

SARS-CoV-2: Relazione Scientifica

ABSTRACT

After having hit China hard in the first months of 2020, the COVID-19 epidemic exploded in Italy and in all the major Western nations, causing serious demographic, economic and political-social damage. This contribution is the result of the collection of data and information to provide clarification from the origin of the virus, to its spread, to the containment measures and solutions for the future. Understanding therefore what causes the expansion of a pandemic and what its origin is, also helps to understand the falsity and / or truthfulness of the information that is spread through the main communication tools that the entire world population has had to deal with. Finding information in scientific literature also helps to deal with any other pandemic situations that may affect our planet and guarantee a key to success for a solution that is as effective as possible.

INTRODUCTION

In December 2019, a new Coronavirus in China causes a series of cases of pneumonia in people who had frequented the Whuan fish market [1]. This virus spreads rapidly to numerous other countries to such an extent that in February 2020 the WHO defines Covid-19, the disease triggered by this Coronavirus [2,3] and on 11 March 2020 declares the pandemic. The virus that causes Covid-19 is a virus of the genus of Beta-coronaviruses and of the SARS-CoV (Severe Acute Respiratory Syndrome-related Coronavirus) species, therefore it is defined as SARS-CoV-2 (Fig.1)

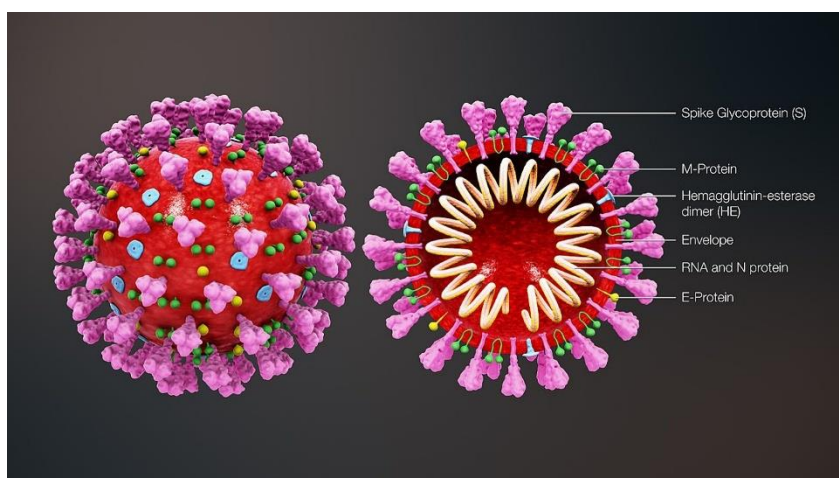


Figure 1. SARS-CoV-2 structure

Coronaviruses have a rounded morphology and dimensions of 100-150 nm in diameter. The SARS-CoV-2 shows projections on its surface, it is the Glycoprotein S ("spike"). The main differences of this new Coronavirus compared to the SARS virus seem to be located precisely in this spike protein. In fact, glycoprotein S is the one that determines the specificity of the virus for the epithelial cells of the respiratory tract, making it able to bind the ACE2 receptor (angiotensin converting enzyme 2), expressed by the cells of the capillaries of the lungs. [2]. In the world in May 2020, the cases infected by Covid-19 amounted to 4,477,351 and the deaths from Covid-19 were 303,389 [3]. The SARS-CoV-2 virus therefore appears to have an inter-human transmission and the main route of transmission is through droplets produced following coughing, sneezing. A route of transmission by contact with contaminated surfaces has also been demonstrated. In particular, the virus was found alive for up to 72 hours on steel and plastic [4]. Studies confirm the need for great attention to hand hygiene and to avoid touching the face, eyes, nose and mouth [5-7]. The incubation time of the infection varies from 2 to 14 days with a median of 5 days [8]. A possibility has also been described for asymptomatic individuals to transmit the virus during the incubation phase, making SARS-CoV-2 decidedly more insidious [9-10]. The death rate related to Covid-19 is not easily identifiable. In particular, it was reported that, in China in February, it stood at around 2.3%, while in Italy it reached 7.2% in March. Probably this disparity could be related to the actual presence of an older population in Italy and more predisposed to developing more serious cases of the disease [11]. In fact, mortality in Italy in the population group between 70-79 years is 25.4% and in the group between 80-89 years it is 30.7% [12], as shown in Table 1.

TABELLA 1

*Tasso di letalità in Italia
nelle varie fasce di età.*

Fascia di età	Deceduti (%)	Letalità (%)
0-9	0	0,2
10-19	0	0
20-29	0	0,1
30-39	0,2	0,3
40-49	0,9	0,9
50-59	3,6	2,7
60-69	10,5	10,4
70-79	27,8	25,4
80-89	40,8	30,7
>90	16,2	27

SARS-CoV-2 DIFFUSION: from China to the rest of the world.

On December 31, 2019, the first cases of infection caused by the new coronavirus SARS-CoV-2 (initially called 2019-nCoV) were recorded in Wuhan, the metropolis of the Chinese province of Hubei. Epidemiological data from Chinese health authorities confirmed direct human-to-human transmission and this prompted the Chinese government to initiate extraordinary measures to contain the infection, quarantining Wuhan and other cities where the outbreak was spreading. Thanks to these measures, most cases remained confined to Chinese territory until the end of January. The initial trend of the epidemic seemed to exclude the risk of spreading outside China or neighboring countries, but the facts soon disproved these predictions. On January 30, 2020, the SARS-CoV-2 infection was declared by the WHO a Public Safety Emergency of International Concern (indicated by the English acronym PHEIC). On February 18, 2020, the first secondary transmission in Italy was recorded in Codogno, Lombardy, i.e. a patient whose case was not attributable to a trip to Asia and who must therefore have been infected on Italian territory. In confirmation of the fact that the virus now circulated freely in our country, a second outbreak was discovered shortly after also in Vo', in the Veneto region. [13]. Nine months after the first COVID-19 cases recorded in Wuhan, over 33 million people worldwide have contracted the SARS-CoV-2 virus and over 1 million people have died from the COVID-19 pandemic (Fig. 2).

Figure 2. COVID-19 Dashboard by the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University (JHU).



ORIGINS OF SARS-CoV-2

The hypotheses circulating through the network are many: they range from natural theories to conspiracy theories, to those of errors committed in the laboratory. Through an in-depth analysis of the scientific literature on the subject, several authors have examined two possible scenarios, concerning the origins of SARS-CoV-2, temporally placed before and after the species jump from animal to man:

1. natural selection in a host animal (bat or pangolin) before the species jump. The new coronavirus has probably gone from animals to humans at the Wuhan meat market. There is a high homology between the SARS-CoV-2 RNA sequence and that of the bat coronavirus itself. The only difference between the spike protein of SARS-CoV-2 and that of the bat is the greater ability of the new coronavirus to penetrate the human body, infecting it. The pangolin, a species of anteater, also possesses a coronavirus similar to SARS-CoV-2. This is therefore the evidence that clearly explains how the spike protein responsible for Covid-19 is the result of natural selection.
2. natural selection in humans after the leap of species. It is possible that a coronavirus "ancestor" of SARS-CoV-2 has introduced itself into the human genome, adapting as it was transmitted from human to human through genetic mutation events to the point of triggering the pandemic. Only by studying a large number of cases in humans will it be possible to understand when this leap of

species or this mutation took place. Therefore, various retroactive serological studies can also be very useful to understand when humans started being exposed to SARS-CoV-2. [14].

SYMPTOMS AND DIAGNOSIS OF SARS-CoV-2

SARS-CoV-2 presents itself as a fairly variable disease. In fact there are conditions of asymptomatic patients, up to severe conditions, usually causing interstitial pneumonia and the presenting symptoms tend to be represented by fever, asthenia, dry cough, dyspnoea, sputum production and myalgia. Fever, as represented by several studies, appears to be a very common symptom of Covid-19 infection [15-16]. Other symptoms that may be encountered are gastrointestinal ones, such as diarrhea, nausea, vomiting and abdominal pain [17], changes in taste and smell [18]. Based on the severity of the symptoms, the management of patients is decided, asymptomatic patients or patients with mild symptoms must be managed at home, while those with a protracted and severe infection are hospitalized, which can take the drug administration up to hospitalization. in T.I.N.

The most used drugs are:

- Chloroquine and hydroxychloroquine, a drug widely used in the last 70 years, basically as an antimalarial drug, is a drug with an anti-inflammatory and immunosuppressive effect.
- Lopinavir is an antiretroviral used in HIV therapy.
- Remdesivir, is a nucleotide analog that is incorporated into the nascent viral RNA chain.
- Tocilizumab, is a humanized recombinant monoclonal antibody.

The severity of the disease and the variability of symptoms also depend on some risk factors that make a subject more or less vulnerable. Among these, age is a parameter widely taken into consideration. In fact, with increasing age, the hospitalization rate and the mortality rate increase.

Other risk factors are represented by [19-21]:

- cardiovascular diseases,
- diabetes mellitus,
- hypertension,
- chronic lung diseases,

- obesity,
- cancer;
- smoke;
- male sex.

As regards the diagnosis, the Ministry of Health, following the indications of the WHO, defines that the diagnosis of SARS-CoV-2 can only be carried out by detecting the virus on a nasopharyngeal swab using the RT-PCR method for amplification of the viral genome. The diagnosis of COVID-19 is based on "Real Time PCR" protocols for SARS-CoV-2 approved by the World Health Organization, where Real Time PCR indicates a particular molecular analysis technique that allows to search for the genetic material (genome) of the virus within a sample [22].

PREVENT INFECTION FROM SARS-CoV-2

Following the declaration by the O.M.S. of the pandemic state, the various countries around the world have taken various decisions, partly common, for the containment and prevention of the infection by Sars-CoV-2. In particular, the Italian Government, in collaboration with the Higher Institute of Health, has drawn up a series of hygiene rules to prevent contagion, such as [23]:

1. Wash your hands often. In the event that soap and water are not available through the use of hydroalcoholic solutions;
2. Avoid close contact with people suffering from acute respiratory infections.
3. Avoid hugs and handshakes.
4. Maintaining an interpersonal distance of at least one meter in social contacts.
5. Sneeze and / or cough into a handkerchief avoiding hand contact with respiratory secretions.
6. Do not touch your eyes, nose and mouth with your hands.
7. Clean surfaces with chlorine or alcohol based disinfectants.
8. Use the surgical mask or FFP2 or FFP3 in public places, hospitals and work places.

VACCINES

The vaccination campaign to deal with Sars-CoV-2 began on 31 December 2021.

Only some vaccines have been authorized by the EMA and AIFA.

Currently the following vaccines have been authorized in Italy:

1. Pfizer-BioNtech's Comirnaty vaccine - is the first vaccine to be authorized in the European Union: on 21 December 2020 by the European Medicines Agency (EMA) and on 22 December by the Italian Medicines Agency (AIFA).
2. Spikevax vaccine (Moderna) - on 6 January it was authorized by the EMA and on 7 January by AIFA.
3. Vaxzevria vaccine from AstraZeneca - on 29 January it was authorized by the EMA and on 30 January by AIFA.
4. Vaccine Janssen (Johnson & Johnson) - on 11 March it was authorized by the EMA and on 12 March 2021 by AIFA
5. Nuvaxovid vaccine (Novavax) - on 20 December it was authorized by the EMA and on 22 December by AIFA.

All vaccines currently under study have been developed to induce a response that blocks the Spike protein and thus prevents cell infection. COVID-19 mRNA vaccines approved for the vaccination campaign use messenger ribonucleic acid (mRNA) molecules that contain instructions for the vaccinated person's cells to synthesize Spike proteins. The proteins produced stimulate the immune system to produce specific antibodies. In those who have been vaccinated and are exposed to viral infection, the antibodies thus produced block the Spike proteins and prevent their entry into the cells.

Vaccination also activates T cells that prepare the immune system to respond to further exposure to SARS-CoV-2.

The vaccine, therefore, does not introduce the actual virus into the cells of the vaccinee, but only the genetic information that the cell needs to build copies of the Spike protein. If, at a later time, the vaccinated person comes into contact with SARS-CoV-2 again, their immune system will recognize the virus and be ready to fight it.

Therefore the vaccine mRNA does not remain in the body, but degrades shortly after vaccination [24-24].

CONCLUSIONS

In the present research work we wanted to highlight the fundamental characteristics of Sars-CoV-2, in order to increase our skills in the field and to be able to understand and better deal with any future pandemic risk situations in the future.

The paper contains only a small part of what really concerns the scientific field on the subject and the literature is therefore constantly evolving.

On March 31, 2022, the state of emergency in Italy for Covid-19 ended, but the solutions and compliance that must be adopted in the future are still uncertain. The government will have to take decisions gradually following the evolution of the pandemic situation which is currently under control but not over.

As for the near future, a plausible scenario could be that of having to carry out an annual vaccination booster to continue the protection given by the anti-Sars-CoV-2 vaccine to the population that has undergone the correct vaccination cycle.

We can therefore conclude that Sars-CoV-2 is currently still circulating among the world population with a rather high contagiousness index and with a lower mortality index both as a result of the vaccination campaign and due to medical-scientific knowledge about the virus itself.

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