

REVIEW

Busting Myths about SARS-CoV-2 Viral Pandemic to Non-medical Personnel

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ABSTRACT

Background: During these moments of anxiety, fear and to some extent despair, it is imperative for everyone to have access to the right information. This can be achieved through breaking down the science and medical terminologies used to express the scenarios emanating from the COVID-19 pandemic. **Forward:** This commentary focuses on the most asked questions that, when not answered with scientific grounds to convince the non-medics can result in non-science based “infodemics”. The brief history behind COVID-19 pandemic, the science of SARS-CoV-2, the taxonomies used, a brief on the Pathophysiology of SARS-CoV-2, the genetic make up, most vulnerable individuals, antibodies against COVID-19, mother to baby transmission, conspiracy theories regarding the virus being weaponized, mutations occurring with SARS-CoV-2 and reoccurrence of COVID-19 in the future are all explained at great length. The review made references to the existing publications regarding this pandemic. **Conclusion:** While the science regarding this virus is not exhausted, we confirmed that, the knowledge gap between non-medics and medics is wide. The results emerging from the pandemic to form data are questionable, so it is our collective responsibility to fight against this virus in order to stop further spreading by providing the right information to the public. If we would not come together to fight and win this battle, we might be witnessing many large cities turning into emerging epicenters of COVID-19.

1. Introduction

January 9th, 2020, the Chinese Center for Disease Control and Prevention (CDC) formally confirmed to the Wall Street Journal that, a novel coronavirus (CoVs) previously unknown to science has been reported to be responsible for an outbreak of respiratory illnesses.

This emerging public health concern at the time will later be responsible for the first coronavirus pandemic^[1,2]. Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) that causes coronavirus disease 2019 (COVID-19) is responsible for the current pandemic, which is affecting lives in various ways. The virus was first isolated in patients seen in Hubei province, Wuhan, China who were

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found to have pneumonia. The cluster of pneumonia cases were seen in patients who were suspected to have links to a seafood market. This led to the closure and decontamination by the Chinese officials^[3]. The World Health Organization (WHO) officially declared COVID-19 epidemic as a public health emergency of international concern (PHEIC) on January 30th and passengers with travel links to Wuhan are being subjected to screening^[4]. A group of Chinese scientists on the 7th of January 2020, rapidly isolated the SARS-CoV-2 a β -coronavirus from a patient within a short time frame and subsequently genome sequencing was done for the global scientific community to join the science behind the new enemy of humanity^[5].

This devastating pandemic has called for an urgent and highly professional containment measures to limit physical, mental and socio-economic problems. The expertise ranges from emergency response which includes, case detection, quarantine and isolation to the need for a more extensive evaluation of diagnostic capacities and preparedness, in anticipation of any disease epidemic^[6,7]. Despite the previous outbreaks and the fatal outcomes associated with, evidence gathered from the media has it that, people around the world are seemingly not taking this pandemic gravely. More than 1 million of people lost their lives to this enemy already and more lives are claimed daily due to complications caused by the disease. Economies and different sectors, which are essential for basic living are also impacted hugely. Therefore, it is crucial to break the medical information to non-medical personnel. This will enhance adequate measures to prevent further damages to lives. Suffice it to say that, the need to shed more light on the fundamentals of this disease and to dispel the many conspiracy theories associated with the pandemic to the non-medical personnel will go a long way in saving many precious lives and also have a minor impact on the socio-economic activities of the world.

2. History of SARS-CoV-2 Pandemic

On the 12th December 2019, initial cases of COVID-19 were discovered in Wuhan, a province in China. However, the origins of the pandemic of the unknown acute respiratory tract infection has no scientific proof as speculations related it to the seafood market in Wuhan. Despite the studies whose conclusions stood as the potential reservoir of SARS-CoV-2, until today there is no scientific evidence that, the virus is contracted from the seafood market^[8]. In addition, based on the virus's genome sequencing that gave 96.2% overall genome sequence similarity between this novel virus and Bat CoV RaTG13, thus making it fit to share same possible

ancestors. It is important to note that, bats are not found in this seafood market in Wuhan. Furthermore, protein sequence alignment and phylogenetic analysis proved possible alternative intermediate hosts, such as pangolins, snakes and turtles. This is based on the similarities of receptors that are observed in many of these species^[9].

3. Novel SARS-CoV-2 Virus

To many, the SARS-CoV-2 causing COVID-19 is totally a new virus. However, this is just the newest form emerging from the coronavirus (CoVs) family and the first coronavirus to be responsible for a global pandemic. There are two other CoVs that emerged as novel coronavirus, causing epidemics and claimed lives previously. SARS-CoV, which emerged in China killed 916 out of 8422 confirmed cases (10.87%) and spread across 32 countries. MERS-CoV infected 2496 and claimed 868 (34.77%) lives while crossing boundaries of 27 different countries. Prior to these two super-spreading viruses, coronaviruses were studied as having a low potential for community transmission. The big family of CoVs are divided into four genera alpha, beta, gamma and delta (α - β - γ - δ -CoV). The first two infect mammals including humans and the last two are found to infect birds. Prior to this novel β -SARS-CoV-2, six CoVs have been identified and apart from the β -CoVs, SARS-CoV and MERS-CoV that caused potentially fatal respiratory tract infections, low pathogenicity induced CoVs strains that caused mild symptoms, very similar to common cold were identified. If interest will rise on studying coronaviruses, these are α -CoVs HCoV-229E and HCoV-NL63, and β -CoVs HCoV-HKU1 and HCoV-OC43^[10].

The newest member of the family, that is devastating the world, started at the end of 2019 through 2020 and now has gained a pandemic status. This is affecting daily activities of living and causing socio-economic crises while claiming lives of many is called severe acute respiratory syndrome virus 2 or SARS-CoV-2 and it was first discovered in a city called Wuhan in central China. The outbreak occurred exactly when the world's largest migration (Chinese lunar new year spring festival) was happening. Meaning extreme high air and train traffics came along with the virus^[11]. That is the reason behind its rapid spread across the globe and despite low fatality compared to diseases caused by both SARS-CoV and MERS-CoV. As of April 21st according to worldometer, the virus had claimed the lives of 170,439 and infected 2,481,528 globally. While the recovery rate is 79% and the death rate is 21% making a case fatality rate of 0.069%. It is important to note that, these figures might not directly represent the true picture of the fatality of the virus as

the data is only based on cases that received an official diagnosis. Some of the asymptomatic cases would never present to a health care facility for diagnosis, therefore they will not be part of the statistics.

The scientific evidences have gathered that this novel coronavirus is more contagious compared to its other family members. In addition, it has diverse epidemiological and biological characteristics, which makes it possible to infect many people in a short duration of time^[11]. The virus is enveloped non-segmented positive-sense RNA virus (subgenus sarbecovirus, Orthocoronavirinae subfamily).

4. The Taxonomy of SARS-CoV-2 and COVID-19

On the 11th February, 2020 WHO officially named the disease caused by this novel virus as coronavirus disease 2019 (COVID-19). The virus is named as Severe acute respiratory syndrome virus 2 or SARS-CoV-2 by the Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses (ICTV) due to its 89% nucleotide identity with bat SARS-like-CoVZXC21 and 82% with that of human SARS-CoV^[11]. The word *coronam* is the Latin term for crown, due to the presence of spike glycoproteins on the envelope in the subfamily *Orthocoronavirinae* of the *Coronaviridae* family (order *Nidovirales*). According to WHO, it is important to name diseases to enable discussions on prevention, spread and transmissibility, severity and treatment. And also these names were chosen to avoid stigmatizing the virus's origin in terms of geography, populations or animal associations.

5. A Brief Summary on the Pathophysiology of SARS-CoV-2

COVID-19 infect the body by holding onto receptors and entering healthy cells. Receptors are proteins on the surface or inside of cells which is able to recognize chemical substances, viruses and drugs for example). Once inside the cell, the virus makes copies of itself and multiplies throughout the cells in the body by making new proteins leading to formation of new viruses. The novel coronavirus uses the same receptor as that of the SARS-CoV, and mainly spreads through the respiratory tract it can gain entry into the body through the eyes, nose, or mouth. It then enters the cells by using its spikey surface proteins to attach to receptors on normal cells, especially those in the airways. The angiotensin-converting enzyme 2 (ACE2) found in abundance in the human's lower respiratory tract, is known as the cell receptor for SARS-CoV which causes SARS^[12] and also regulates both cross-

species and human-to-human transmission^[13].

This viral entry was reported, when they isolated COVID-19 from the bronchoalveolar lavage fluid, and they confirmed that the SARS-CoV-2 uses the same cellular entry mechanism (ACE2) as SARS-CoV^[14]. The CoVs S protein mediates the entry of the virus into host cells^[15], then receptor-binding domain (RBD) within the S1 domain facilitate binding to host cell receptor and S2 domain facilitate the viral fusion between host cell membrane and viral membrane which is an essential part in the entry of CoVs into host cells^[16,17]. Once inside, the coronavirus hijacks the healthy cells and takes over command. Eventually, they kill some of the healthy cells and new viruses will infect other healthy cells and this goes on and on since it is in control of the genetic mechanism of the cells.

As the infection reaches the lower respiratory system, including the lungs, breathing becomes difficult. This is when more serious medical problems can develop, problems like pneumonia. This makes the airways swell and the lungs fill with fluid. In the most severe cases, this fluid in the lungs can lead to acute respiratory distress syndrome, or ARDS. People with ARDS are usually already hospitalized. ARDS makes it difficult or impossible to breathe because the lungs are grossly inflamed making gas exchange with the breathing in of oxygen and expulsion of carbondioxide as a waste product difficult leading to suffocation of tissues. As fluid collects in the lungs, they carry less oxygen to the blood. That means the blood may not supply organs with enough oxygen to survive. This can cause organs like the kidneys, lungs, and liver to fail and stop working leading to multi organ failure and eventually death^[16].

However, it is important to mention that not everyone who gets infected with COVID-19 will develop serious complications needing hospital admission and advanced medical attention. Asymptomatic and mild cases may need supportive treatment at home or at an isolation center.

6. The Genetic Make Up of SARS-CoV-2

This virus is an enveloped positive single-stranded RNA (ssRNA) from the coronavirus family. The open reading frame (ORF 1a/b) encodes 16 non-structure proteins (NSPs) and two-thirds of the viral RNA mainly located in the (ORF 1a/b). The rest of the viral genome encodes for essential structural protein such as spike (S) glycoprotein, matrix (M) protein, nucleocapsid (N) protein, small envelope (E) protein and several accessory proteins^[13]. The virulent factor that enables SARS-CoV-2 to binds to host cells receptor angiotensin-converting enzyme (ACE2) and enter in the host cells is S glycoprotein. Receptor-

binding domain (RBD); heptad repeat (HR) 1 and 2. What is yet to be clear until today, is the possible molecules facilitated membrane invagination for SARS-CoV-2 endocytosis. Like many “self and nonself” mechanisms occurring, host factors (Lower panel) influences susceptibility to infection and disease progression^[19].

7. People Most Vulnerable to SARS-CoV-2

Risk factors for severe COVID-19 includes and is not limited to advanced age, immunocompromised state, diabetes, cardiovascular disease including hypertension, chronic pulmonary disease, chronic kidney disease, liver disease, cancer and severe obesity^[20]. Everyone is at risk but the groups mentioned with underlying health problems are at greater risk due to weak immune systems and dysfunctions in various organ systems of the body. Smoking, to date, has been assumed to be possibly associated with adverse disease prognosis, as extensive evidence has highlighted the negative impact of tobacco use on lung health and its causal association with a plethora of respiratory diseases^[21]. Previous studies have shown that smokers are twice more likely than non-smokers to contract influenza and have more severe symptoms, while smokers were also noted to have higher mortality in the previous MERSCoV outbreak^[22,23]. Smoking cigarettes increases viral receptors on the respiratory surface, which might explain the increase in deaths in smokers reported by early researches on the disease.

It is noteworthy that, infants and children have not been featured prominently in COVID-19 case statistics. Despite the global pandemic of COVID-19, the clinical patterns and epidemiological findings remain unclear, especially among these groups. According to reports on COVID-19 among Chinese children in Wuhan, compared to adults, children were less likely to be infected and to have a severe illness, but they are still at risk from this pandemic. A nationwide study of 2143 COVID-19 pediatric patients conducted between January and February 2020 by the Chinese Center for Disease Control and Prevention, reported that all children of all ages were susceptible to COVID-19 without significant gender difference. Moreover, the severity of clinical manifestation among children infected with SARS-CoV-2 was generally less severe compared to adult patients and infants that were vulnerable to infection^[24].

Another analysis from China also saw that, children younger than 10 years account for only 1% of COVID-19 cases^[25], similar to the proportion for SARS-CoV and MERS-CoV epidemics^[26,27]. Infants and young children are typically at high risk for admission to hospital after respiratory tract infection with viruses such as respiratory

syncytial virus and influenza virus. Immaturity of the respiratory tract and immune system is thought to contribute to severe viral respiratory disease in this age group^[28]. Therefore, the absence of paediatric patients with COVID-19 has perplexed clinicians, epidemiologists, and scientists. Case definitions and management strategies for children are absent because of the limited number of paediatric patients with COVID-19.

Although blood groups are not established biomarkers, based on existing studies, people with blood type A are at higher risk of infection compared to non-A blood groups while blood type O has a significant lower risk for infection and severity compared to non-O blood groups. Although the higher death rate are seen among elderly people and those with pre-existing health issues. A study conducted in Wuhan, China found that, those with type A blood group are more likely to die from COVID-19^[29].

8. Antibodies Against COVID-19

Based on the available scientific data, the evidence on COVID-19 induced immunity is limited. That is to say, whether any immunity would give long-lasting protection against the virus is yet to be clear. A woman in Japan was reported to have tested positive for the second time after been given all the clear and also in China SARS-CoV-2 positive men became positive for the second time^[30]. Until we see different occurrences, it means that, there is possibility for reinfections and repeated rounds until there is a vaccine or a herd immunity is developed. Herd immunity is when 50% of the population got sick and recovered while developing antibodies against the viral antigen^[31]. Again since there is a knowledge gap surrounding the entire science of this virus, not everything said or speculated is uncertain. According to Ira Longini at the University of Florida, there is an evidence centered on anecdotal reinfection. But he added, that “we really don’t know”.

A breakthrough was seen on mouse model study conducted by the Chinese Academy of Medical Sciences in Beijing after exposing four rhesus macaques to the virus, they came up with the conclusion that, mice have antibodies to the virus in their bloodstream. And they tried to re-infect them but it fails, meaning the animals are immune. However, this might not necessary be a long-term induce immunity. For example, some people develop common cold immunity but this induced immunity are most often relatively short-lived. On the contrary to this as per humans, researchers at the London School of Hygiene & Tropical Medicine (LSHTM) reported that there is an increasing convincing evidence that, infection with SARS-CoV-2 leads to an antibody response that is protective. Although they request more evidence, their stance is on

antibody protection for life. That means, there will be no second experience for infection. However, everything we are learning about this virus is new and independent researchers are required in order to understand how protective the antibody response will be in the long-term. To sum of the issue of re-infecting, WHO warned against declaring recovered patients “risk free” since currently there is no evidence that people recovered from COVID-19 and have antibodies are protected from second infection.

9. Mother to Baby Transmission

According to the CDC, during pregnancy, the transmission of SARS-CoV to the fetus or the baby during delivery is still unknown. Although, no neonates born to positive mothers are seen to have COVID-19 or infected and tested positive for the virus. In such cases, which were a small number, the amniotic fluid or breastmilk was free of the virus^[32]. Moreover, a very recent case report conducted by Chen Y, et al^[33] described the clinical course of four live-born infants. These infants were born to pregnant women infected with the COVID-19. Due to concerns about symptomatic maternal infection, three of the four women had a Cesarean (C) section and the for the fourth infant, his birth was through a vaginal delivery. None of the four newborns developed COVID-19 infection^[33]. Another recent study conducted by Chen et al in February 2020 in China, that involved nine pregnant women infected with SARS-CoV-2 and developed pneumonia. There was no reported evidence of verticle transmission of the virus from women infected with the novel coronavirus to their infants^[34]. However, a new study conducted by Zeng et al^[35] suggested that, vertical transmission of the virus from infected mother with COVID-19 to the fetus is possible.

10. Conspiracy on the Virus being Weaponized

Following the rumors that the virus might escaped from a high-security biochemical lab in Wuhan, China, experts used the e genome sequences made available by the Chinese to explore the origins of and evolution of SARS-CoV-2. Apparently, from the studies done by scientists around the globe, they could not find any proof that the virus is made in a laboratory or engineered. This is based on the public genome sequence data from SARS-CoV-2 and related viruses. The science behind is to analyze the genetic template for spike proteins, armatures on the outside of the virus that grabs and penetrate the outer walls of host cells.

Until now, we could not established scientific grounds

as to the virus being weaponized although the levels of genetic similarity existing between SARS-CoV-2 and RaTG13 suggested no variant that caused the outbreak in humans by the latter. Almost half of the genome of the distinct lineage of SARS-CoV is within the betacoronavirus and this gives evidence that this novel coronavirus is not-mosaic^[36].

The two important features of the protein spikes are the receptor-binding domain (RBD) and the cleavage site. RBD can be viewed as a male since it has a kind of grapping hook that grips onto the host cells and the cleavage site can be seen as a female with a molecular can opener that allows the virus to crack open and enter host cells. If someone was going to engineer a new virus as a pathogen, then the backbone or the molecular structure would be a known virus that can cause illness. However this virus has mutations in its RBD portion of the spike protein and a distinct molecular structure thus, this is enough to rule out laboratory manipulations as a potential origin.

Although the quest to know the exact origin of this virus is ongoing and independent research groups were able to correlate results of SARS-CoV-2 β -coronavirus, with similar geneticmake up to bat coronavirus (Bat-SARSr-CoV RaTG13). The genome sequence of SARS-CoV-2 is 96.2% identical to a bat CoV RaTG13, whereas it shares 79.5% identity to SARS-CoV. The natural source of the virus orgin is suspected to be bat based on virus genome sequencing and SARS-CoV-2 might be transmitted from bats via unknown intermediate hosts to infect humans. The similarities found is the receptor, angiotensin-converting enzyme 2 (ACE2) is the same for SARS-CoV and they both dpread through respiratory mechanisms^[11].

11. Mutations Occurring within SARS-CoV-2

A study conducted on the genotype of SARS-CoV-2 in different patients in different provinces found that, the virus had mutated in different patients in China^[37]. Another study on population genetic analysis of 103 SARS-CoV-2 genomes revealed two types; SARS-CoV-2 type L (~70%) and S type (~30%). The evolutionary more aggressive and contagious strains in L types are derived from S type^[15]. The mutation occurring in the NSP2 and NSP3 confers the infectious capability and also differentiation mechanism of SARS-CoV-2. This form of mutation is crucial for therapeutic targets. However, the mutation in S1 spike protein is not affected in the sequences and hence the antigen that scientists are targeting for vaccine production is not affected. Most coronaviruses caused upper respiratory infections like

common cold but of recent, fatal respiratory diseases and outbreak including the strain that causes COVID-19 has the potential to mutate. In fact, the early studies speculate that this virus is being caused by mutants from species spillover in Wuhan's wild animal market^[38]. However, this begs for further studies that will bring in evidence based on experiments.

12. Expectations to See COVID-19 in the Future

With experience from SARS and MERS epidemics, the asymptomatic and pre-symptomatic transmission and the chances of gene viral mutations, if effective vaccines are not developed to win the battle, we are likely to face this outbreak again and perhaps in a different form or strain. Those receiving antiviral drugs should establish a complete elimination of the viral particles in the body. Failure for complete eradication will promote drug resistance that will lead to drawing back of therapeutic interventions back to the basics.

13. Conclusion

The global citizens must be reminded that in as much as we have suffered losses, pain and undending anxieties, one fundamental thing that should always be remembered is that, an outbreak of disease just like floods, storms and earthquakes as well are natural disasters. In essence, there should be no stigmatization or discrimination. We need to come clean and plain at the right time for global scientific interventions. Both the medical institutions and the Governments should be honest and transparent so that we can win this war against the novel coronavirus by providing the right directions. WHO 2020 continues to advise on the importance of solidarity when it comes to fighting a common enemy and in containing any outbreaks, epidemics or pandemics, discipline is key as to experts guidelines.

Everyone is affected either directly or indirectly even if you are not infected, the outbreak halted the global functions and everyone should strive to ensure that bad memories are never repeated. Essentially, we need to draw our resolution and work towards any similar enemy to the human race. It is a collective responsibility to fight against this virus in order to stop further spreading by providing the right information to the public. If we do not come together to fight to win the battle, we might not be lucky by witnessing many countries with long-lasting sequela.

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