendations on reduction of disease spread risks.

MATERIALS AND METHODS

The statistical data on morbidity and mortality in humans and animals due to rabies virus (Table 1), number of movements of domestic carnivores, number of detected violations in the process of such movements (Data from IS "MERCURY") were used in the study. The population indicators of the epidemic process made it possible to analyze the effect of prevention measures on human morbidity. Data on vaccination of domestic and wild animals allowed to evaluate the reduction of human rabies risks by modeling.

To assess the epidemic situation intensity in the Federal Districts of the Russian Federation the epidemicity index, calculated using the following formula, was used:

$$Ie = t/T,$$

where 'Ie' is the epidemicity index; '*t*' is the number of days (months, years), when the disease was reported; '*T*' is the number of days (months, years) of observation.

Based on the epidemicity index value, the Federal Districts were ranked against their infection level.

To quantitatively assess the effect of vaccination performed on risks of public infection, the modeling of possible number of human infections due to bites of wild and domestic animals was carried out. The modeling was performed using probabilistic approach for two scenarios: 1) preventive vaccination of animals against rabies is not practiced; 2) vaccination is practiced. The probable number of infected humans was modeled using hypergeometric distribution, assessing the probability of '*s*' human infections where data on animal population number (*M*), number of infected animals within it (*D*) and number of reported bites (*n*) are available (Table 1).

The following initial parameters were taken into account: mean potency of the vaccine – 87% [5]; average uptake of vaccine baits by wild animals – 50% [6]. The following assumptions were used: 1) probability of human infection if bitten by an infected animal is 100%; 2) baits were consumed only by foxes [7].

To study the relationship between the vaccination coverage and morbidity level in the Federal Districts in 2010–2019, the correlation analysis using Pearson correlation coefficient (*r*) was performed.

RESULTS AND DISCUSSION

Rabies is endemic to the Russian Federation. In 2010–2019 60 human deaths and 45,219 animals' deaths due to this disease were registered in the country (RF MoA and Rospotrebnadzor data).

Table 1
Statistical data for modeling

Таблица 1
Статистические данные для проведения моделирования

Indicator (for 2019)	Rated value	Source
Number of infected wild animals	587 animals	RF MoA, IAC annual report
Number of infected domestic animals	586 animals	RF MoA, IAC annual report
Number of contacts between wild animals and humans	10,232	Rospotrebnadzor
Number of contacts between domestic carnivores and humans	387,016	Rospotrebnadzor
Number of wild carnivores	753,200 animals	Ministry of Natural Resources, RF Central Hunting Control Institution
Foxes, out of them	496,300 animals	Ministry of Natural Resources, RF Central Hunting Control Institution
Number of domestic carnivores	52,600,000 animals	Evaluated value [4]
Vaccine baits distributed	20,684,436 doses	RF MoA
Domestic carnivores vaccinated	8,548,904 animals	RF MoA

Out of 86 Subjects of the Russian Federation the following regions were permanently infected with rabies in 2010–2018: Republic of Karelia, Kamchatka Krai, Arkhangelsk, Murmansk, Irkutsk, Magadan and Sakhalin Oblasts, Saint Petersburg. In 2019 the following regions became also infected: Republic of Komi, Republic of Chechnya, Kemerovo Oblast and Primorsky Krai.

The infection level in the Federal Districts was ranked based on the epidemicity index (Table 2).

Within the observation period humans got infected in 53.6% of cases after contacts with domestic carnivores (dogs and cats). Herewith the ratio of infections due to dogs was 39% and cats were responsible for 14% of infections. The other rabies infection sources were represented by foxes (18%), raccoon dogs (14%), wolves (4%), polar foxes (4%), ferrets (4%), unknown sources (3%) [9] (Figure 1).

The major reasons for human mortality are: incorrect diagnosis, delayed post-exposure prophylaxis, refusal from vaccination of domestic carnivores [9].

Vaccination

19,842,548 domestic animals, including livestock were vaccinated in the Russian Federation in 2019. Besides 20,684,436 vaccine baits were distributed for wild animals. 8,548,904 cats and dogs out of 52.6 million population were vaccinated, it means 16.25%, which is clearly not enough to develop an effective herd immunity (vaccination is effective if 90% of domestic animals (dogs) and at least 70% of wild carnivores are immunized [10, 11]).

The graphs presenting correlation between morbidity and vaccination coverage in domestic and wild carnivores for the last 10 years by Federal Districts are given below (Fig. 2–4).

The correlation between the vaccination coverage and morbidity was: $r = 0.96$ for domestic carnivores; $r = 0.86$ for wild carnivores; $r = 0.95$ for livestock. Herewith no correlation was established between the number of tests and animal morbidity. Based on the results of correlation analysis, it may be concluded that it is not effective to increase the vaccination coverage, if the current approaches to prevention are maintained, i.e. if the risk populations are not regarded. However this supposed ineffectiveness of the vaccination programme through the increase in urban vaccination coverage among susceptible animals is associated with the practice to vaccinate only registered domestic carnivores (service animals, exhibition animals, animals kept in shelter and so on) alongside a high morbidity of stray and this means non-vaccinated animals. The effectiveness of urban rabies prevention directly depends on the vaccination coverage among target populations [11]. It is recommended to develop measures, aimed at recording and control of urban animals (microchipping, passport system, population control) and increase the vaccination coverage up to 90% [10].

As for wild animals, the supposed ineffectiveness of the vaccination programme through the increase in the number of baits distributed is probably associated with the focus on fox populations, while the number of the other wild carnivore species populations is unknown. Moreover such carnivores are strongly involved into the epidemic process. It is recommended to develop oral vaccination tools for most species of wild carnivores to cover at least 70% of population [10].

Livestock is the dead-end of the rabies epidemic chain. These animals are often vaccinated to comply with the requirements of anti-epidemic measures in the rabies outbreak area, herewith not all livestock facilities stick to biosecurity norms, which creates the risk for the livestock to get infected from wild or stray carnivores. That is why, when planning vaccination of livestock it is recommended to use a risk-oriented approach and pay special attention to the vaccination programme for high risk populations with due consideration of biosecurity requirements and within the set of measures to decrease rabies spread (90% vaccination coverage for urban populations and 70% vaccination coverage for wild carnivores [10, 11]).

Post-Exposure Prophylaxis

A factor, facilitating death rate increase, is a lack of public awareness about potential risks of bites/licking/

Table 2
Ranking of RF Federal Districts based on rabies infection level

Таблица 2
Ранжирование федеральных округов РФ по уровню неблагополучия по бешенству

Federal District	Mean Epidemicity Index (2010–2019)	Rank [8] (risk level*)
Central (CFD)	0.99	0.9–1.0 (catastrophic)
Volga (VFD)	0.978	
North Caucasian (NCFD)	0.88	> 0.9–0.5 (high)
Southern (SFD)	0.86	
Ural (UFD)	0.85	
Siberian (SbFD)	0.77	
Far East (FEFD)	0.35	> 0.5–0.1 (moderate)
Northwestern (NWFD)	0.32	
Baikonur	0.0	> 0.1 (low)

*Risk levels:
catastrophic – the disease was reported in all regions throughout the observation time (practically 100% likelihood of the disease spread to the other Federal Districts);
high – the disease is reported in most regions, the improvement of the situation within the studied period is minimal (high likelihood of the disease spread to the other Federal Districts);
moderate – less than half of the regions are infected (within the observation period the tendency towards improvement was noted; the likelihood of the disease spread to the other Federal Districts is low);
low – the territory is free or sporadic rabies cases are reported (very low likelihood of the disease spread to other regions due to natural or artificial geographical barriers).

*Уровни риска:
катастрофический – заболевание выявлено во всех регионах и за все время наблюдения (практически 100%-я вероятность распространения в другие федеральные округа);
высокий – заболевание наблюдается в большинстве регионов, улучшение ситуации за исследуемый период минимальное (высокая вероятность распространения в другие федеральные округа);
умеренный – меньше половины регионов затронуты заболеванием (в течение срока наблюдения прослеживается тенденция к улучшению эпизоотической ситуации; вероятность распространения в другие регионы мала);
низкий – благополучие территории или спорадические случаи бешенства (очень низкая вероятность распространения в другие регионы ввиду наличия естественных и искусственных географических барьеров).

scratching by both wild and domestic animals and poor patient compliance.

When a victim seeks for a medical help, his/her wound is treated depending on the type of the wound, antirabic immunoglobulin is injected and then COCAV antirabic vaccine is used on 0, 3, 7, 14, 30 and 90 days post exposure. In most cases, this therapy is effective, but if the wound is located close to brain or the wound is vast, the virus high infective dose nullifies all the efforts to prevent the disease clinical signs.

In 2010–2019 60 people died from rabies in the Russian Federation due to the following reasons: failure to seek medical assistance – 67.8%; unauthorized violation of the vaccination scheme – 17.9%; fault of medical staff – 1 person (3.6%); bites of dangerous location, notwithstanding the correct therapy and short incubation period – 2 persons (7.1%); unknown reasons – 1 person (3.6%). 195 persons died from rabies during the previous 20 years [9].

In 2019, 397,248 cases of licking/scratching/biting were reported, out of them 10,232 exposures from wild animals, followed by two human deaths were registered [9].

Due to the fact, that non-carnivorous animals and humans are the end hosts of the infection, we used prevalence values among wild and domestic animals for the risk assessment.

The modeling results (Fig. 5, 6) demonstrate that if the vaccination is not practiced, the most probable number of infected humans can be: 7–8 humans after exposures from wild animals; four humans after exposures from domestic animals. If wild and domestic animals are vaccinated, the probable number of infections is decreased: five humans after exposures from wild animals and three humans after exposures from domestic animals. Herewith the number of infected animals in wild population decreases from 587 to 409 individuals, in domestic population from 586 to 504 individuals.

Hypothetic increase in the vaccine potency to 100% does not significantly influence the situation: the expected number of infected people is not changed.

Some authors describe the 40–60% uptake rate of vaccine baits [6], while the other publications specify 80–90% rates [12]. We took the mean value of a lower uptake rate for our modeling at high risks of spreading. This is associated

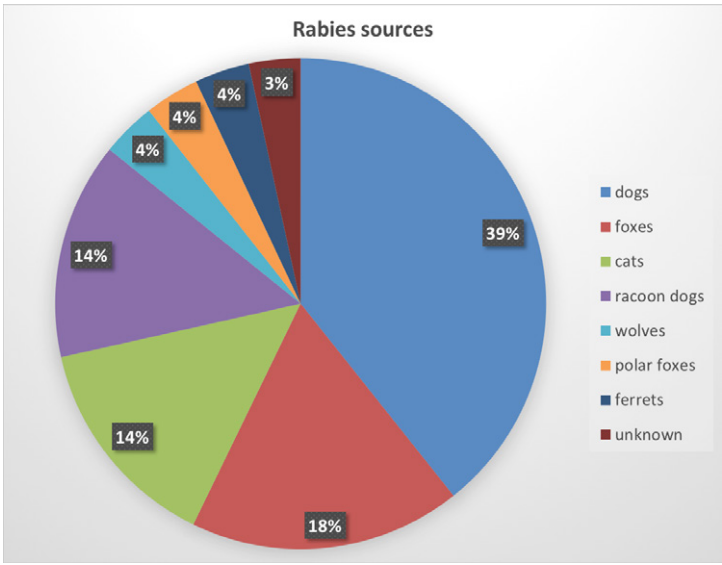

Fig. 1. Human infection sources [9]

Рис. 1. Источники заражения людей бешенством [9]

with the fact that we did not take into account the other species of carnivores, which are not vaccinated in contrast to foxes, but they are involved into the epidemic process (martens, badgers, corsac foxes, etc.). That is why there is a certain proportion of biased data and modeling results, which in turn necessitates the need to increase the volume of output data.

Increased bait uptake rate by wild animals could lead to a greater effect. For example, if bait uptake rate by foxed is 100%, the number of infected people post exposures from wild animals could be decreased to three persons.

The problem of vaccination lies in impossibility to catch and vaccinate all stray animals. It is necessary to immunize domestic carnivores, which have the access to outdoors, and animals, residing in private houses. Today the oral vaccination is envisaged only for foxes due to their specific uptake behavior, needed for effective vaccination [7]. However, other susceptible animals remain intact and are actively involved into the epidemic process.

Average annual human mortality rates due to rabies suggest the lack of public awareness raising events, contributing to understanding of the necessity to take prevention measures.

Animal movement surveillance

In 2010–2019, 10 cases of imported rabies were reported. In most cases, these were tourists, who had contacts with diseased animals in other countries and sought for medical assistance due to clinical signs, manifested at home [9].

279,391 movements of domestic carnivores between regions were registered in 2019. Pursuant to p. 4.11 of Sanitary Rules (SP) 3.1.096-96, Veterinary Rules (VP) 13.3.1103-96 (approved by the State Committee of Public Health Surveillance No. 11 on May 31, 1996 and Ministry of Agriculture and Food No. 23 on June 18, 1996) "Prevention and Control of Infectious Diseases Common for Humans and Animals. 13. Rabies" movements of dogs out of the Oblast (Krai, Republic) are allowed only if they are accompanied with the veterinary certificate, bearing the stamp on rabies vaccination.

Based on the reports of the Rosselkhoznadzor Territorial Administrations eight attempts to move carnivores, accompanied with incorrectly prepared veterinary and sanitary documents were detected and prevented in 2019.

The prevented attempts of illegal movements suggest that the system functions well, but the danger of non-vaccinated domestic carnivores, moved by summer visitors

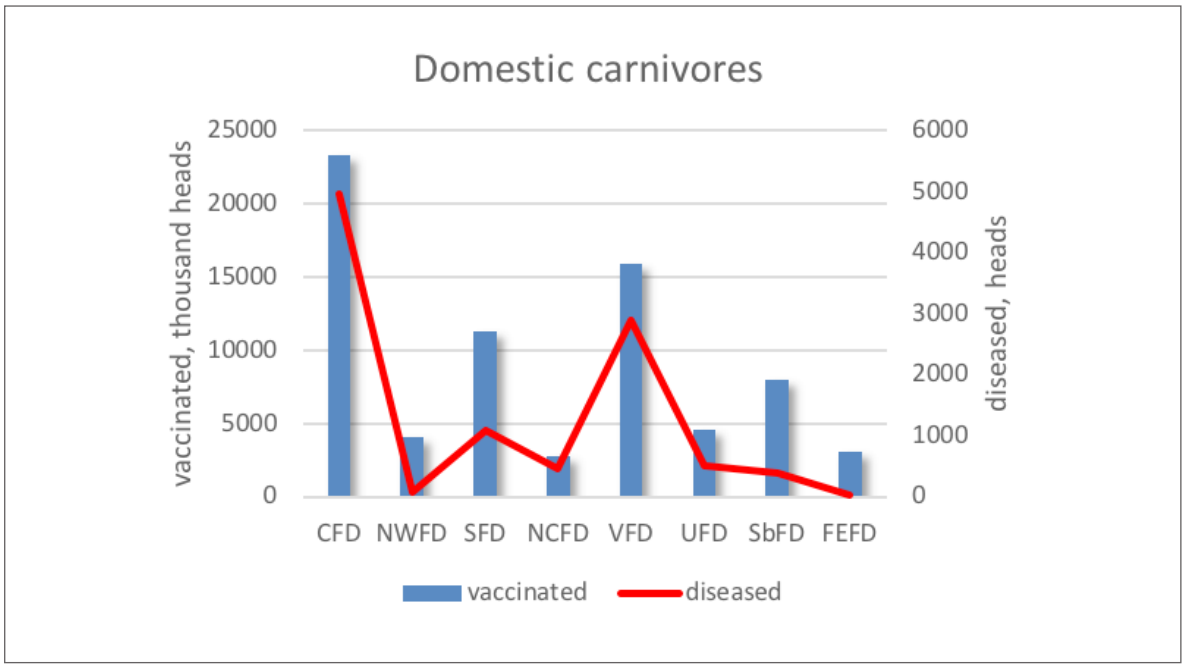

Fig. 2. Correlation between morbidity and vaccination coverage against rabies in domestic carnivores (2010–2019)

Рис. 2. Корреляция заболеваемости с фактическим охватом вакцинацией против бешенства у домашних плотоядных за 2010–2019 гг.

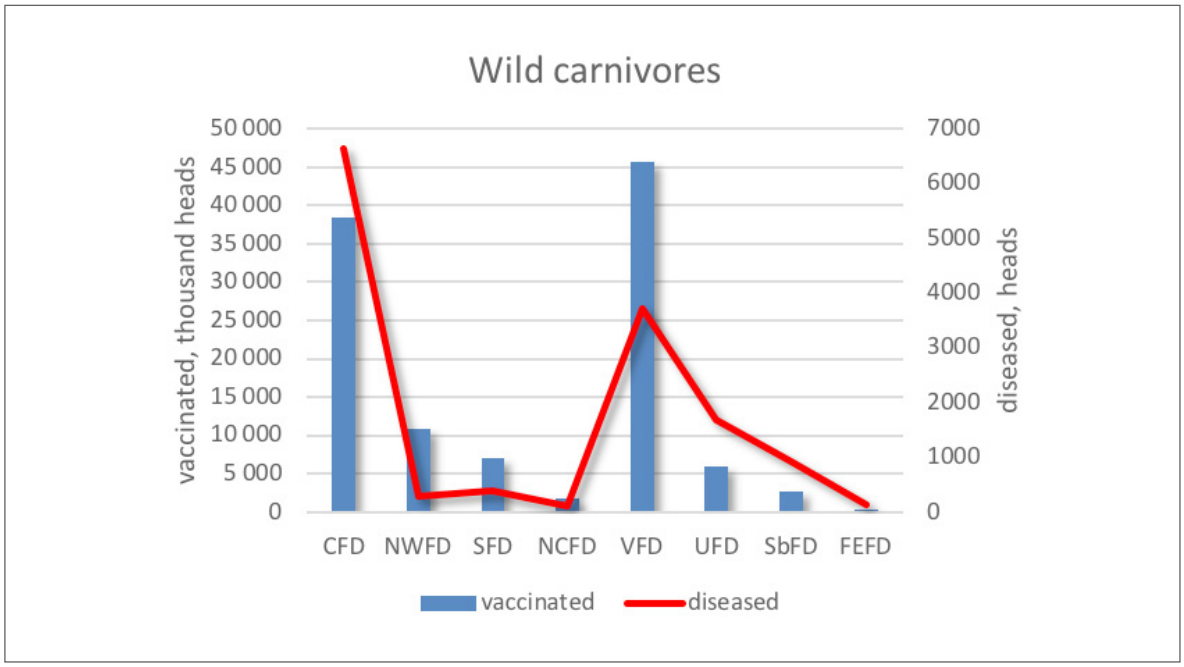

Fig. 3. Correlation between morbidity and amount of distributed baits against rabies in carnivores (2010–2019)

Рис. 3. Корреляция заболеваемости с количеством разложенных приманок против бешенства у диких плотоядных за 2010–2019 гг.

(to the summer houses and back), tourists (for the vacation) and hunters (to hunting areas) should be taken into account.

CONCLUSION

Rabies is a serious threat for human and animal lives. Notwithstanding the efforts made, two persons died and about 400 thousand peoples received antirabic treatment in 2019. These figures suggest the lack of public awareness campaigns and the need to develop and implement additional measures to prevent rabies. Such measures include, except for the stamp on rabies vaccination in the veterinary certificate, if an animal to be moved out of the region, the enhancement of movement

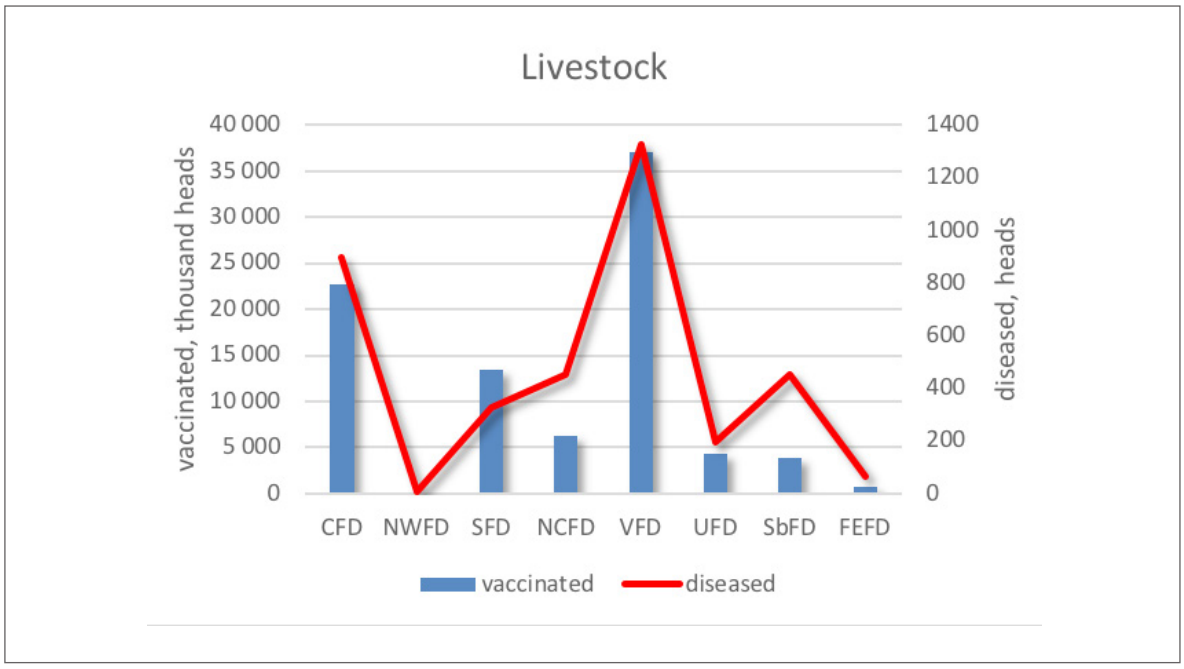

Fig. 4. Correlation between morbidity and vaccination coverage against rabies in livestock (2010–2019)

Рис. 4. Корреляция заболеваемости с фактическим охватом вакцинацией против бешенства у сельскохозяйственных животных за 2010–2019 гг.

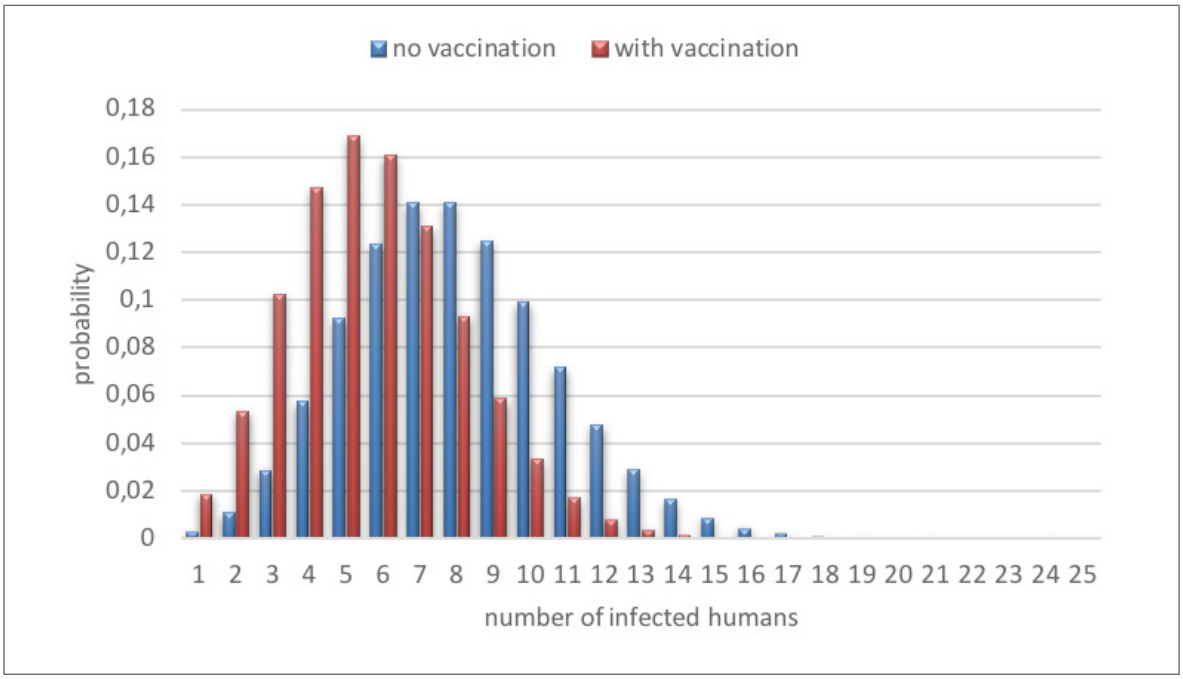

Fig. 5. Distribution of the expected number of infected humans when bitten by wild animals (vaccinated and non-vaccinated)

Рис. 5. Распределение ожидаемого количества инфицированных людей при покусах дикими животными (с вакцинацией и без вакцинации)

control for susceptible non-vaccinated animals within the Oblast (Krai, Republic).

The direct link between vaccination coverage and morbidity among target groups is established, which at first glance, suggests the inadequacy of the programme on vaccination coverage increase. The detailed analysis showed the necessity of a more careful vaccination programme planning, involving control of populations and coverage of a bigger number of animals. The lack of vaccination coverage for the purposes of effective

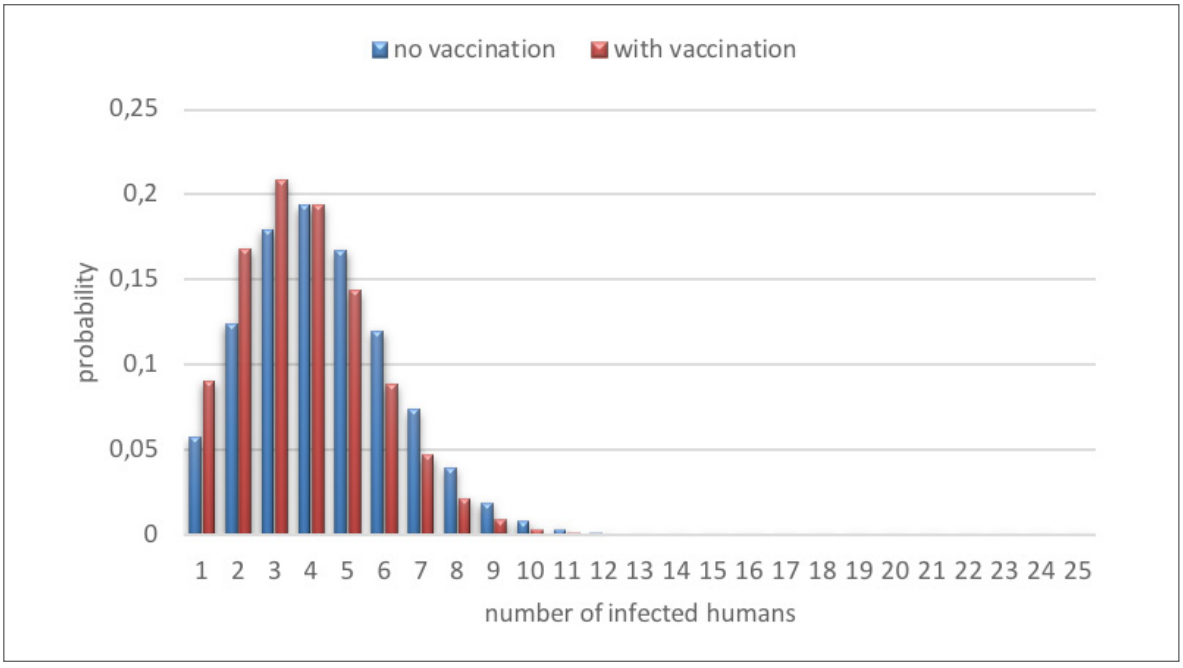

Fig. 6. Distribution of the expected number of infected humans when bitten by domestic animals (vaccinated and non-vaccinated)

Рис. 6. Распределение ожидаемого количества инфицированных людей при покусах домашними животными (с вакцинацией и без вакцинации)

herd immunity and disease restrain was established. It was revealed that out of 52.6 million dogs and cats, only 8,548,904 animals were vaccinated, which is 16.25% of the population. The necessity to improve the methods of wild carnivore vaccination was shown, due to the focus on oral vaccination of foxes.

The data obtained support the relevance of measures, envisaged by the Set of Joint Measures of the CIS Member Countries to prevent and control rabies till 2025. The implementation of the Set will enable to reach rabies freedom in target populations (if 90% of domestic animals (dogs) and 70% of wild carnivores are vaccinated) [10].

REFERENCES

1. Freuling C. M., Hampson K., Selhorst T., Schröder R., Meslin F. X., Mettenleiter T. C., Müller T. The elimination of fox rabies from Europe: determinants of success and lessons for the future. *Phil. Trans. R. Soc. B.* 2013; 368 (1623): 20120142. DOI: 10.1098/rstb.2012.0142.

2. Makarov V. V. Modern concepts of rabies. *The herald of game management*. 2018; 15 (3): 215–227. eLIBRARY ID: 35450767. (in Russian)

3. Rabies. World Health Organization. Available at: https://www.who.int/news-room/fact-sheets/detail/rabies (date of access: 09.07.2020).

4. How many pets are there in the world? [Skol'ko vsego v mire domashnih zhivotnyh?]. *Argumenty i Fakty*. Available at: https://aif.ru/society/nature/skolko_vsego_v_mire_domashnih_zhivotnyh (date of access: 09.07.2020). (in Russian).

5. Chernyshova Ye. V., Nazarov N. A., Metlyn A. Ye., Rybakov S. S., Chepurkin A. V., Sukharkov A. Yu., et al. Potency testing of vaccines used for rabies prevention in the territory of the Russian Federation. *Proceedings of the Federal Centre for Animal Health*. 2010; 8: 64–73. eLIBRARY ID: 15595682. (in Russian)

6. Fertikov V. I. Jubilee volume [Yubilejnyj sbornik]. M.: OLMA-PRESS; 2004. 280 p. (in Russian)

7. Makarov V. V., Petrov A. K., Vasilyev D. A. Basics of the doctrine of infection (manual). M.: RUDN; Ulyanovsk: UlGAU, 2018. 136 p. (in Russian)

8. Oganesyan A. S., Baskakova N. E., Korennoy F. I., Gulenkin V. M., Doudnikov S. A., Karaulov A. K. Methodical recommendations on semi-quantitative assessment of epidemic risk during animal and animal product import operations [Metodicheskie rekomendacii po polukolichestvennoj ocenke epizooticheskogo riska pri provedenii importnyh operacij s zhivotnymi i produkciej zhivotnogo proiskhozhdeniya]: approved by FGBI "ARRIAH" on 06.02.2015 No. 14–15. Vladimir; 2015. 29 p. (in Russian)

9. Poleschuk E. M., Sidorov G. N., Nashatyreva D. N., Gradoboeva E. A., Pakskina N. D., Popova I. V. Rabies in the Russian Federation: data analytical bulletin [Beshenstvo v Rossijskoj Federacii: informacionno-analiticheskij byulleten']. Omsk: Publishing centre KAN; 2019. 110 p. eLIBRARY ID: 41024936. (in Russian)

10. Gruzdev K. N., Metlin A. E. Animal rabies. Vladimir: FGBI "ARRIAH"; 2019. 394 p. eLIBRARY ID: 41355659. (in Russian)

11. Sukharkov A. Yu., Nazarov N. A., Metlin A. Ye., Rybakov S. S., Chernyshova Ye. V., Yeryomina A. G., Iovleva A. Yu. Analysis of efficacy of oral rabies vaccination of wild animals by the example of some regions of the Russian Federation. *Proceedings of the Federal Centre for Animal Health*. 2010; 8: 57–63. eLIBRARY ID: 15595681. (in Russian)

12. Sukhar'kov A. Yu., Chernyshova E. V., Metlin A. E., Kalishenko V. D., Nazarov N. A., Egorov A. A., et al. Ways of assessing of bait uptake rate for oral rabies vaccines. *Veterinariya*. 2011; 11: 31–34. eLIBRARY ID: 17015958. (in Russian)

Received on 20.07.2020
Approved for publication on 10.08.2020

INFORMATION ABOUT THE AUTHORS / ИНФОРМАЦИЯ ОБ АВТОРАХ

Sergey V. Shcherbinin, Leading Veterinarian, Information and Analysis Centre, FGBI "ARRIAH", Vladimir, Russia.

Tatiana V. Vadopalas, Leading Veterinarian, Information and Analysis Centre, FGBI "ARRIAH", Vladimir, Russia.

Fedor I. Korennoy, Candidate of Science (Geography), Researcher, Information and Analysis Centre, FGBI "ARRIAH", Vladimir, Russia.

Ksenia A. Blokhina, Leading Veterinarian, Information and Analysis Centre, FGBI "ARRIAH", Vladimir, Russia.

Anton K. Karaulov, Candidate of Science (Veterinary Medicine), Head of Information and Analysis Centre, FGBI "ARRIAH", Vladimir, Russia.

Щербинин Сергей Владимирович, ведущий ветеринарный врач ИАЦ ФГБУ «ВНИИЗЖ», г. Владимир, Россия.

Вадопалас Татьяна Владасовна, ведущий ветеринарный врач ИАЦ ФГБУ «ВНИИЗЖ», г. Владимир, Россия.

Коренной Федор Игоревич, кандидат географических наук, научный сотрудник ИАЦ ФГБУ «ВНИИЗЖ», г. Владимир, Россия.

Блохина Ксения Андреевна, ведущий ветеринарный врач ИАЦ ФГБУ «ВНИИЗЖ», г. Владимир, Россия.

Караулов Антон Константинович, кандидат ветеринарных наук, руководитель ИАЦ ФГБУ «ВНИИЗЖ», г. Владимир, Россия.