SHORT COMMUNICATIONS

Epidemiological significance of detection of SARS-CoV-2 RNA among different groups of population of Moscow and Moscow Region during the COVID-19 outbreak

Vasily G. Akimkin[1], Stanislav N. Kuzin[1]✉, Olga Yu. Shipulina[1], Svetlana B. Yatsyshina[1], Elena V. Tivanova[1], Anna V. Kalenskaya[1], Irina V. Solovieva[1], Marina A. Vershinina[1], Olga A. Kvasova[1], Antonina A. Ploskireva[1], Marina V. Mamoshina[1], Mariya A. Elkina[1], Elena E. Andreeva[2], Aleksandr V. Ivanenko[3], Olga M. Mikailova[4]

[1]Central Research Institute for Epidemiology of the Federal Service for Supervision of Consumer Rights Protection and Human Welfare, 197101, Moscow, Russia;
[2]Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in Moscow, 129626, Moscow, Russia;
[3]Center for Hygiene and Epidemiology in the City of Moscow, 129626, Moscow, Russia;
[4]Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in Moscow Region, 141014, Mytishchi, Russia

The Central Research Institute of Epidemiology of Rospotrebnadzor presents priority data obtained from the large-scale population PCR-based study of the changes in the rates of circulation of SARS-CoV-2 among relatively healthy residents of Moscow and Moscow Region.

Keywords: *RNA; SARS-CoV-2; population-based study; relatively healthy residents; COVID-19; epidemic process.*

Acknowledgments. The study had no sponsorship.

Conflict of interest. The authors declare no apparent or potential conflicts of interest related to the publication of this article.

For citation: Akimkin V.G., Kuzin S.N., Shipulina O.Yu., Yatsyshina S.B., Tivanova E.V., Kalenskaya A.V., Solovieva I.V., Vershinina M.A., Kvasova O.A., Ploskireva A.A., Mamoshina M.V., Elkina M.A., Andreeva E.E., Ivanenko A.V., Mikailova O.M. Epidemiological significance of detection of SARS-CoV-2 RNA among different groups of population of Moscow and Moscow Region during the COVID-19 outbreak. *Journal of microbiology, epidemiology and immunobiology = Zhurnal mikrobiologii, èpidemiologii i immunobiologii.* 2020; 97(3): 197–201.

DOI: https://doi.org/10.36233/0372-9311-2020-97-3-1

Received 25 May 2020
Accepted 29 May 2020

Эпидемиологическое значение определения РНК SARS-CoV-2 среди различных групп населения Москвы и Московской области в период эпидемии COVID-19

Акимкин В.Г.[1], Кузин С.Н.[1]✉, Шипулина О.Ю.[1], Яцышина С.Б.[1], Тиванова Е.В.[1], Каленская А.В.[1], Соловьева И.В.[1], Вершинина М.А.[1], Квасова О.А.[1], Плоскирева А.А.[1], Мамошина М.В.[1], Елькина М.А.[1], Андреева Е.Е.[2], Иваненко А.В.[3], Микаилова О.М.[4]

[1]ФБУН «Центральный научно-исследовательский институт эпидемиологии» Роспотребнадзора, 197101, Москва, Россия;
[2]Управление Федеральной службы по надзору в сфере защиты прав потребителей и благополучия человека по г. Москве, 129626, Москва, Россия;

[3]ФБУЗ «Центр гигиены и эпидемиологии в городе Москве», 129626, Москва, Россия;
[4]Управление Федеральной службы по надзору в сфере защиты прав потребителей и благополучия человека по Московской области, 141014, Мытищи, Россия

ФБУН ЦНИИ эпидемиологии Роспотребнадзора представляет приоритетные данные широкомасштабного популяционного ПЦР-исследования динамики уровня циркуляции SARS-CoV-2 среди условно-здорового населения Москвы и Московской области.

Ключевые слова: *РНК; SARS-CoV-2; популяционное исследование; условно здоровое население; COVID-19; эпидемический процесс.*

Источник финансирования. Авторы заявляют об отсутствии финансирования при проведении исследования.

Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

Для цитирования: Акимкин В.Г., Кузин С.Н., Шипулина О.Ю., Яцышина С.Б., Тиванова Е.В., Каленская А.В., Соловьева И.В., Вершинина М.А., Квасова О.А., Плоскирева А.А., Мамошина М.В., Елькина М.А., Андреева Е.Е., Иваненко А.В., Микаилова О.М. Эпидемиологическое значение определения РНК SARS-CoV-2 среди различных групп населения Москвы и Московской области в период эпидемии COVID-19. *Журнал микробиологии, эпидемиологии и иммунобиологии.* 2020; 97(3): 197–201.

DOI: https://doi.org/10.36233/0372-9311-2020-97-3-1

Поступила 25.05.2020
Принята в печать 26.05.2020

From 6/4/2020 to 24/5/2020, scientists from the Central Research Institute of Epidemiology conducted a population-based study, which made it possible to estimate the rate of SARS-CoV-2 circulation among residents of Moscow and Moscow Region. The study included a total of 75,940 relatively healthy individuals displaying no symptoms of respiratory diseases. In addition, with an increase in the number of COVID-19 cases in Moscow Region, different categories of patients were examined (n = 83,699). The studies were performed by using the AmpliSens® Cov-Bat-FL test system (Registration Certificate RZN 2014/1987 of 25/3/2020) designed and manufactured by the Central Research Institute of Epidemiology.

In the examined cohort of relatively healthy residents of Moscow Region, SARS-CoV-2 RNA was detected in 5,321 (7.01%) individuals (95% CI[1] 6.83–7.19%); the detection frequency for SARS-CoV-2 RNA was 7.12% (6.87–7.37%) in Moscow and 6.87% (6.60–7.14%) in Moscow Region, thus demonstrating no difference in the SARS-CoV-2 RNA detection frequency in these constituent territories of Russia.

The dynamics of the analyzed indicator is highly important both for assessment of the epidemiological situation and for identification of its evolution pattern (**Figure**).

It should be noted that the rates of SARS-CoV-2 RNA detection varied quite considerably; the fluctuations were more noticeable in Moscow Region than in Moscow. For example, in Moscow Region, 5 peak values call for special attention: 11/4/2020 (15.2%), 28/4/2020–29/4/2020 (15.4 and 17.9%, respectively), 3/5/2020 (13.5%) and 7/5/2020 (14.7%).

The minimum values were observed during the overall decrease in the detection frequency of SARS-CoV-2 RNA and amounted to 2.7% (20/5/2020), 2.5% (21/5/2020) and 2.8% (24/5/2020). In Moscow, the peak values were slightly lower and amounted to 11.9% (16/4/2020), 11.0% (17/4/2020), 11.9% (21/4/2020), 11.2% (28/4/2020) and 10.4% (8/5/2020). The minimum values were also registered during the last days of the monitoring period from 23/5/2020 to 24/5/2020 (1.8% and 1.9%, respectively).

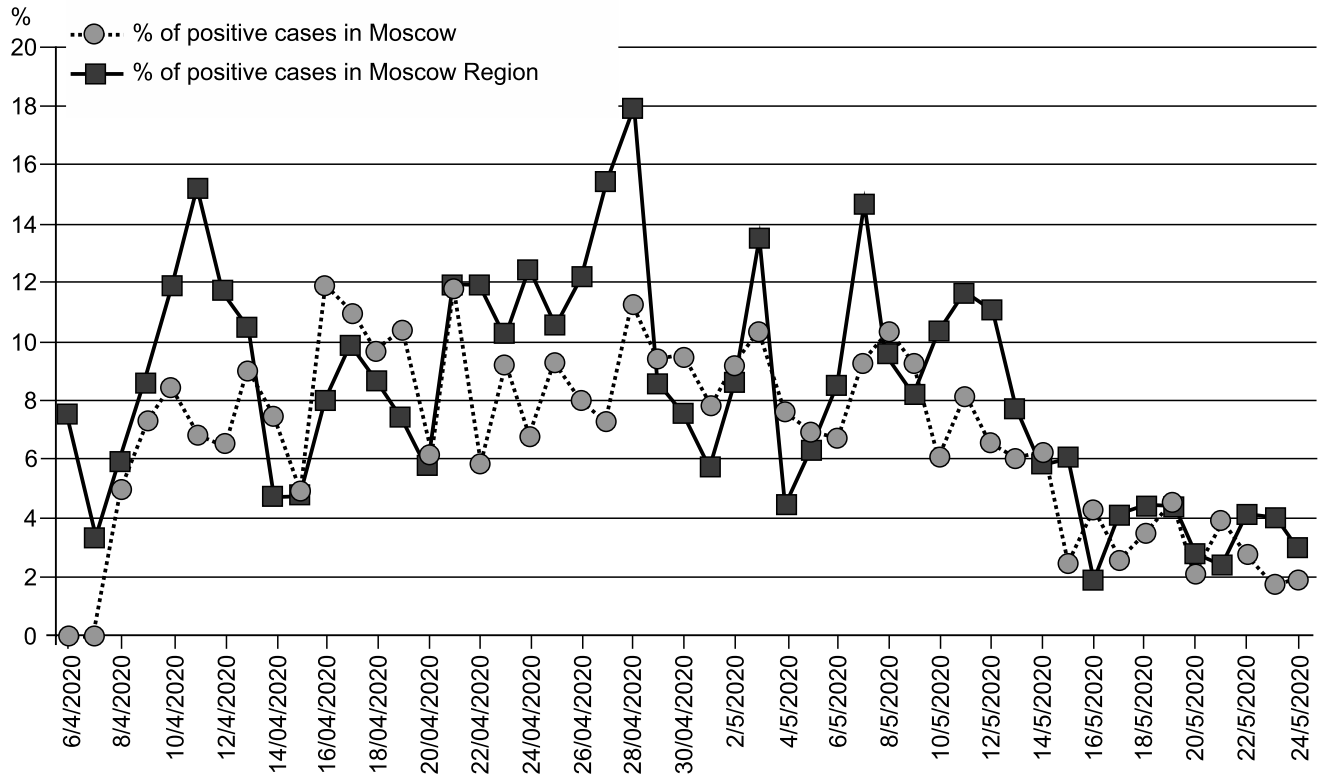
Based on the curve values of the frequency of SARS-CoV-2 RNA detection among the population, we singled out three time segments (6/4/2020–28/4/2020, 29/4/2020–12/5/2020 and 13/5/2020–24/5/2020), for which dynamic trends of the analyzed indicator were estimated. During 6/4/2020–28/4/2020, the moderate increase at positive growth rates of 1.3% and 3.0% per day was registered in Moscow and Moscow Region, respectively. In our opinion, the increasing number of potential sources of infection is indicative of intensification of the COVID-19 epidemic process in the studied territories of Russia.

In the middle of the monitoring period (29/4/2020–12/5/2020), Moscow and Moscow Region showed differences in the dynamics of the analyzed indicator. In Moscow, the frequency of SARS-CoV-2 RNA detection in the population began decreasing at a moderate negative rate of 1.8% per day, while Moscow Region continued demonstrating moderate increase at a positive rate of 3.3% per day.

The last 10 days of the monitoring period were characterized by rapidly decreasing frequency of SARS-CoV-2 RNA detection, demonstrating negative growth rates of 5.9% and 11.1% per day in Moscow and Moscow Region, respectively.

[1] Hereinafter parentheses contain a 95% confidence interval.

DOI: https://doi.org/10.36233/0372-9311-2020-97-3-1



The rate of SARS-CoV-2 circulation among relatively healthy residents of Moscow and Moscow Region during the COVID-19 epidemic outbreak

In the meantime, the positive trend in development of the COVID-19 epidemic process, which was suggested by the dynamics of the frequency of SARS-CoV-2 detection in the population, does not imply overall epidemiological welfare. In our opinion, the rate of circulation of SARS-CoV-2 in a population is one of the indicators that can provide a quantitative assessment of the epidemiological situation. We compared mean frequencies of detection of SARS-CoV-2 RNA in the examined individuals at 7–9-days intervals from 6/4/2020 to 24/5/2020 (**Table**).

It can be said that during the entire monitoring period, Moscow and Moscow Region demonstrated a substantial (3–4-fold; $p < 0.001$) decrease in the proportion of the individuals who were potential sources of infection, which, in our opinion, can serve as a prediction of further improvement of the epidemiological situation.

The obtained data indicate the effectiveness of the implemented epidemic control measures. The mandatory self-isolation imposed in Moscow on 25/3/2020 began to have a significant effect resulting in a decrease in the proportion of individuals infected with SARS-CoV-2 approximately by the 6^{th} –7^{th} week (Figure). We assume that the time when the self-isolation in Moscow started having its impact and the time when the frequency of SARS-CoV-2 started decreasing can be indicative of the COVID-19 incubation period lasting more than 14 days as well as of the long duration of virus shedding in convalescent patients, though our assumption requires a thorough study [1].

At the same time, this improvement of the epidemiological situation is not sufficient for immediate and total lifting of the restrictive measures, as herd immunity against SARS-CoV-2 RNA has not been achieved yet. The preliminary data indicate that at the epidemic

The mean frequency of detection of SARS-CoV-2 RNA in Moscow and Moscow Region, 6/4/2020–24/5/2020

Duration of study	Moscow		Moscow Region	
	%	95% confidence interval	%	95% confidence interval
6/4/2020–12/4/2020	7,04	6,13–8,04	11,66	10,09–13,39
28/4/2020–4/5/2020	7,60	6,90–8,35	8,53	7,63–9,50
16/5/2020–24/5/2020	3,30	2,93–3,70	3,39	3,06–3,75

stage defined as stabilization (by the dynamics of the COVID-19 incidence), from 16/5/2020 to 24/5/2020, the frequency of detection of specific antibodies to SARS-CoV-2 in the random selection of individuals in Moscow Region was 12–15%, thus totally correlating with our data on the virus circulation rate among population.

The detection of SARS-CoV-2 RNA in different groups of patients had high diagnostic significance. SARS-CoV-2 RNA was detected in 81.65% (81.18–82.11%) cases among the patients provisionally diagnosed with acute respiratory viral infection. It means that amid the COVID-19 epidemic this etiological agent is the primary one for this specific disease. Among the patients diagnosed with pneumonia, which was supported by the clinical evidence, SARS-CoV-2 RNA was detected in 70.92% (70.22–72.61%) cases. The frequency of detection of SARS-CoV-2 RNA in individuals who were in contact with COVID-19 patients was quite high, amounting to 65.78% (65.23–66.33%). The fact that 2/3 of the exposed individuals were infected indicates a high level of SARS-CoV-2 contagiousness and corresponds to the later model of the COVID-19 spread [2, 3]. The separate group included patients examined by the doctor's order. During the epidemic, the frequency of SARS-CoV-2 RNA detection was 77.34% (76.53–78.13%).

The obtained results demonstrate that PCR-based detection of SARS-CoV-2 during the COVID-19 epidemic outbreak in Russia has critical and independent significance. Firstly, the examination for presence of SARS-CoV-2 RNA is important for timely identification and isolation of potentially infectious individuals as well as for etiological differential diagnosis to distinguish from other acute respiratory diseases and influenza, which has fundamental significance in prevention of SARS-CoV-2 spread. Secondly, the accurate identification of the etiology of a disease is an essential prerequisite for the correct decision regarding case management. Thirdly, the performed dynamic population-based study showed that obtained results are important in assessing the stage of the COVID-19 epidemic development [4].

In our study, during the first week (6/4/2020–12/4/2020) the frequency of detection of SARS-CoV-2 RNA among randomly selected healthy people was 7.04% and 11.66% in Moscow and Moscow Region, respectively. It means that 1 of 10–13 individuals who consider themselves healthy is infected and is a potential source of infection for other people. Such virus carriers are responsible for the high intensity of the epidemic process in Moscow and Moscow Region.

In the middle of the studied period (28/4/2020–4/5/2020) the frequency of detection of SARS-CoV-2 RNA remained unchanged (7.60%) in Moscow, while the detection frequency in Moscow Region demonstrated a slight decrease (8.53%). The highly important fact is that the proportion of the infected individuals reduced significantly during the last week (16/5/2020–24/5/2020). In Moscow and Moscow Region, SARS-CoV-2 RNA was detected in 3.30 and 3.39% of the examined individuals, respectively.

Thus, the frequency of SARS-CoV-2 circulation in a population is an essential integrative epidemiological indicator providing reliable assessment of the intensity of the epidemic process and effectiveness of the epidemic control measures [5].

The mass, population-based screening for presence of SARS-CoV-2 RNA is a vitally important epidemic control method providing real-time and unbiased information about development of the epidemic process. Considering their significance for assessment of the epidemiological situation, proportions of infected individuals among healthy groups, which demonstrate rates of virus circulation among the population, most likely, will be used as one of the monitoring parameters in the system of epidemiological surveillance [5, 6].

REFERENCES

1. Zheng S., Fan J., Yu F., Feng B., Lou B., Zou Q., et al. Viral load dynamics and disease severity in patients infected with SARS-CoV-2 in Zhejiang province, China, January-March 2020: retrospective cohort study. *BMJ*. 2020; 369: m1443. DOI: http://doi.org/10.1136/bmj.m1443
2. Sanche S., Lin Y.T., Xu C., Romero-Severson E., Hengartner N., Ke R. Contagiousness and rapid spread of severe acute respiratory syndrome Coronavirus 2. *Emerg. Infect. Dis.* 2020; 26(7): 10.3201/eid2607.200282. DOI: http://doi.org/10.3201/eid2607.200282
3. Courtemanche C., Garuccio J., Le A., Pinkston J., Yelowitz A. Strong social distancing measures in the United States reduced the COVID-19 growth rate. *Health Aff. (Millwood).* 2020; 101377hlthaff202000608. DOI: http://doi.org/10.1377/hlthaff.2020.00608
4. Omori R., Mizumoto K., Chowell G. Changes in testing rates could mask the novel coronavirus disease (COVID-19) growth rate. *Int. J. Infect. Dis.* 2020; 94: 116-8. DOI: http://doi.org/10.1016/j.ijid.2020.04.021
5. Signorelli C., Scognamiglio T., Odone A. COVID-19 in Italy: impact of containment measures and prevalence estimates of infection in the general population. *Acta Biomed.* 2020; 91(3-S): 175-9. DOI: http://doi.org/10.23750/abm.v91i3-S.9511
6. Shearer F.M., Moss R., McVernon J., Ross J.V., McCaw J.M. Infectious disease pandemic planning and response: Incorporating decision analysis. *PLoS Med.* 2020; 17(1): e1003018. DOI: http://doi.org/10.1371/journal.pmed.1003018

Information about the authors

Vasily G. Akimkin — D. Sci. (Med.), Full Member of the Russian Academy of Sciences, Director, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0003-4228-9044.

Информация об авторах:

Акимкин Василий Геннадиевич — д.м.н., академик РАН, директор ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0003-4228-9044.

Stanislav N. Kuzin✉ — D. Sci. (Med.), prof., Head, Laboratory of viral hepatitis, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-0616-9777.
E-mail: drkuzin@list.ru.

Olga Yu. Shipulina — PhD (Med.), Head of subdivisions, of laboratory medicine and laboratory services promotion, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0003-4679-6772.

Svetlana B. Yatsyshina — PhD (Biol.), senior researcher, Head, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0003-4737-941X.

Elena V. Tivanova — Head, area of laboratory medicine and laboratory services promotion, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0003-1286-2612.

Anna V. Kalenskaya — Deputy head, area of laboratory medicine and laboratory services promotion for customer service, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-9126-1155.

Irina V. Solovieva — Head, Quality assurance group, Clinical and diagnostic laboratory, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-3136-9500.

Marina A. Vershinina — leading consultant in laboratory medicine, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0001-8582-5199.

Olga A. Kvasova — epidemiologist, Laboratory of Infections associated with the provision of medical assistance, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-4545-1804.

Antonina A. Ploskireva — D. Sci. (Med.), Deputy Director, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-3612-1889.

Marina V. Mamoshina — junior researcher, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-1419-7807

Mariya A. Elkina — junior researcher, Department of molecular diagnostics and epidemiology, Central Research Institute for Epidemiology, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0003-4769-6781

Elena E. Andreeva — D. Sci. (Med.), prof., Head, Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in Moscow, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0001-6687-7276

Alexandr V. Ivanenko — chief physician, Center for Hygiene and Epidemiology in the City of Moscow, Moscow, Russia.
ORCID ID: https://orcid.org/0000-0002-7122-017X

Olga M. Mikailova — PhD (Med.), Head, Office of the Federal Service for Supervision of Consumer Rights Protection and Human Well-Being in Moscow Region, Mytishchi, Russia.
ORCID ID: https://orcid.org/0000-0003-3842-6368

Contribution: the authors contributed equally to this article.

Кузин Станислав Николаевич✉ — д.м.н., проф., зав. лаб. вирусных гепатитов ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-0616-9777.
E-mail: drkuzin@list.ru.

Шипулина Ольга Юрьевна — к.м.н., рук. подразделения лабораторной медицины и продвижения лабораторных услуг отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0003-4679-6772.

Яцышина Светлана Борисовна — к.б.н., с.н.с., отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0003-4737-941X.

Тиванова Елена Валерьевна — рук. направления лабораторной медицины и продвижения лабораторных услуг отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0003-1286-2612.

Каленская Анна Валентиновна — зам. рук. направления лабораторной медицины и продвижения лабораторных услуг по клиентскому сервису отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-9126-1155.

Соловьева Ирина Владимировна — рук. группы обеспечения качества Клинико-диагностической лаборатории ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-3136-9500.

Вершинина Марина Анатольевна — ведущий консультант по лабораторной медицине отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0001-8582-5199.

Квасова Ольга Андреевна — врач-эпидемиолог лаборатории инфекций, связанных с оказанием медицинской помощи, ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-4545-1804.

Плоскирева Антонина Александровна — д.м.н., зам. директора ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-3612-1889.

Мамошина Марина Васильевна — м.н.с. отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-1419-7807

Елькина Мария Александровна — м.н.с. отдела молекулярной диагностики и эпидемиологии ЦНИИ Эпидемиологии Роспотребнадзора, Москва, Россия.
ORCID ID: https://orcid.org/0000-0003-4769-6781

Андреева Елена Евгеньевна — д.м.н., проф., рук. Управления Роспотребнадзора по городу Москве, Москва, Россия.
ORCID ID: https://orcid.org/0000-0001-6687-7276

Иваненко Александр Валентинович — главный врач ФБУЗ «Центр гигиены и эпидемиологии в городе Москве», Москва, Россия.
ORCID ID: https://orcid.org/0000-0002-7122-017X

Микаилова Ольга Михайловна — к.м.н., рук. Управления Роспотребнадзора по Московской области, Мытищи, Россия.
ORCID ID: https://orcid.org/0000-0003-3842-6368

Участие авторов: все авторы сделали эквивалентный вклад в подготовку публикации.