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Design and Fabrication of Two-Filter Nano SL Mask to Deal with Covid-19

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ABSTRACT

OBJECTIVE: These days, due to the spread of infectious diseases such as COVID-19 and influenza, as well as the increase in air pollutants, the use of a face mask has become a necessity.
METHODOLOGY: The technical field of invention is in the field of medical-health engineering. The present mask consists of 3 layers: from outside to inside, including Nano silk fabric, movable filter for peppermint essential oil (PEO) and silk cotton fabric, it makes COVID-19 disappear.
RESULTS: The use of a replaceable filter in the construction of the mask makes it washable and replaceable if contaminated, while re-washing existing masks to reuse them is incorrect; Because of the opening of the fibers in the mask and also changes in the physical and chemical structure, the mask loses its effectiveness and will have severe viral or microbial contamination. The use of a PEO filter in the construction of the mask has an effective role in treating pneumonia, strengthening the immune system and disinfecting. Also, the layers of the mask are new compared to the existing masks, especially in the adhesive part of the layers and its connections, and their impermeability to the virus is innovative and inventive.
CONCLUSION: By using this product, it is possible to take a big step in preventing COVID-19 and also to help move the economic wheels of the country. By implementing this plan, we can find a criterion for a suitable mask that for the first time the quality of the fabric mask is important in terms of filter interchangeability, wash ability, leakage and its filtering efficiency in the country.

Key Words: COVID-19, PEO, Filter, Mask.

INTRODUCTION

The widespread prevalence of the Coronavirus (COVID-19) has affected the vast majority of countries around the world. This COVID-19 pandemic began in Wuhan, China on December 31, 2019[1]. Some countries overcame this crisis with minimal damage by implementing timely and accurate policies, but some countries faced such damage and impact that it seems that the consequences will continue for years. The world health organization (WHO) named it a global pandemic on March 11, 2020 due to the rapid spread of the disease worldwide[2]. The course of any pandemic depends on a number of important factors such as initial reproduction rate, doubling or serial spacing, and mortality [3,4].

The aromatic plant mint, which is a native plant of Europe, is cultivated in most parts of the world today. Peppermint essential oil (PEO) is a combination of peppermint and mint water. Peppermint contains more than 40 distinct chemical compounds (including menthol, menthol and methyl acetate) and its safety has been proven in toxicological research[5]. PEO possesses a broad range of biological activities including, antiseptic, antibacterial, antiviral and antispasmodic [6,7].

Protective equipment plays an important role in preventing COVID-19, according to new research from the University of Oregon Health and Science (OHSU). According to this study, even ordinary surgical masks that do not have a filter can prevent doctors and nurses from getting COVID-19.The science of using masks by the general public to prevent the transmission of COVID-19 is advancing rapidl[8]. The World Health Organization has changed its recommendation on the use of masks and now says that people should wear masks in public places to prevent the spread of the corona virus[9,10]. However, with COVID-19, face masks may be helpful in protecting healthcare workers and the public[11].

According to most studies, mask can reduce the incidence of COVID-19(12). Therefore, all masks from simple surgical masks to N95 masks can be effective in this field. Proper use of a face mask can help reduce the prevalence of COVID-19 and protect dangerous groups from infection in a simple and inexpensive way[8]. About half of all infections are in people who have no symptoms and often do not know they are infected. They can spread the virus subconsciously when coughing, sneezing and talking, but if everyone has a mask, we can prevent up to 99% of these droplets from spreading to another person (Figure I). In the absence of a vaccine or antiviral drug, this is a proven way to protect others as well as yourself. Research has shown that, using a mask is very effective in fighting the flu and virus.

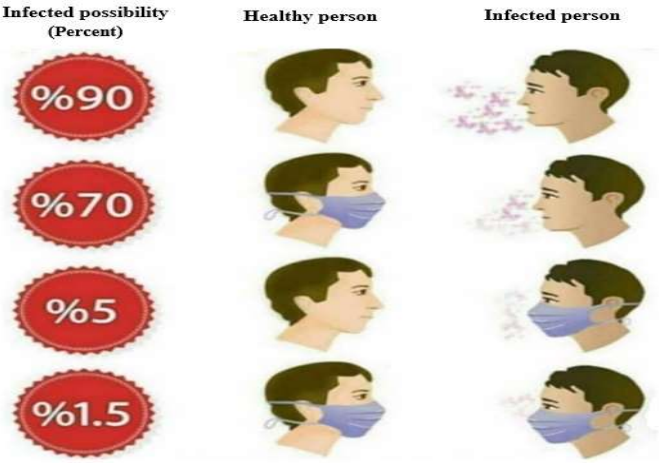
Meanwhile, research has been done on the positive and significant effect of PEO on improving athletic performance[13,14]. The effectiveness of PEO on perceived physical load, temporary workload, effort, augmenting cognitive performance and anxiety has also been studied[13,15]. The results of Memarbashi (2014), research showed, revealed significant improvement in all of the variables after oral administration of PEO. Physiological parameters also improved significantly after five minutes. Therefore, other results of the study indicated that there is a significant increase in grip force, spirometer and other parameters[16].

The based on different study designs, the protective effects of mask use in cluster randomized experiments and observational studies were significant[17]. Studies show that using a face mask reduces the relative risk of COVID-19 infection. For COVID-19, this evidence is of low or very low certainty because it is derived from observational studies with important risk of various biases, or indirect evidence from randomized studies of other respiratory viruses with methodological limitations[11].

PEO, and some other members of the mint family, may have effects on performance or health that you are unaware of[16]. The PEO improved performance, respiratory function, blood pressure, heart rate, and respiratory gas exchange. It also lowers blood pressure and resting heart rate. For example, PEO and mint has been shown to be an analgesic and has anti-inflammatory, antispasmodic and antioxidant effects. These effects are beneficial for performance, recovery and health. However, few studies have been undertaken to actually demonstrate the power of mint, until now.

Today, coronavirus has become a dangerous global disease, and we are witnessing the daily infection of many of our compatriots with this virus and the high death rate due to coronavirus disease. Given that there is a lot of right and wrong information about the type and material of the mask, not paying attention to them may increase the risk of coronavirus (COVID-19) disease. Many people think that using any mask, from cloth and handmade to medical and filtered, has the same effect on preventing coronavirus disease, which is a completely wrong and irrational belief. However, the commitment to use a face mask in public is a serious matter. On the other hand, the WHO has recommended that they use a mask in situations where it is not possible to observe physical distance or social intercourse (about two meters from others) (Figure 1). In this example, the problems of the previous masks have been eliminated and it is a suitable alternative in the market. The use of masks is now the most effective way to prevent COVID-19 worldwide.

FIGURE I: THE EFFECT OF THE SL MASK ON COVID-19



Now that COVID-19 is more and more lurking, everyone is looking to buy the right mask at the right price to reduce the risk of contracting the virus as much as possible. However, there is no mask that can be washed and a removable and replaceable filter. This invention aims to design a Nano antivirus mask with two removable and fixed COVID-19 filters, which combines cotton with silk (increasing the filter coefficient air) and was made of a special movable (replaceable) filter that has a preventive aspect. This mask is less polluting due to not using too much fiber that is harmful to the environment, if left in nature. In the unique design of this mask, it has been tried to reach international standards and in this respect, it will not have a competitor in the world. The mask introduced in this project is able as a suitable health-medical tool to meet the need of all patients for fresh air treatment and virus-free treatment. Easy to breathe, easy to use and high durability (washable without deformation) are the key features of this mask.

METHODOLOGY

Technical Field of Invention

With coronavirus prevalent in the community, everyone must prepare themselves to deal with it. Tips that everyone should follow: Regular hand washing of hands with disinfectants, avoiding hand contact with mouth, nose and eyes, as well as using masks in crowded places. The latter is especially important for the elderly and the sick. The technical field of invention is in the field of engineering-medicine-health.

Material and Methods

This mask consists of 3 layers, which are from the outside to the inside of the mask (Figure II, III): **Layer No. 1** (outer) of nano-silk fibers, **Layer No. 2** (middle) of Melet Blon filter is different with peppermint essential oil (PEO) with high particle absorption capacity, **Layer 3** (inner) of silk-cotton fabric acts as a physical barrier against the coronavirus.

FIGURE II: SL MASK BUILDING

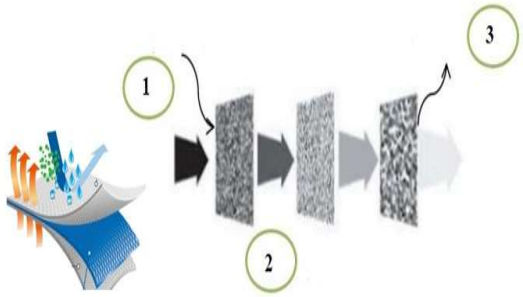
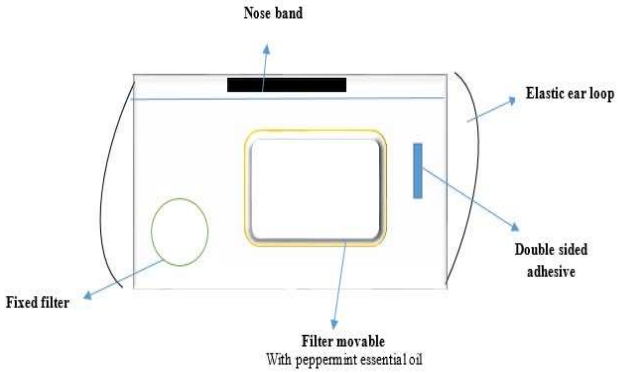


FIGURE III: SL MASK BUILDING



This SL mask to deal with COVID-19 consists of the following components:

- 2 filters (fixed and movable with PEO): The main role of the fixed filter is to prevent contaminants and viruses from entering the body, excessive sweating and exhalation. To strengthen the immune system and the therapeutic aspect of the mask, a moving filter impregnated with PEO made of Melet Blon has been used. This filter can filter at least 95% of very small particles and prevent them from entering the lungs.
- Nose band: To prevent leakage of air inside the mask, a special strap Nose band has been used.
- Elastic ear loop: A elastic ear loop has been used to hold the mask on the face.
- Double sided adhesive: Adhesive tape is used to hold the middle layer firmly and prevent the moving filter from coming out (Figure IV).

FIGURE IV: DOUBLE SIDED ADHESIVE

- Silk fabrics: A layer of Nano silk fabrics has been used to prevent the virus from entering the mask space and at the same time preventing the passage of very fine aerosol particles. This layer is known as the first defense barrier of the mask. Silk, on the other hand, acts as an electrostatic barrier due to its static electric charge.
- Cotton cloth: This layer can provide significant protection against virus transmission with airborne particles. A cotton like fabric with a compact texture acts as a physical barrier against the virus.
- Peppermint essential oil (PEO): Thus, this filter has an effective role in treating pneumonia, colds and flu, strengthens the immune system and disinfects, chest and flank pain, to relieve sore throat, reduce fever (Figure V).

FIGURE V: PEPPERMINT ESSENTIAL OIL

RESULTS

Leak test with mask designed

To test the impermeability of the adhesive of the layers and its joints, the edges, mask fibers of impermeable material were selected so that penetration is possible only through the adhesive of the layers and edges. In a static test, such a mask was mounted on the mannequin's face, and as the mannequin breathed, air could barely pass through the mask's pores, causing severe respiratory resistance, causing the mask to move up and down each time it was inhaled. This was a good sign of no leakage and impermeability of the adhesive layers and mask joints.

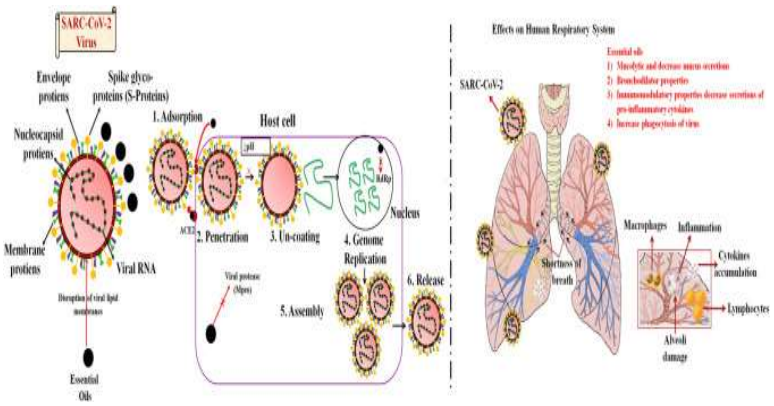
Therefore, before breathing, baby powder containing fine talc particles was sprayed around the mask to penetrate into the mask in case of leakage. After the mannequin breathed a few times, the mask and the surrounding area were first cleaned of powder. The mask was gently removed from the mannequin, and the adhesive tape placed inside the mask was removed for microscopic observation to examine the penetration of talc particles from the edges into the mask. We repeated this test several times and examined the adhesive tapes under a microscope each time. Talcum powder did not pass through the designed mask after installing the mask on the mannequin's face and creating inhalation and exhalation by the mannequin lungs, which can be a convincing reason for the mask not leaking.

The effect of PEO on the virus

Higher concentrations of PEO reduced viral titers of by more than 90%. Unfortunately, there are very limited approved drugs available with established efficacy against the SARs-CoV-2 virus and its inflammatory complications. Vaccine development is actively being researched, but it may take over a year to become available to general public. Certain medications, for example, dexamethasone, antimalarial (chloroquine/hydroxychloroquine), antiviral (remdesivir), and IL-6 receptor blocking monoclonal antibodies (tocilizumab), are used in various combinations as off-label medications to treat COVID-19. PEO have long been known to have anti-inflammatory, immunomodulatory, bronchodilatory, and antiviral properties and are being proposed to have activity against SARC-CoV-2 virus. Owing to their lipophilic nature, PEO are advocated to penetrate viral membranes easily leading to membrane disruption. Moreover, PEO contain multiple active phytochemicals that can act synergistically on multiple stages of viral replication and also induce positive effects on host respiratory system including bronchodilation and mucus lysis. At present, only computer-aided docking and few in vitro studies are available which show anti-SARC-CoV-2 activities of PEO. In this review, fabrication of two-filter Nano SL mask to deal with COVID-19 is discussed. A discussion on possible side effects associated with PEO as well as anti-corona virus claims made by PEO manufacturers are also highlighted. Based on the current knowledge a chemo-herbal PEO combination of the drugs could be a more feasible and effective approach to combat this viral pandemic.

In summary, data of in silico and in vivo animal models give a clue about the potential role of eugenol, menthol, and carvacrol in the treatment of COVID-19 but further studies designed to evaluate the anti-SARC-CoV-2 efficacies of these EOs are required[18]. Figure 6 depicts the effects of these discussed EOs on the host respiratory system as well as on viral and hosts' pulmonary cells.

FIGURE VI: THE PROPOSED ANTI-SARC-COV-2 ACTIONS OF ESSENTIAL OILS AND THEIR COMPLEMENTARY EFFECTS ON THE HUMAN RESPIRATORY TRACT



FINDINGS

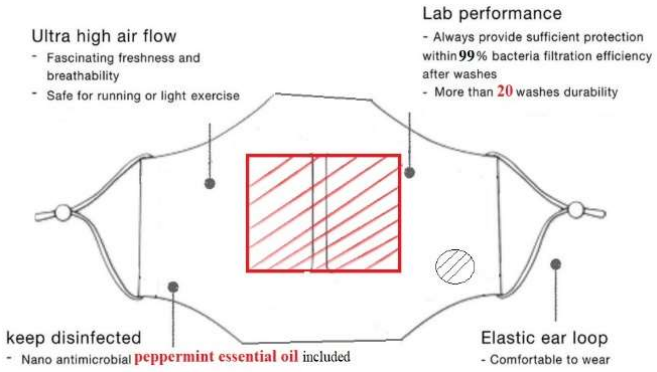
The findings showed that the use of surgical masks is not recommended in dusty environments, because this type of breathing mask cannot protect the lungs from dangerous contaminants smaller than 2.5 microns. But the unique design of the present mask has solved this fundamental problem (Figure VII). This means that the existing mask can be designed from all the different types of masks that have been produced to date and cause the consumer to be safe from the emerging COVID-19 virus. In this regard, it is necessary to use special masks with special filters and disinfectants that prevent the virus from passing. According to the WHO website, the use of masks prevents up to 95% of COVID-19 disease. The mask is introduced with a simple but functional building. This mask consists of 3 different layers, which are from outside to inside, respectively;

Layer 1 (outer) displays silk Nano fibers that act as the first defense barrier to the mask, when a person with coronavirus disease sneezes or coughs up relatively large saliva particles, 1.5 mm in size and 1.5 to 2 m in radius. Scattered around, located. Particle filtration coefficient above 300 nm for silk fabrics is more than 90%. Also, due to the Nano-filaments in their building, they prevent suspended particles and dust from sticking to it.

Layer No. 2 (middle), which achieves the main purpose of using the mask, is a Melet Blon -filter with interchangeability with high particle absorption capacity. The mechanism of action of this process is as follows: According to scientists in various articles, the corona virus has a membrane of lipids or fats around its genetic contents, the only known way to eliminate this virus is the complete destruction of the protective layer. Be. Therefore, the reason for using a Melet Blon -replaceable Nano-filter is that after the virus hits the existing filter, the fatty acid molecules, which consist of a hydrophilic head and a hydrophobic tail, begin to move towards the virus membrane. The hydrophobic or lipophilic tail of these molecules then surround the virus as a sphere and attach to the coronavirus lipid membrane, preventing it from entering the body. This layer is able to trap 99% of airborne particles depending on the size of the filter particles.

Layer 3 (inner) is made of cotton silk fabric, which can provide significant protection against virus transmission with airborne particles. A cotton-like fabric with a compact texture acts as a physical barrier against the virus; Silk, on the other hand, acts as an electrostatic barrier due to its static electric charge.

FIGURE VII: BUILDING AND BENEFITS OF THE SL MASK



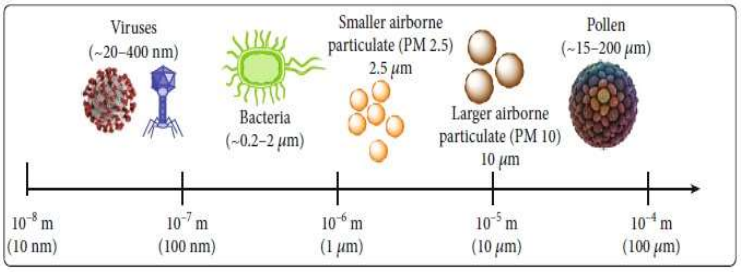
A summary of the problems of masks available in the market is as follows:

- In the existing fabric masks, in addition to the weak permeability of the fibers, the amount of leakage from the edges of the mask, especially from the side of the nose and from under the chin, has reduced its efficiency. Also, talking, laughing, yawning and even small movements of the facial muscles can cause polluted air to penetrate into the mask, which is not preventable in any of the cloth masks on the market, and as a result, the air is not well filtered.
- Lack and cost of N95 mask and other medical masks
- In the existing fabric masks, in addition to the weak permeability of the fibers, the amount of leakage from the edges of the mask, especially from the side of the nose and from under the chin, has reduced its efficiency.
- Lack of mask with which a separate filter can be used.
- Sweating inside the mask
- Do not replace existing mask filters.

DISCUSSION

As the COVID-19 becomes a global pandemic, it has many economic and human consequences[19] this virus affecting almost every country in the world, is therefore expected to pass the global economy by 2021 with a significant recession. The size of pollutants in the air is very different (Figure VIII), the size of SARS-CoV-2 is from 60 to 140 nm (20). Particles between 10 nanometers and 10 microns enter the lungs through respiration, so covering the mouth and nose is essential to prevent suspended particles from entering the lungs.

FIGURE VIII: DIAGRAM OF THE RELATIVE SIZE OF POLLUTANTS AND COMMON PATHOGENS IN THE AIR



The best no pharmaceutical interventions against COVID-19 disease, proper use of masks and social distancing are two measures that many countries have always considered to prevent the spread of coronavirus[21,22]. "Social distancing" is a term used for some non-pharmacological infection control measures used by public health authorities to stop or slow the spread of highly contagious diseases and they have even considered crimes if these points are not observed. Using a mask in daily interactions reduces the risk of COVID-19. Because COVID-19 is transmitted through sneezing, coughing, or talking from a close distance (social intercourse) to a healthy person; Viruses are transmitted from person to person through droplets that are spread through the respiratory tract when sneezing and coughing. Masks can prevent the transfer of large droplets that are released into the air after sneezing and coughing. This means that the use of health masks is not useless[23]. The COVID-19 has led to a shortage of face masks worldwide, leading people to produce masks from home appliances. Today, due to the lack of masks, it is possible to use fabric and home masks in public spaces. Therefore, cloth and washable masks approved by the Ministry of Health can reduce household costs. However, not all fabrics have the same level of inhibitory and air filtering power and are not capable of filtering droplets of virus. Because when a person with COVID-19 disease sneezes or coughs, they scatter relatively large saliva particles, about 1.5 millimeters in diameter, with a radius of 1.5 to 2 meters. According to Sputnik, citing research by the ACS Publishing website, the best property of household masks made of composite fabrics, for example, cotton from a kind of silk fabric, flannel cotton. The ability of the mask to filter particles not only depends on the material and type, but it is also important how it covers your mouth and nose, however, the comfort and breathability of the user varies in different models of masks available in the market[19].

Peppermint essential oil (PEO) are very popular with the public too, on the other hand, aromatherapy is one of the processes that is considered in complementary medicine to maintain patients' mental health. The anti-inflammatory properties, antimicrobial properties of PEO are very strong, useful and naturally lowers fever. Also, PEO has been shown to have good physiological effects on the body[14]. In fact, a number of studies have shown that the fragrant odors of PEO have, antiviral, anti-inflammatory, and

immune modulatory properties psycho-physiological effects and proved that they can bring fast relief from stress and ease emotional difficulties[18,24]. In fact, a number of studies have shown that PEO fragrances have psycho-physiological, anti-viral, anti-inflammatory, and immune-modifying properties, and have proven that they can relieve stress and reduce emotional problems[25].

Some existing health factors and mental states can impair the full functioning of the immune system. PEO can support the body's immune response[16,26]. As has been proven viruses are sensitive to PEO[27]. The filtering capacity, and hence the level of protection against pollutants and pathogens, depends on the materials used and the engineering design[28,29]. In the current situation where we are witnessing an increase in the number of cases and deaths in the world and the possibility of contact with infected or asymptomatic infected people in the community has increased, we should avoid attending communities as much as possible. The use of a mask can prevent a healthy person from becoming infected and prevent others from becoming infected by preventing the virus from spreading to asymptomatic patients or patients who have not yet developed symptoms. Scientific articles show that using a mask reduces the risk of transmitting the virus by about 25 percent and keeping a physical distance of about two meters by about 80 percent.

At least one year after the outbreak of COVID-19, the use of masks as a protective layer against the prevention and spread of the COVID-19 plays an important role. The main purpose of this mask is to solve the problem of masks on the market that have already been introduced Then we designed and invented, two-filter Nano SL mask to deal with COVID-19 as an alternative to commercial masks. The Nano SL mask discussed research advances in the development of materials with improved filtering capacity and antimicrobial activity. Because, the use of a replaceable filter in the construction of the mask makes it washable and replaceable if contaminated, while re-washing existing masks to reuse them is incorrect; Because of the opening of the fibers in the mask and also changes in the physical and chemical structure, the mask loses its effectiveness and will have severe viral or microbial contamination. The use of a PEO filter in the construction of the mask has an effective role in treating pneumonia, strengthening the immune system and disinfecting[30-32]. Also, the layers of the mask are new compared to the existing masks, especially in the adhesive part of the layers and its connections, and their impermeability to the virus is innovative and inventive (Figure IX). By using this product, it is possible to take a big step in preventing COVID-19 and also to help move the economic wheels of the country. By implementing this plan, we can find a criterion for a suitable mask that for the first time the quality of the fabric mask is important in terms of filter interchangeability, wash ability, leakage and its filtering efficiency in the country.

FIGURE IX: THE FINAL SHAPE OF THE SL MASK

The first application of the mask in urban life is infected with the COVID-19 virus and is the second application in the medical industry. To produce this mask, large and expensive devices or special technology are not needed and it can be produced by the simplest devices in different organs and can be reached by people in the shortest possible time. This design can also be implemented by all manufacturers of cosmetics, medical devices, clothing and fabrics. The use of the proposed product, as mentioned, is to protect the health of the community against COVID-19 and protects consumers from the risk of contracting this disease by protecting them.

CONCLUSIONS

In general, it can be concluded from recent research by scientists that although respiratory transmission and contact with its secretions is the most well-known way of transmitting the virus, but given the widespread prevalence of the COVID-19 and its presence in different clinical specimens, Other ways of transmitting the disease require further studies and, of course, use a mask, full observance of the principles of distance in social life and in contact with suspects or infected people before accurately identifying other ways of transmission.

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AUTHOR CONTRIBUTIONS

Pashaie S: Concept & main contributor
Fişne M: Analysis
Habibpour R: Analysis

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