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Review

HYGIENIC ASPECTS OF ANTI COVID-19 MEASURES

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The aim of this analytical review was to hygienically assess non-specific prevention of the COVID-19 infection. Such measures have been examined profoundly both by Russian and foreign researchers all over the world. The pandemic of this new coronavirus infection has shown that sanitary and preventive measures are among the most significant components in fighting against it, along with anti-epidemic activities and treatment measures, development of new vaccines and medications. All over the world, many countries introduce several sanitary-epidemiological and social measures to prevent spreading of the SARS-CoV-2 virus that causes COVID-19.

The review dwells on the results obtained by investigating effectiveness of non-specific prevention of the new coronavirus infection in different countries. As illustrated in the review, it was important to introduce restrictive measures with their major aim being to prevent (or limit) the infection transmission by airborne droplets or through household contacts. Researchers performed hygienic assessment of personal protective equipment used for protection of respiratory organs and hand skin and developed recommendations on its safe and effective use and utilization.

Self-isolation as a restrictive measure to prevent the COVID-19 pandemic from spreading was a temporary one. Nevertheless, during the pandemic peak billions of people all over the world had to remain at home after the strict self-isolation had been introduced. The review provides some data on estimating the level of commitment among population to follow recommendations on limiting the infection spread in Russia and abroad. In Russia, there is a reliable and effective state infrastructure of public healthcare. It made it possible to keep the pandemic situation under control starting from the early days when cases of pneumonia with unspecified etiology were reported in December 2019 and the first COVID-19 cases were registered in the country. Several measures were introduced including administrative, organizational, technical and sanitary-hygienic ones. However, it was a challenging task to create a relevant response to the COVID-19 pandemic that the public healthcare system in Russia had to tackle.

Keywords: *COVID-19, pandemic, public health, non-specific prevention, risk assessment, face masks, gloves, social distancing, self-isolation.*

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Most countries introduced restrictive sanitary-hygienic measures to prevent the new coronavirus infection from rapid spreading. Such measures included curfew (people being prohibited to visit public places at certain time), 'lockdown' (closing down enterprises, restaurants, bars, etc.), and limitations on mass events; also, social distancing became widely spread when employees had to work remotely, people had to keep a social distance between each other of 1.0–1.5 meters minimum in public transport and public places, and self-isolation was the strictest measure in this respect [1–3]. In addition, wearing face masks became mandatory in public transport and public places[1] [4].

Experts from Cambridge and Oxford investigated the significance of physical distancing as a measure aimed at reducing risks of COVID-19 infection. However, they failed to establish precisely what distance was safe during contacts with an infected person within varied contexts and safe duration of such contacts. Instead of creating some unified fixed rules for a minimal distance, differentiated recommendations were developed; they considered multiple factors, which collectively determined a risk of biological threats posed by COVID-19. This made it possible not only to provide the greatest protection in case risks of infection were high but also to help people keep greater freedom in case risks were not so high. The authors offered to introduce combined measures that included keeping a safe minimal distance, air ventilation, disinfecting surfaces and air in enclosed spaces, as well as wearing face masks. It was also thought necessary to bear in mind duration of contacts with a potential source of infection [5].

Large-scale examinations were performed by Canadian experts; they presented an analytical review and meta-analysis of 172 research articles written by authors from 16 different countries located on six continents including 44 works that addressed issues related to assessing risks of SARS-CoV-2 spread in healthcare organizations and non-medical institutions as well (n = 25,697). The authors analyzed research articles that described patients with confirmed or suspected COVID-19, SARS-CoV-1 or MERS (Middle-East Respiratory Syndrome) and people who had close contacts with them. They analyzed effects produced on a risk of infection by several factors including a distance between healthy people and people infected with COVID-19 (1 meter, more and less than 1 meter); wearing various types of face masks; eye protection; etc. The study aimed to estimate these factors in order to identify what physical distance would provide a reduction in risks of infection when taking care of a person infected with SARS-CoV-2, SARS-CoV-1 or MERS-CoV. Respiratory protective equipment included surgical masks and respirators No. 95; eye protection was provided by visors, face shields and protective glasses. The analysis revealed that virus transmission was lower in case a physical distance between people was 1 meter or more in comparison with a situation when it was less than 1 meter (n = 10,736, combined adjusted odds ratio [aOR] – 0.18, 95 % CI: between 0.09 and 0.38; risk difference [RD] – 10.2 %, 95 % CI: between -11.5 to -7.5; moderate validity); protection became stronger as this distance got longer (a change in relative risk [RR] – 2.02 per 1 meter; $p_{\text{interaction}} = 0.041$; moderate validity). Wearing a face mask can

[1] O vvedenii rezhima povyshennoi gotovnosti: Ukaz mera Moskvy ot 5 marta 2020 goda № 12-UM (s izm. na 06.10.2020) [On introducing the increased readiness regime: The Order by the Moscow mayor issued on March 5, 2020 No. 12-UM (last edited on October 06, 2020)]. *KODEKS: electronic fund for legal and reference documentation*. Available at: http://docs.cntd.ru/document/564377628 (August 02, 2022) (in Russian); O dopolnitel'nykh merakh po snizheniyu riskov rasprostraneniya COVID-19 v period sezonnogo pod"ema zabolevaemosti ostrymi respiratornymi virusnymi infektsiyami i grippom: Postanovlenie Glavnogo gosudarstvennogo sanitarnogo vracha RF ot 16 oktyabrya 2020 goda № 31 (s izm. na 20.06.2022) [On additional activities aimed at reducing risks of COVID-19 spread during a seasonal rise in morbidity with acute respiratory virus infections and flu: The Order by the RF Chief Sanitary Inspector issued on October 16, 2020 No. 31 (last edited on June 20, 2022)]. *KODEKS: electronic fund for legal and reference documentation*. Available at: http://docs.cntd.ru/document/566108530 (August 02, 2022) (in Russian).

lead to a significant decrease in a risk of infection (n = 2647; aOR = 0.15, 95 % CI: between 0.07 and 0.34, RD = -14.3 %, between -15.9 and -10.7; low validity), and there was a stronger association with N95 or similar respirators against disposable surgical masks or similar ones (for example, reusable 12–16-layer cotton masks; $p_{\text{interaction}}$ = 0.090; posterior probability > 95 %, low validity). Eye protection was also associated with lower risks of infection (n = 3713; aOR = 0.22, 95 % CI: between 0.12 and 0.39, RD = -10.6 %, 95 % CI: between -12.5 and -7.7; low validity) [6].

Experts from Singapore assessed risks posed by duration of contacts between healthy people and patients infected with COVID-19, the infection confirmed by laboratory tests. Household contacts were identified as contacts between people who lived together with a COVID-19 patient. Close contacts that could not be considered household ones were those between people who contacted for not less than 30 minutes and a distance between a healthy person and an infected patient was within 2 meters. The authors examined 7700 close contacts (1863 household contacts, 2319 work contacts and 3588 social contacts) associated with 1114 cases confirmed with a PCR-test. Living in the same apartment (multi-dimensional odds ratio [OR] – 5.38 [95 % CI: 1.82–15.84]; p = 0.0023) and a contact with an infected person that lasted 30 minutes or longer (7.86 [3.86–16.02]; p < 0.0001) were associated with SARS-CoV-2 transmission in household conditions. As for contacts beyond households, SARS-CoV-2 transmission was associated with the following: a contact with more than one patient (multi-dimensional OR – 3.92 [95 % CI: 2.07–7.40], p < 0.0001), talking to an infected patient for 30 minutes or longer (2.67 [1.21–5.88]; p = 0.015) and a drive in the same car (3.07 [1.55–6.08]; p = 0.0013). Indirect contact, having a meal together or sharing a toilet were associated with SARS-CoV-2 transmission both for household contacts and those beyond it [7].

T. Harweg with colleagues estimated effectiveness of not only a minimal social distance but also a safe square per one person in their study [8]. They created a numeric model to describe the number of pedestrians in cities in dynamics aiming to identify duration of exposure and the overall effectiveness of distancing. The modeling results showed that in case a person kept the minimal social distance of 1.5 meters established by the governmental regulations in Germany, a square equal to 16 m^2 per one person was sufficient for effective prevention of infection.

Experts from France [9] modeled infection by airborne transmission as well as an infecting dose. They highlighted the importance of calculating a pathogen unit that was closely connected with the ‘dose – reaction’ law. New COVID-19 variants with a greater viral burden such as delta (dose) or higher contagiousness such as omicron (contacts) could lead to more intensive airborne transmission. The researchers think that the existing ventilation standards are not sufficient and are not conformed to, especially in public places. This creates higher risks of infection. To prevent airborne transmission, it is necessary to perform multi-indicator analysis considering duration of exposure, a dose of an infectious agent, face mask wearing, as well as a share of infected people in a given population. Therefore, a risk of COVID-19 spread by airborne transmission requires investigating with a focus on duration of exposure and not the minimal distance.

B. Abbas with colleagues assessed risks of infection for healthcare workers in dental clinics [10]. In case a dental procedure lasted longer than 60 minutes, it was given 0.75 score; between 30 and 60 minutes, 0.50 score; in case a procedure lasted for less than 30 minutes, it was given 0.25 score. The total score estimation was calculated for each patient. A risk of SARS-CoV-2 transmission was assessed as low (the score estimation < 4), average (between 4 and 6) or high (the score estimation > 6) depending on the total estimation calculated for each procedure. Therefore, the shorter duration of a contact with a potentially infected person (‘protection by time’), the lower score estimation was given for establishing a risk rank.

Previously, a score estimate was suggested for a risk of the new coronavirus infec-

tion COVID-19 based on social-hygienic and behavioral indicators. Score estimation was performed to identify risk categories as regards the new coronavirus infection. Indicators that described adherence to wearing face masks when visiting certain social objects, trips by varied kinds of public transport and their duration, visits to social objects, and keeping a proper social distance were identified as the most significant risk factors.

Also, we suggested a procedure for assessing risks of COVID-19 transmission at social objects and transport infrastructure. An online survey with 1325 respondents from Moscow participating in it revealed that the most significant risk factor was neglecting the requirements to wear face masks and not a failure to keep a social distance in transport. We identified risk categories and suggested a hygienic classification of objects as per high, average, and low risks of COVID-19 transmission.

The COVID-19 pandemic had considerable influence on mass trips by population. Researchers from China examined a risk of the disease transmission between subway commuters by using the SEIR model ('susceptible – exposed – infected – recovered'). The model considered factors that could produce effects on the virus transmission such as effective ventilation, a time spent by a commuter on a trip, the number of commuters in a carriage and at a station, etc. As a result, it was established that a risk of infection grew considerably in case a trip lasted for more than 25 minutes. Physical distances between commuters, effective ventilation as well as quality of disinfection were also significant risk factors. It was recommended to improve ventilation and disinfection inside carriages and impose limitations on duration of trips together with introducing a social distance being not less than 1 meter [11].

Researchers from Argentina reported it was necessary to transform theoretical knowledge on resistance to the new coronavirus infection SARS-CoV-2 into preventive measures for healthcare workers. Regular training provided for both healthcare workers and patients reduced risks of the coronavirus infection spread. As a result, recommendations were developed and implemented with their major purpose being to assess COVID-19 risks in healthcare organizations in Argentina and safety management at the national level [12].

Preventing or limiting airborne transmission or transmission through household contacts is among the most important non-specific preventive measures against the new coronavirus infection COVID-19. Various types of screens including face masks, respirators, face shields and others are applied to reduce risks of airborne transmission. People in Russia were recommended to wear gloves in public places during a period when the COVID-19 incidence grew in order to exclude or limit the virus transmission by contacts.

After 'wearing gloves and masks' introduction, the WHO experts developed many guidelines on how to protect oneself from the coronavirus infection[2]. Wearing gloves is an additional anti-epidemic measure against the COVID-19 spread. Up-to-date medical gloves are made of different materials with different chemical structure, their manufacture relies on various production technologies and processing, and their target functions can also be different. They should conform to requirements securing their protective (barrier) and consumer properties[3], and be manufactured in conformity with the Standard EN 455 that corresponds to the interstate standard GOST EN 455-2014 in the Russian Federation.

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[2] Advice for the public: Coronavirus disease (COVID-19). *WHO*. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public (August 11, 2022).

[3] MR 3.5.1.0113-16. Ispol'zovanie perchatok dlya profilaktiki infektsii, svyazannykh s okazaniem meditsinskoi pomoshchi, v meditsinskikh organizatsiyakh. 3.5.1 Dezinfektologiya (utv. Federal'noi sluzhboi no nadzoru v sfere zashchity prav potrebitelei i blagopoluchiya cheloveka, Glavnym gosudarstvennym sanitarnym vrachom RF 2 sentyabrya 2016 g.) [MG 3.5.1.0113-16. Use of gloves to prevent healthcare associated infections in healthcare organizations. 3.5.1 Disinfectology (approved by the Head of the Federal Service for Surveillance over Consumer Rights protection and Human Wellbeing, the RF Chief Sanitary Inspector on September 2, 2016)]. *GARANT: information and legal portal*. Available at: https://www.garant.ru/products/ipo/prime/doc/71382342 (August 09, 2022) (in Russian).

It is noteworthy that prior to the COVID-19 pandemic there has never been such mass use of respiratory protective equipment and hand skin protection by both general public and healthcare workers in the history of mankind. The COVID-19 pandemic led to a drastic increase in using personal protective equipment both in healthcare and other organizations all over the world. Wearing a face mask is an economical and affordable way to prevent COVID-19.

Given that, it is becoming urgent to hygienically assess respiratory protective equipment and hand skin protection and to develop recommendations on their safe and effective use and subsequent utilization.

Wearing face masks involved certain changes in skin. Researchers from Serbia assessed short-term effects produced by cotton and medical masks on biophysical skin properties. They measured four biophysical skin properties including transepidermal water loss, the stratum corneum hydration, skin pH changes and the erythema index. Examinations were accomplished prior to and after 3 hours of wearing a mask on a skin covered by it and on open face surface. It was shown that transepidermal water loss increased on open skin after wearing a cotton face mask for three hours and decreased insignificantly after wearing a medical mask. After wearing a mask for three hours, there was an increase in the stratum corneum hydration and pH of mask-covered skin went down. The erythema index grew in both groups (cotton and medical masks); however, those differences were not statistically significant. Therefore, the authors established that skin characteristics changed even after wearing a mask for only 3 hours [13].

Researchers from China described outcomes for face skin caused by long-term wearing a mask, to be exact, during 6 months. Several skin characteristics were estimated in all participants three times a day including transepidermal water loss (TEWL), skin hydration, skin elasticity, skin pore area, skin keratin amount, skin temperature, skin color, and other indicators. As a result, it was established that skin hydration, skin pore area, skin keratin amount and skin color differed greatly on open spots and spots covered by a mask. The experts concluded that long-term daily use of a face mask can change skin characteristics [14].

Other researchers identified bacterial contamination of face masks after use. Their research involved questioning with participating employees of an airport in Moscow and investigating levels of bacterial contamination of face masks. Questioning established that skin sweating under a mask (68.60 %), and feelings of air shortage (66.94 %) were the most frequent and apparent among all the reactions ($p < 0.001$). The more frequent a negative reaction, the more apparent it is ($r = 0.79–0.95$). The authors established a moderate positive correlation between duration of wearing a mask and frequency of face skin sweating ($r = 0.31$). Face skin reactions were more frequent and apparent in people who wore a cotton mask against those who selected a neoprene or a non-woven one: sweating ($p = 0.04$), reddening / peeling / irritation ($p = 0.035$), more apparent pustules, skin rash and inflammation ($p = 0.02$). The experts also identified a correlation between frequency and intensity of skin reactions and bacterial contamination that occurred on an inner surface of a mask after use. There was a moderate positive correlation between the number of colonies and duration of use for a neoprene and cotton mask ($r = 0.33$ and 0.46 accordingly). The number of colonies grows as duration of use becomes longer. There are also several factors that aggravate frequency and intensity of negative reactions including skin problems, young age, work with average and high hardness [15].

Effectiveness of mask protection properties depends on how effectively a material a mask is made from is capable to block drops and aerosol particles that contain viruses. Bacterial filtration as well as permeability of a material can be used as indicators in estimating effectiveness of protection provided by a mask. The authors comparatively assessed effectiveness of a medical, cotton, and neoprene mask. The study revealed that a neoprene mask provided the highest bacterial filtration whereas a cotton one had the highest air per-

meability. All the examined masks were comparable with a medical one as per a combination of all the analyzed properties and could be used as means to reduce a risk of infection spread [16].

An analytical review of research articles in foreign and Russian editions has established that by now in literature there is not any available conventional terminology for face mask use as well as any unified classification of respiratory protective equipment. Based on this literature review, the authors suggested a new classification of respiratory protective equipment as per effectiveness of protection against airborne diseases. FFP3/KN100/N99/N100 respirators turned out to be the most effective. FFP2/KN95/N95/DS/DL2/KF94 respirators had average effectiveness. Effectiveness of FFP1 respirators and type IIR, II, I medical non-woven masks and gauze masks was below average (the means are mentioned in a descending order as per their effectiveness). Effectiveness of various non-medical masks (non-woven, woven cotton and synthetic ones) and face shields was low and extremely low accordingly[4]. There are also no exact concepts of a 'medical' and 'non-medical' mask.

Experts from China established that most respondents who participated in online survey used face masks correctly during the pandemic. However, certain difficulties occurred in selecting the optimal type of a mask, a possibility to reuse it, as well as a proper way to utilize it. The authors concluded that people should be provided with all the relevant information [17].

Another study aimed to examine personal protection measures during the pandemic in Germany and any potential differences in behavioral patterns depending on an age, sex and education. The total sample included 20,317 respondents who took part in an online survey. As a result, it was established that wearing a face mask was considered the top priority; it was followed by keeping a minimal necessary social distance and hand washing. It was established that more protective measures were usually taken by women, people with higher education and younger people. Risk groups included elderly people, men, and people with low levels of education. The priority prevention activities should be aimed exactly at these population groups [18].

After the Chinese Government introduced mandatory face mask wearing in public places, most people started using them. L. Zhang with colleagues accomplished two online surveys with their aim to identify peculiarities of face mask wearing by urban and rural population as well as people who were under quarantine or self-isolated [19]. As a result, it was established that face masks were worn by more than 90.0 % of the respondents. A share of those who wore masks was higher among educated people, people with high incomes and among elderly people. Face masks were worn rarer by rural population and people under quarantine or self-isolation.

Russian experts established in their studies that most respondents who participated in online surveys in Russia wore masks (96.4 %). This was due to the necessity to conform to the requirements established by the introduced mandatory face mask wearing (72.4 %) as well as due to close contacts with other people (54.0 %). Ninety-one per cent of the respondents wore face masks when visiting food shops, drug stores and medical organizations; 64.0 %, when visiting non-food retail outlets; 76.9 %, in land public transport; and 76.1 %, in underground public transport. The respondents used variable kinds of respiratory protective equipment (RPE). Disposable medical (93.3 % of the respondents) and reusable cotton masks (25.4 % of the respondents) were the most widely spread. One third of the respondents (33.6 %) wore a disposable medical mask strictly for the recommended hours; 35.2 %, for more than 2 hours a day; 28.0 %, during several days. Another online survey

[4] Mask use in the context of COVID-19: interim guidance, 1 December 2020. *WHO*, 2020, 22 p. Available at: https://apps.who.int/iris/bitstream/handle/10665/337199/WHO-2019-nCov-IPC_Masks-2020.5-eng.pdf?sequence=1&isAllowed=y (September 13, 2022).

was performed among personnel employed at public transport (n = 4732); it identified three types of face masks that were used the most frequently: medical (55.6 %), cotton (11.9 %) and neoprene ones (30.4 %). Face mask wearing was uncomfortable for 57.0 % of the respondents. They complained about face hyperhidrosis (65.5 % of the respondents), uncomfortable breathing (48.9 %), skin hyperemia, itching and peeling (26.5 %), headaches (21.3 %), sneezing and lacrimation (13.0 %), pyo-inflammatory diseases of face skin (11.5 %). Frequency and intensity of all the analyzed reactions depended on a material a mask was made from [20].

Taxi and fixed-run bus drivers were recommended to be working in medical masks during the COVID-19 pandemic. A.B. Nevzorova with colleagues established that a face mask produced certain effects on changes in psychophysiological properties of a car driver in city traffic. They revealed that drivers in a face mask had a drastic decline in neural-psychic functions against those who drove without it. Subjective estimations given by the respondents established a considerable (41.7 %) or insignificant (20.4 %) decline in reactions cand 38.0 % of the drivers did not have any deviations due to influence exerted by a mask on driving. Based on these results, the authors concluded that a face mask could be a predictor of a pre-accident situation on the road [21].

Estimation of how well people are aware of proper preventive measures and online training with its focus on the rules for proper use of respiratory protective equipment are important trends in prevention of the new coronavirus infection.

S. Kundu with colleagues estimated knowledge about COVID-19 prevention measures under quarantine among people in Bangladesh. They conducted an online survey in social networks with 1765 adults participating in it. As a result, it was established that 96.6 % of the respondents wore masks when going out to prevent the infection; 98.7 % of the respondents washed their hands with soap after returning home [22]. This estimation indicates that people were highly aware about proper preventive measures.

X. Xue and others believe households contacts to be among major ways of COVID-19 transmission; therefore, wearing gloves reduces a risk of infection when providing cleaning services, delivering foods and socializing with other people [23].

Other authors established that effectiveness of wearing gloves by all the population to prevent COVID-19 was unknown. In their study, the authors made an attempt to identify how effective regular use of gloves by healthy people was in terms of COVID-19 prevention [24].

Iranian experts performed an online survey with 2097 people participating in it. As a result, it was established that 61.9 % of the respondents always washed their hands, 58.2 % wore gloves, and 55.7 % wore masks. The authors detected a significant relation between sex and hand washing (p = 0.006) as well as sex and use of masks and gloves (p < 0.001). The results also revealed that use of gloves had a significant relation with education (p = 0.029) and material welfare (p = 0.011). Mask wearing also had a significant relation with the financial position (p = 0.032). Women were better in taking preventive measures. Overall, almost half of the respondents did not use any non-specific preventive measures against COVID-19 [25].

A study accomplished by Indian experts focused on estimating preventive measures against COVID-19 in treating patients at home. The results established that 15.3 % of the respondents had previously had COVID-19 and 82.2 % of them had been treated at home. Disposable face masks were worn uninterruptedly for 8 hours by 62.2 % of the respondents. A disposable mask was not always thrown away after it had become wet. Only 37.8 % of those who were taking care of COVID-19 patients wore gloves. The experts made a conclusion it was necessary to increase people's awareness about preventive measures. This could be done by introducing training programs for population [26].

The World Health Organization recommended healthcare workers to wear gloves during the COIVID-19 pandemic in case they

were taking direct care of patients. Medical gloves are made from variable materials including latex, nitrile rubber, polyvinylchloride, polyurethane, and neoprene. Nitrile and latex gloves are preferable due to their durability. Many negative skin reactions, including irritating contact dermatitis, allergic contact dermatitis and contact urticaria, were registered after using all types of gloves.

Healthcare workers often use latex gloves. Elevated sensitivity to latex made of natural rubber is becoming more and more significant. Between 2.8 and 17 % of healthcare workers were reported to have elevated sensitivity to latex gloves [27].

A study by T. Montero-Vilchez with colleagues aimed to estimate influence exerted by wearing a face mask and nitrile gloves on the epidermis barrier function and skin homeostasis. Thirty-four healthcare workers took part in the study; they all wore nitrile gloves and a face mask uninterruptedly for 2 hours. The experts estimated transepidermal water loss, the stratum corneum hydration, erythema, and skin temperature. As a result, it was established that transepidermal water loss, skin temperature and erythema were significantly higher on a spot covered by gloves than on an uncovered one. Transepidermal water loss, skin temperature and erythema were considerably higher on an area covered by a face mask whereas the stratum corneum hydration was lower. Transepidermal water loss was higher on an area covered by a surgical mask than on one covered by a respiratory mask with a filtrating face window. The experts concluded that skin homeostasis and the epidermis barrier function could be impaired by wearing gloves and face masks. Healthcare workers were recommended to use high-quality personal protective equipment and means for preventing skin diseases [28].

The necessity to use personal protective equipment during the COVID-19 pandemic affected the majority of people worldwide. Mandatory use of masks and gloves by population was introduced in different regions in the Russian Federation depending on an epidemiological situation. Russian experts accomplished sanitary-chemical laboratory tests of masks and gloves to identify chemical contents in them. Levels of analyzed chemicals in samples of all the examined masks did not exceed permissible levels. Cotton gloves and cotton gloves with coating turned out to contain formaldehyde in concentrations that were by 1.48 and 1.16 times higher accordingly than permissible ones. In addition, zinc was identified in cotton gloves with coating in concentrations being by 1.17 times higher than permissible levels. So, cotton gloves with coating had both formaldehyde and zinc in quantities higher than permissible levels. Formaldehyde in gloves can case negative skin reactions. Stricter control over glove production is necessary in order to prevent distribution of low-quality and dangerous items.

Bacterial contamination occurring on the inner surface of gloves used by transport workers was estimated in a study by Russian experts. They established a statistically significant increase in the CFU number after gloves had been used for two hours against the control samples ($p < 0.01$). Statistically significant differences in bacterial contamination of gloves after they had been used for a period between 2 and 12 hours were identified only in the group of workers who used cotton and knitted gloves ($p < 0.01$). The authors did not establish statistically significant differences in bacterial contamination of gloves after 2 and 12 hours of use ($p > 0.05$) [29].

Self-isolation during the COVID-19 pandemic was a temporary measure aimed at preventing the infection from rapid spreading. During the peak in the pandemic, billions of people had to remain at home due to introduced strict self-isolation. In Russia, the total number of people who had to be self-isolated reached 100 million people. All people who came to Russia from abroad had to maintain self-isolation.

In hygienic terms, self-isolation is a forced and long-term (longer than a month) period when a person should remain in an enclosed space keeping low physical activity and spending insufficient time outdoors.

Self-isolation involves hypodynamia, hypoxia, negative changes in eating habits and lifestyle, and psychoemotional burdens. Given that, vital sanitary-hygienic tasks to be tackled include performing sanitary-hygienic assessment of self-isolation and identifying priority risk factors causing non-communicable diseases.

The results of the study [30] made it possible to develop hygiene-based preventive measures aimed at minimizing risks during self-isolation. Low physical activity, hypoxia, nutrient deficiency (an imbalanced diet), and improper work and rest regimes are major sanitary-hygienic risk factors during self-isolation. The authors also developed a hygienic self-isolation index point score (HSIPS) considering the sanitary requirements to diets, work, rest and physical activity in the Russian legislation. Therefore, use of hygienic standards has certain advantages for health risk prevention both under routine conditions and extreme ones including self-isolation.

Experts from Great Britain carried out an online survey among adults (n = 8425; 44.5 ± 14.8 years). The task was to assess physical activity and mental health in the United Kingdom, Ireland, New Zealand and Australia after the governments in these countries introduced either self-isolation or mandatory remote work. Major indicators included a scale showing how mental behavior changed when a person was doing physical exercises. As a result, the authors concluded it was advisable to encourage physical activity during the COVID-19 pandemic and in the post-COVID period since it helps improve mental health and welfare. Men, young people and people with concomitant diseases should pay special attention to exercises [31].

The COVID-19 pandemic affects human health greatly as it changes routine lifestyle due to social distancing and self-isolation at home. This leads to social and economic outcomes including changes in lifestyle and eating habits. Experts from Italy investigated influence exerted by the pandemic on eating habits and lifestyles among people aged between 12 and 86 years (n = 3533). The performed questioning included anthropometric parameters (weight and height); data on eating habits; data on a lifestyle (food purchase, smoking, quality of sleep and physical activity). Weight growth was established in 48.6 % of the respondents; 3.3 % of the smokers decided to quit; there was a slight increase in physical activity, especially with its aim to reduce a person's weight [32].

Nutrition is a major health-determining factor that affects functions of all the mechanisms protecting the body from harmful environmental exposures. Correction of improper nutrition, including vitamin and micronutrient deficiency, has great significance for preventing and treating the new coronavirus infection COVID-19 [33]. Given that, nutrition guidelines have been developed for adults and children who have to stay at home under self-isolation or quarantine due to COVID-19. An information-reference contact-center was opened for timely communication and advice provided for population as regards optimization of nutrition; it has been functioning uninterruptedly since the opening. Activities aimed at preventing COVID-19 infection in food products are of the same importance. Preventive activities have been developed to limit the transmission of the new coronavirus infection through foods.

Z.D. Kifle with colleagues reported that an online survey of 348 Ethiopians revealed certain changes in consumption of some foods, regularity in having meals, duration of sleep, physical activity and psychoemotional strain. There was a significant decline in consumption of food that was not home-made, from 20.4 % to 13.4 % at ($p < 0.001$), growing food consumption (more than eight cups a day) from 11.5 % to 14.7 % ($p < 0.01$). Before the pandemic, only 4.9 % of the respondents had psychoemotional strain whereas the indicator grew up to 22.7 % during it. Six point three percent of the respondents had bad sleep before the pandemic but the share grew to 25.9 % during it ($p < 0.001$) [34].

The system of the sanitary-hygienic standards existing in the Russian Federation estab-

lishes certain requirements to people's diets, work and rest regime, and physical activity. It was used for developing hygienic criteria to assess self-isolation. Russian experts developed the hygienic self-isolation index including assessment of physical activity, a diet, psychoemotional burden, and some other indicators [3].

A.A. Antsiferova with colleagues estimated people's commitment to following recommendations to limit the spread of new coronavirus infection in the Russian Federation as a whole and some RF regions in the autumn–winter period 2020–2021. The authors performed an online survey with the total number of participants being 5537 people from 62 RF regions, including Moscow (n = 1157), the Ulyanovsk region (n = 735), the Irkutsk region (n = 595), the Omsk region (n = 452), and the Komi Republic (n = 408). The survey established that 97.3 % of the respondents used masks as a measure to limit the spread of the new coronavirus infection; 97.3 % often washed their hands; 71.1 % kept social distance; use of gloves was the least common measure (42.9 %). The respondents with higher education, both complete and incomplete, more often followed the recommendations on COVID-19 prevention including use of gloves (38.9 %) [35].

Experts from China estimated mental health of healthcare workers during a 4-week quarantine introduced in Hubei. Depression was established to become stronger in 17.9 % of the respondents and stress was identified in 13.7 %. Doctors and nurses were more susceptible to anxiety whereas other healthcare workers and medical students were susceptible to stress [36].

G. Barros [37] presented statistical data on influence exerted by the pandemic on students' mental health in different countries. The results indicated that negative mental outcomes had been growing among students during the COVID-19 pandemic. Most HEI students reported mental disorders that could be associated with lack of direct contacts with people due to switching to distance learning, quarantine and social distancing.

Housing environment is among major health-determining factors and the COVID-19 pandemic again highlighted it was important to analyze housing conditions. Insufficient spacing and absence of confidentiality might result in such mental disorders as anxiety and depression [38].

As people have to spend longer time indoors during the pandemic, they become more and more susceptible to indoor space environmental factors. Color of walls inside a dwelling does not only stimulate the human vision but also influences stress levels. Intense visual irritation changed occupants' mentality and this resulted in depression [39].

It is noteworthy that self-isolation in indoor environment at home can create new habits and lifestyles [30, 40].

Conclusions. In Russia, there is a reliable and effective state infrastructure of public healthcare. It made it possible to keep the pandemic situation under control from the first days. Introduced administrative, organizational, technical and sanitary-hygienic measures gave an opportunity to react adequately to the COVID-19 pandemic. Rospotrebnadzor implemented a set of activities that included there stages:

Stage 1. Preventive and sanitary activities;

Stage 2. Organizational and technical activities;

Stage 3. Organizational and preventive activities [41, 42].

The postulate of protecting by 'time', 'quantity', 'screen' and ' distance' is widely spread in the Russian hygienic science. It is commonly used in radiation hygiene and occupational hygiene and at present is entirely applicable within preventive activities aimed at limiting the coronavirus infection spread. The shorter a contact with an infection source, the lower a dose (the number of infectious agent particles per one cubic meter of air), the greater a distance from an infectious source, the lower is a risk of infection.

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