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Research Article

Epidemiological effectiveness of domestic influenza vaccines in cases with vaccination against a new coronavirus infection in 2022–2023

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Abstract

The study presents the results of an epidemiological prospective field cohort study on a comparative assessment of the epidemiological effectiveness of domestic inactivated influenza vaccines and vaccines against new coronavirus infection during immunization of adults aged >18 years. Statistically significant differences were found in the incidence of influenza, acute upper respiratory infections, and new coronavirus infection between the vaccinated and unvaccinated groups. The etiologies of cases of acute upper respiratory infections registered in the study participants during the epidemic season of influenza in 2022–2023 were verified. The clinical symptoms of influenza in the vaccinated group were significantly less severe than those in the unvaccinated group. No significant differences were found in the clinical picture of acute upper respiratory infections between the compared groups. Influenza immunoprophylaxis is an urgent problem, which consists of the ability of viruses to change their antigenic structure and avoid immunity, remaining in constant circulation. Thus, the antigenic composition of influenza vaccines must be systematically updated to ensure the formation of effective population immunity. More studies on the etiological spectrum of respiratory pathogens and assessment of the epidemiological effectiveness of vaccination against vaccine-controlled infections in the analyzed groups are needed. Therefore, to assess immunological protection, including the assessment of the epidemiological effectiveness of seasonal vaccines used against influenza and new coronavirus infection, the priority age group includes individuals aged 18–25 years (especially those belonging to organized collectives) and adults with an unfavorable premorbid background. The use of domestic vaccines against influenza and the new coronavirus infection for specific immunoprophylaxis is generally recognized as the most effective sanitary and anti-epidemic (preventive) measure in the morbidity management of several infectious diseases.

Keywords: vaccination; immunity; influenza; new coronavirus infection; acute respiratory infections of the upper respiratory tract; epidemiological efficacy; immunoprophylaxis.

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Научная статья

Эпидемиологическая эффективность отечественных вакцин против гриппа на фоне вакцинации против новой коронавирусной инфекции в эпидемическом сезоне 2022–2023 гг.

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Резюме

Представлены результаты эпидемиологического полевого проспективного когортного исследования по сравнительной оценке эпидемиологической эффективности отечественных инактивированных вакцин против гриппа и вакцин против новой коронавирусной инфекции при иммунизации взрослых лиц в возрасте от 18 лет. Показаны статистически значимые различия в уровнях заболеваемости гриппом, острыми респираторными инфекциями верхних дыхательных путей и новой коронавирусной инфекции в исследуемых группах, привитых по сравнению с непривитыми лицами. Описаны результаты этиологической верификации случаев заболевания острыми респираторными инфекциями верхних дыхательных путей, зарегистрированных у участников исследования в эпидемический сезон по гриппу 2022–2023 гг. Отмечено, что выраженность клинических симптомов гриппа в исследованных группах вакцинированных лиц была достоверно меньше, чем в группе невакцинированных. Значимых различий между сравниваемыми группами в отношении клинической картины острых респираторных инфекций верхних дыхательных путей не выявлено. Показана актуальность проблемы иммунопрофилактики гриппа, заключающаяся в способности вирусов изменять свою антигенную структуру и, таким образом, избегать давления иммунитета, сохраняясь в постоянной циркуляции. В связи с этим необходимо систематическое обновление антигенного состава вакцин против гриппа для того, чтобы обеспечить формирование эффективного популяционного иммунитета. Также показана целесообразность продолжения изучения этиологического спектра возбудителей респираторных инфекций и проведения оценки эпидемиологической эффективности вакцинации против вакциноуправляемых инфекций из рассматриваемых групп. Следовательно, для проведения оценки иммунологической защищенности, в том числе оценки эпидемиологической эффективности используемых сезонных вакцин против гриппа и новой коронавирусной инфекции, приоритетной возрастной группой являются лица в возрасте 18–25 лет (в особенности — принадлежащие к организованным коллективам), а также взрослые лица с неблагоприятным преморбидным фоном. В целом использование отечественных вакцин против гриппа и новой коронавирусной инфекции как средств специфической иммунопрофилактики является общепризнанным и наиболее эффективным санитарно-противоэпидемическим (профилактическим) мероприятием в системе управления заболеваемостью целого ряда инфекционных заболеваний.

Ключевые слова: вакцинация; иммунитет; грипп; новая коронавирусная инфекция; острые респираторные инфекции верхних дыхательных путей; эпидемиологическая эффективность; иммунопрофилактика.

Как цитировать

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ЭКО•ВЕКТОР

BACKGROUND

According to the World Health Organization, >15% of the global population have influenza and acute respiratory infections of the upper respiratory tract in one clinical form or another annually [1]. Despite the high genetic flexibility and variability of pathogens, vaccination most effectively prevents influenza [2]. In healthy adults, influenza vaccines provide protection even when influenza viruses circulating during an epidemic do not correspond exactly to the vaccine strains [3–5].

During the coronavirus disease 2019 (COVID-19) pandemic, which was caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), vaccination against influenza has become important, and the seasonal increase in the incidence can significantly overload the healthcare system [6–9].

The maximum efficiency of vaccines against influenza (including against COVID-19) can only be achieved if large proportions of the entire population are vaccinated [10, 11]. Calculations performed by Grech and M. Borg [13] indicated that increasing the level of vaccination coverage to 80%, even with low vaccine effectiveness (within 50%), provides sufficient collective immunity and allows for an even more significant reduction in the incidence of influenza, which will have a beneficial influence on the healthcare system, including during the persistent spread of SARS-CoV-2 [12–17].

Considering the above, the analysis of the epidemiological efficiency of Russian vaccines against influenza and COVID-19 appears to be an urgent scientific task. Thus, this study aimed to conduct a comparative assessment of the epidemiological efficiency of Russian influenza and COVID-19 vaccines in adults aged ⩾ 18 years during the 2022–2023 influenza epidemic season.

MATERIALS AND METHODS

The study analyzed the incidence of influenza and COVID-19 in the adult population of St. Petersburg against specific immunoprophylaxis of these diseases with vaccines registered in the Russian Federation.

An epidemiological prospective cohort study was performed. At preparatory stage 1. 4116 patients aged ⩾ 18 years were selected to participate in the study. The inclusion criteria were as follows: age ⩾ 18 years, vaccination against influenza and COVID-19 (main groups), absence of vaccination against influenza and COVID-19 or only against influenza (control group), and a signed voluntary informed consent to participate in the study. The exclusion criteria were as follows: voluntary refusal to participate in the study and vaccination against influenza and COVID-19 (control group). During the study period, 183 patients were excluded from the study for appropriate reasons in stage 1, and 21 patients withdrew in stage 2. At the end of the enrollment, the study group included 3.914 patients.

The study participants were distributed into four main groups based on vaccination status with a specific influenza vaccine. They were also divided into subgroups by sex (men and women) and age (18–39, 40–59, and ⩾ 60 years).

Group 1 consisted of 72 patients aged 18–39 years, 12 aged 40–59 years, and 4 aged ⩾ 60 years, who received the quadrivalent inactivated split vaccine Ultrix® Quadri (FORT, Russia).

Group 2 included 964 patients aged 18–39 years, 163 aged 40–59 years, and 19 patients aged ⩾ 60 years, who received the inactivated subunit vaccine Sovigripp® (NPO Microgen, Russia).

Group 3 consisted of 129 patients aged 18–39 years, 22 aged 40–59 years, and 8 aged ⩾ 60 years, who received the Grippol® Quadrivalent vaccine (NPO PetrovaxPharm, Russia).

Group 4 consisted of 1.286 patients aged 18–39 years, 175 aged 40–59 years, and 32 aged ⩾ 60 years, who received the Flu-M Tetra vaccine (St. Petersburg Research Institute of Vaccines and Serums of the Federal Medical and Biological Agency, Russia). The control group consisted of 1.028 patients aged ⩾ 18 years who were neither vaccinated against influenza nor vaccinated or revaccinated against COVID-19.

The strain composition of all drugs complied with the recommendations of the World Health Organization for use in the 2022–2023 season in the Northern Hemisphere. For the 2022–2023 season, the following quadrivalent vaccines were cultured on chicken embryos: A/Victoria/2570/2019 (H1N1)pdm09-like virus, A/Darwin/9/2021 (H3N2)-like virus, B/Austria/1359417/2021 (B/Victoria lineage)-like virus, and B/Phuket/3073/2013(lineage B/Yamagata)-like virus. Moreover, for the same season, the following trivalent vaccines were cultured on chicken embryos: A/Victoria/2570/2019 (H1N1)pdm09-like virus, A/Darwin/9/2021 (H3N2)-like virus, and B/Austria/1359417/2021 (B/Victoria lineage)-like virus.

During the recruitment for the groups vaccinated against influenza and COVID-19, vaccination, without taking into account the type of vaccine, was considered. Moreover, 2.690 patients were vaccinated with Gam-COVID-Vac (Sputnik-V), 119 with Sputnik-Light, 9 with Sputnik-M, and 2 with CoviVac.

The study was conducted at the S.M. Kirov Military Medical Academy during the period of the expected rise in

the incidence of influenza and acute respiratory infections (ARI) and the post-epidemic period (from December 26, 2022, to April 30, 2023).

To assess the epidemiological efficiency of vaccination, the study groups were actively monitored to identify cases of influenza-like diseases during the period with increased incidence of influenza and ARI of the upper respiratory tract in 2022–2023. Preventive effectiveness was determined by two indicators, namely, the efficiency index (*K*) expressed in conventional units (c.u.) and the efficiency (protection) coefficient (*E*) expressed in %:

$$K = \frac{b}{a}\ ;\ E = \frac{100 \times (b-a)}{b},$$

where *a* is the incidence among vaccinated patients and *b* is the morbidity among unvaccinated patients.

All patients were also assessed for the etiology and nature of the clinical manifestations of acute respiratory diseases, such as severity, duration, and complications of the disease.

For the etiological verification of the causative agent of influenza-like disease, biological samples were collected from the upper respiratory tract (swabs from the nasal cavity and nasopharynx) for subsequent molecular genetic studies using reverse-transcription polymerase chain reaction (PCR) to identify the presence of causative agents of influenza, ARI, and COVID-19.

In patients with ARI of the upper respiratory tract, samples were taken no earlier than 12 h and no later than 4 days from disease onset. The biological samples were collected, stored, and transported in accordance with the instructions of the standard surgical procedures of the S.M. Kirov Military Medical Academy and the A.A. Smorodintsev Research Institute of Influenza.

When collecting smears, a referral for the study was filled out, which included the date of collection; case report form number; last, first, and patronymic names (if any) of the study participants; age; sex; information about vaccination against influenza and COVID-19; date of illness; disease severity; clinical diagnosis; epidemiological history; antiviral therapy; and data on concomitant chronic diseases. In addition, the referral included information about the sample delivery, including the date and time of delivery, and compliance with delivery requirements.

All samples were examined for the presence of genetic materials of influenza virus types A and B; respiratory syncytial virus; rhinoviruses; metapneumovirus; parainfluenza viruses types 1, 2, 3, and 4; seasonal coronavirus strains OC 43, HKU-1, NL-63, and 229E; adenoviruses of groups B, C, and E; bocavirus; and SARS-CoV-2 using real-time PCR with the AmpliSens ARVI-screen-FL reagent kit (InterLabservice, Russia) and AmpliPrime® SARS-CoV-2 /Flu(A/B/H1N1pdm09) (NextBio, Russia).

MS Excel 2016 was used to create a database and graph the results. Statistical analysis was performed using SPSS Statistics version 17.0 and the Data Analysis software module of MS Excel 2016. The average values of the quantitative parameters are presented as $M \pm m$, where *M* is the arithmetic mean and *m* is the standard deviation.

Parametric and nonparametric statistical methods were used for the statistical processing of data, the choice of which was determined by the nature of the distribution of the characteristics studied and the type of materials analyzed, that is, Student's test or analysis of variance for quantitative ones and Mann–Whitney and Chi-square tests for qualitative and ordinal tests. Differences were accepted as statistically significant at $p < 0.05$.

The study was approved by the independent ethics committee at the S.M. Kirov Military Medical Academy (Protocol No. 270, October 28, 2022).

The study was performed within the state assignment of the Ministry of Health of the Russian Federation on the topic "Long-term assessment of collective immunity and the effectiveness of specific prevention of the population under conditions of dynamic circulation of COVID-19 and influenza pathogens in the Russian Federation".

RESULTS AND DISCUSSION

In the epidemic season of major respiratory infections in 2022–2023 in St. Petersburg, data revealed high intensity, increased morbidity levels compared with the long-term average indicators and those of the year, earlier seasonal increase and earlier excess in the total incidence of influenza and ARI.

During the study, the incidence of influenza was significantly lower (22.1 times) in the main groups (overall) than in the control group (3.12‰ and 69.06 ‰, respectively, $\chi^2 = 164.652$; $p < 0.001$). In turn, the incidence rates of other respiratory infections in the main (overall) and control groups were not significantly different, which were 206.72‰ and 214.98‰, respectively ($\chi^2 = 0.414$; $p > 0.05$).

Given that influenza, ARI, and COVID-19 cases were not identified in all sex and age subgroups of the compared groups (which made a correct differentiated comparison of indicators impossible), further analysis of the incidence was performed based on the total number of cases of the corresponding infection in each study group, excluding the sex and age subgroups.

In the evaluation of the indices of the epidemiological effectiveness of influenza vaccines and efficiency (protection) coefficients, all agents analyzed demonstrated high epidemiological efficiency (Table 1).

Moreover, in the comparative analysis of the preventive effectiveness of various vaccines, Sovigripp® and Flu-M Tetra vaccines exhibited higher preventive efficiency in adults from different sex and age subgroups. The incidence of ARI was not statistically significantly different between the groups unvaccinated and vaccinated with Ultrix® Quadri and Grippol® Quadrivalent vaccines. In turn, the differences in the incidence rates of ARI between the vaccinated (Sovigripp® and Flu-M Tetra vaccines) and unvaccinated groups were statistically significant (Table 2).

When assessing the epidemiological efficiency of COVID-19 vaccines, the incidence of COVID-19 in the vaccinated group was significantly lower than that in the unvaccinated group (5.19‰ and 96.31 ‰, respectively, $\chi^2 = 222.493$; $p < 0.001$). Moreover, the epidemiological effectiveness index and efficiency (protection) coefficient in the vaccinated group ($K = 18.55$ c.u., $E = 94.61\%$) indicated the high preventive effectiveness of COVID-19 vaccines. Thus, the studied Russian influenza and COVID-19 vaccines are characterized by high preventive effectiveness in vaccinated individuals.

During the active follow-up of the study participants, influenza and ARI cases of varying severities were recorded. Mild and moderate cases were noted in 52.47% and 47.53% of the participants, respectively. No cases of severe morbidity were recorded. The results of the analysis of disease severity depending on the vaccination status and immunobiological drugs administered are presented in Table 3.

The proportion of patients with mild influenza in the unvaccinated group was statistically significantly higher than that in the vaccinated group by 14.5 times, and the proportion of moderate influenza was higher by 6.3 times ($\chi^2 = 6.837$; $p = 0.009$; $\chi^2 = 4.711$; $p = 0.030$, respectively). In turn, the proportions of patients with mild and moderate ARI were also statistically significantly higher than those among vaccinated ones by 3.6 and 3.9 times, respectively ($\chi^2 = 88.931$; $p < 0.001$; $\chi^2 = 61.954$; $p < 0.001$, respectively).

The analysis of the severity of clinical symptoms of ARI and influenza in the vaccinated and unvaccinated groups showed several statistically significant differences. Thus,

Table 1. Indices of the epidemiological effectiveness of influenza vaccines and coefficients of effectiveness (protection) of the vaccinated group

Таблица 1. Значения индексов эпидемиологической эффективности вакцин против гриппа и коэффициенты эффективности (защищенности) вакцинированных лиц в исследуемых группах

Group	Vaccine	*K*, c. u.	E, %	χ^2	OR [95% CI]	*p*
1	Ultrix® Quadri	5.52	81.90	3.979	5.594 [0.787–39.746]	= 0.047
2	Sovigripp®	28.07	96.44	77.683	28.064 [8.866–88.834]	< 0.001
3	Grippol® Quadrivalent	10.29	90.28	8.882	10.360 [1.450–74.014]	= 0.003
4	Flu-M Tetra	24.93	95.99	89.911	24.985 [9.154–68.191]	< 0.001

Note: CI, confidence interval.
Примечание: ДИ — доверительный интервал.

Table 2. Evaluation results of the statistical significance of differences in the incidence of acute respiratory infections in the vaccinated and unvaccinated groups

Таблица 2. Результаты оценки статистической значимости различий в уровнях заболеваемости ОРИ в исследуемых группах привитых по сравнению с непривитыми лицами

Group	Vaccine	Number of the disease cases	Number of patients in group	χ^2	*p*
1	Ultrix® Quadri	23	88	0.728	= 0.394
2	Sovigripp®	91	1146	87.745	< 0.001
3	Grippol® Quadrivalent	31	159	0.581	= 0.447
4	Flu-M Tetra	452	1493	29.244	< 0.001
5	Unvaccinated	228	1028	–	–

the duration of symptoms of systemic infection, individual respiratory symptoms, and general course of influenza in the vaccinated group was significantly shorter than that in the unvaccinated group. In ARI, the differences in the duration of most symptoms in the compared groups were not statistically significant (Table 4).

According to the results of PCR diagnostics, pathogens of acute respiratory viral infections were detected in 524 and 294 individuals from the vaccinated and unvaccinated groups, respectively. The positivity rates from the total number of patients were 18.2% and 28.6%, respectively. The differences in the detection rates in the vaccinated and unvaccinated groups were statistically significant ($\chi^2 = 50.003$; $p < 0.001$).

The etiological verification of nasopharyngeal smears showed that rhinoviruses and adenoviruses were detected most often in the vaccinated group (ranking first and second in terms of frequency of detection, respectively). Influenza B viruses were found in seven cases, and one case each of influenza A/H1N1pdm09 and A/H3N2 was identified. SARS-CoV-2 was most commonly found in the nasopharyngeal swabs of the unvaccinated group. Influenza A/H1N1pdm09 and B viruses ranked fourth (13%) and sixth (6.4%) in terms of detection rates, respectively. The comparison of the detection rates in the vaccinated and unvaccinated groups showed statistically significant differences in the detection rates of influenza A/H1N1pdm09 ($\chi^2 = 4.719$; $p < 0.001$) and influenza B ($\chi^2 = 12.696$; $p < 0.001$). Among seasonal respiratory viruses,

Table 3. Comparative analysis of disease severity in the studied groups
Таблица 3. Сравнительный анализ степени тяжести заболевания у лиц исследуемых групп

Group	Vaccine	Influenza				ARI			
		Severity							
		Mild		Moderate		Mild		Moderate	
		n	%	*n*	%	*n*	%	*n*	%
1	Ultrix® Quadri	–	–	1	11.1	25	3.9	2	0.3
2	Sovigripp®	1	11.1	1	11.1	110	17.4	2	0.3
3	Grippol® Quadrivalent	–	–	2	22.2	33	5.2	2	0.3
4	Flu-M Tetra	1	11.1	3	33.4	455	71.8	5	0.8
	Total vaccinated:	2	22.2	7	77.8	623	98.3	11	1.7
5	Unvaccinated	29	39.7	44	60.3	174	80.2	43	19.8

Table 4. Comparative analysis of the severity of clinical symptoms of influenza and acute respiratory infections in the vaccinated and unvaccinated groups, *Me*; [Q1–Q3]
Таблица 4. Сравнительный анализ выраженности клинических симптомов гриппа и ОРИ в вакцинированных и невакцинированных группах, *Me*; [Q1–Q3]

Clinical symptom	Influenza				ARI			
	Vaccinated against influenza	Unvaccinated	tSt	*p*	Vaccinated against influenza	Unvaccinated	tSt	*p*
Fever, °C, $M \pm mx$	37.6 ± 0.3	38.5 ± 0.2	9.63	< 0.001	37.7 ± 0.2	37.8 ± 0.1	0.41	= 0.684
Duration of fever, days	2; [1–3]	3; [2–4]	18.40	< 0.001	3; [2–4]	3; [2–4]	0.80	= 0.427
Duration of illness, days	3; [2–3]	3; [2–3]	1.40	0.164*	3; [2–3]	3; [2–4]	0.60	= 0.548
Duration of headache, days	2; [1–3]	3; [2–4]	11.73	< 0.001	3; [2–4]	3; [2–4]	0.29	= 0.775
Duration of muscle and joint pains, days	1;[1–2]	4; [2–4]	2.46	0.022	3; [2–3]	4; [2–4]	3.16	< 0.004
Duration of cough, days	3; [2–3]	3; [2–4]	0.33	0.744*	4; [2–4]	3; [2–4]	2.14	= 0.099
Duration of sore throat, days	3; [1–3]	3; [2–4]	0.79	0.428*	3; [2–3]	4; [3–4]	1.80	= 0.085
Duration of dyspnea, days	2; [1–2]	2; [1–3]	1.31	0.201*	2; [1–2]	2; [1–2]	0.27	= 0.697
Duration of rhinorrhea, days	3; [2–3]	5; [4–6]	22.80	< 0.001	3; [2–4]	5; [3–5]	2.86	= 0.007
Duration of illness, days	7; [5–7]	9; [6–9]	3.52	< 0.001	6; [4–6]	6; [4–6]	1.47	= 0.146

Note: Q1–Q3 indicated the first and third quartiles, respectively.
Примечание: Q1–Q3 — 1-й и 3-й квартили.

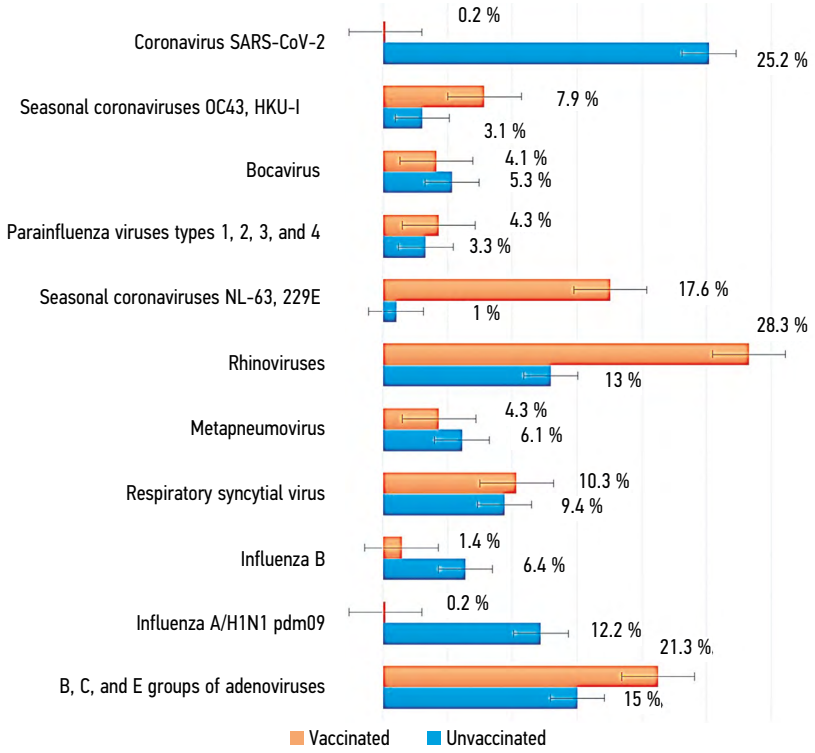

Fig. 1. Frequency of detection of viral acute respiratory infections pathogens among study participants based on the laboratory examination results of nasopharyngeal smears
Рис. 1. Частота выявляемости возбудителей вирусных ОРИ среди участников исследования (по результатам лабораторного исследования носоглоточных мазков)

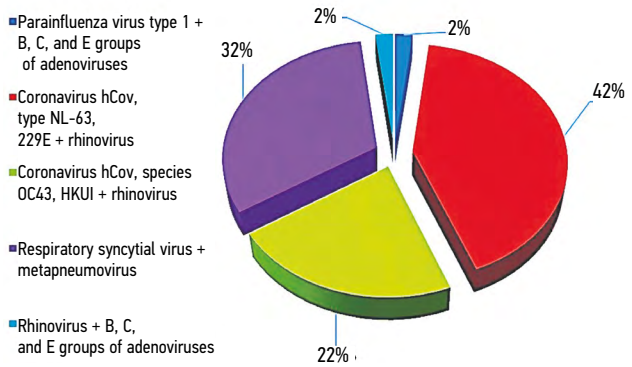

Fig. 2. Verification of pathogens of viral acute respiratory infections in nasopharyngeal smears by polymerase chain reaction in cases of mixed infections in the vaccinated group
Рис. 2. Этиологическая верификация возбудителей вирусных ОРИ в носоглоточных мазках методом ПЦР в случаях микст-инфицирования среди привитых

statistically significant differences were noted in the detection of group B, C, and E adenoviruses ($\chi^2 = 4.719$; $p = 0.30$), rhinoviruses ($\chi^2 = 24.109$; $p < 0.001$), seasonal coronaviruses NL-63 and 229E, and OC43 and HKU-I as mixed infections ($\chi^2 = 49.577$; $p < 0.001$; $\chi^2 = 7.109$; $p = 0.008$, respectively) in the vaccinated and unvaccinated groups. In addition, the most pronounced statistically significant difference in the detection rate was found in SARS-CoV-2 between the vaccinated and unvaccinated groups ($\chi^2 = 122.099$; $p < 0.001$).

Figure 1 presents the results of the comparative etiological verification of registered cases of respiratory infections in the study groups (according to studies of nasopharyngeal smears).

Among patients with ARI in the vaccinated group, mixed infection was found in 9.3% of cases, whereas in the unvaccinated group, only two similar cases were identified, namely, mixed infection of SARS-CoV-2 with influenza viruses A/H1N1pdm09 and B, characterized by a moderate course of the corresponding clinical symptoms. The distribution of the pathogens in these cases is presented in Figure 2.

The differences in the rates of detection of pathogens in cases of mixed infection between individuals vaccinated with

different influenza vaccines were not statistically significant. The limitations of the study were related to the level of vaccination coverage and individual seroconversion activity in the vaccinated group.

CONCLUSION

The use of specific immunoprophylaxis is a generally recognized and most effective sanitary and anti-epidemic (preventive) measure for the management of certain infectious diseases.

The known facts that influenza viruses, evading the immune system, constantly "drift," changing the antigenic structure and remain in circulation, further emphasize the importance of virological monitoring in epidemiological surveillance of this infection and monitoring of population immunity.

The study confirmed the high efficiency of specific prophylaxis in preventing influenza and COVID-19 and the positive effect of vaccination on reducing disease severity. All influenza vaccines have proven to be highly epidemiologically effective. In addition, the Sovigripp® and Flu-M Tetra vaccines were studied on a large sample of participants, which indicates the significance of the results obtained. COVID-19 vaccines have also demonstrated high epidemiological efficiency.

Further studies of the etiological range of pathogens of respiratory infections and assessment of the epidemiological efficiency of vaccines against vaccine-preventable infections appear relevant and appropriate. To assess immunological protection, including the epidemiological effectiveness of seasonal vaccines against influenza and COVID-19, individuals aged 18–25 years (particularly those belonging to organized groups) and adults with unfavorable premorbid background are the priority.

ADDITIONAL INFORMATION

Authors' contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

The contribution of each author: D.A. Lioznov — general concept development, research design; A.A. Kuzin — general concept development, research design, article writing; A.E. Zobov — material collection, epidemiological studies, data analysis and statistical processing, article writing; M.K. Erofeeva — data analysis, content analysis; M.A. Stukova — review literature, writing an article; Zh.A. Buzitskaya — collecting material, epidemiological studies; O.Y. Golubtsov — writing an article.

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Вклад авторов. Все авторы внесли существенный вклад в разработку концепции, проведение исследования и подготовку статьи, прочли и одобрили финальную версию перед публикацией.

Вклад каждого автора: Д.А. Лиознов — разработка общей концепции, дизайн исследования; А.А. Кузин — разработка общей концепции, дизайн исследования, написание статьи; А.Е. Зобов — сбор материала, эпидемиологические исследования, анализ и статистическая обработка данных, написание статьи; М.К. Ерофеева — анализ данных, контент-анализ; М.А. Стукова — обзор литературы, написание статьи; Ж.А. Бузицкая — сбор материала, эпидемиологические исследования; О.Ю. Голубцов — написание статьи.

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