Review Article

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SARS-CoV-2: How Science has Advanced in the Era of the COVID-19 Pandemic

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ABSTRACT

Background : *The SARS-CoV-2 (Severe Acute Respiratory Syndrom Corona Virus) virus causes COVID-19 (Corona Virus Disease) disease, which was first diagnosed in late December 2019 among a few people with unknown respiratory illness in Wuhan city, Hubei province, China. Presumably this virus jumped from a natural host to human, and that occurred in one of the open food markets in Wuhan city, spreading very quickly to neighbouring provinces, neighbouring countries and eventually different continents. The World Health Organization declared the outbreak a Public Health Emergency of International Concern on 30 January 2020 and a pandemic on 11 March 2020. As of writing, this virus has infected close to 185 million people and killed over 3.97 million people globally. People from all colours and tribes have fallen victim to this virus and the world is struggling to restore pre-pandemic life, which seems far away. While this virus hijacked the freedom of human beings in so many ways, on the other hand SARS CoV-2 also forced us to invent new skills and technology not only to defeat it but also to propel ourselves forward. For instance, diagnostic tests for SARS CoV-2 became available in weeks instead of years, vaccines were produced using newer as well as traditional technology from scratch in a matter of months rather than 10-14 years, a variety of online platforms were adopted and widely used in the past year. While the speed at which science progressed has reached new dimensions, we have experienced many unintended consequences as well since we were forced to focus on SARS CoV-2. In this article a brief update on the history, origin, characteristics of this virus, its epidemiology, transmission, laboratory diagnoses, whole genome sequencing will be given, highlighting the scientific gains driven by the pandemic such as the development of new drugs and repurposing of old drugs, vaccines, prevention measures and infection control.*

Methodology : *Title, abstract and text of relevant scientific articles were retireved from PubMed, Goole Scholar and WHO websites from 1974 to 2021.*

Conclusion : *Finally, unintended consequences, post COVID-19 issues, myths and superstitions and adoption of technological development and new innovations will be discussed.*

Key words : COVID-19; Pandemic; SARS-CoV-2; Wuhan.

Introduction

The Severe Acute Respiratory Syndrome Corona Virus-2 (SARS-CoV-2) and the Corona Virus Diseases-19 (COVID-19) it causes first appeared in Wuhan, China but spread to the rest of the world in a record time. As of July 2021, there have been 183.2 million cases and 3.97 million deaths reported globally. Currently India, Brazil and a few other South American countries are experiencing high numbers of death. In Bangladesh high case numbers were initially limited to big cities but have since spread all over the country, even at village level with higher numbers in border towns and cities. As a result, recently Bangladesh is also experiencing more cases and deaths[1-3].

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This article will provide a general update on the SARS CoV-2 virus with a special emphasis on how the pandemic has contributed to the advancement of science, as we are continually witnessing during this pandemic.

Search Strategy

Availabel studies and abstract were indentified through PubMed, Goole Scholar, Medlines databases (From 1974-2021) Cochrane databases and WHO websites. Key search topic were "SARS-CoV-2: How Science has Advance in the Era of the COVID-19 Pandemic" and relavant articles. The reference list of review articles were also searched. The Search term were following key words used in verious combination : COVID-19 Pandemic; SARS-CoV-2; Wuhan.

Discussion

Coronaviruses

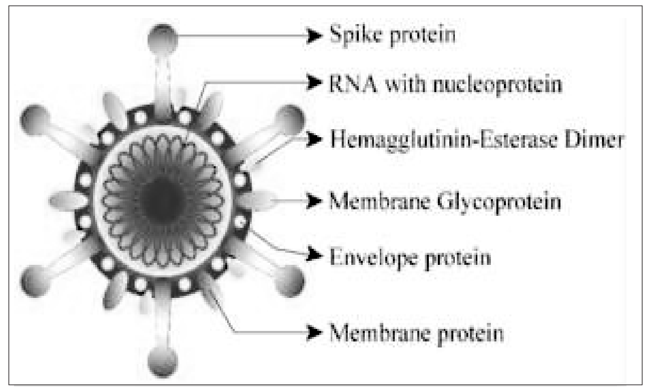
Coronaviruses are enveloped positive sense RNA viruses ranging from 60 nm to 140 nm in diameter and when viewed with electron microscopy they look like a ping pong ball with spike-like projections on its surface, giving it a crown-like appearance (Hence the name coronavirus). The first human coronavirus was identified in 1965 as causal agent of the common cold. There are over 200 members of Coronaviridae and four of these - namely HKU1, NL63, 229E and OC43 - are well known to the medical community, having been in circulation in humans and causing cause mild respiratory disease. Two other coronaviruses have caused outbreaks of global concern. The first, named SARS (Severe Acute Respiratory Syndrome) originated from Guangdong province of China in 2002-2003 and claimed over 10,000 people (Mostly from China and Hong Kong) before being contained. The second coronavirus outbreak emerged from Saudi Arabia in 2012 and was named MERS-CoV (Middle Eastern Respiratory Symptoms Corona Virus) and claimed over 4,000 lives. Case fatalities of SARS and MERS were approximately 11% and 34% respectively. Both coronaviruses originated from bats, palm civet cats acted as intermediary hosts for SARS while dromedary camels acted as intermediaries for MERS[4-6].

Origin of SARS-CoV-2

There is no dispute that SARS-Cov-2 emerged from Wuhan in late December 2019. However, the origin of this virus is a matter of debate. The majority of scientific community supports the theory of a natural animal origin and transmission through an intermediary host to humans; others however believe that SARS-CoV-2 is a laboratory developed virus with the body of a coronavirus to which a modified spike protein was added, which is supported by a small group of experts. This latter hypothesis has gotten extra attention because of the recent comments made by Dr. Anthony Fauci (Director of the U.S. National Institutes of Allergy and Infectious Disease), who was "…not convinced" that coronavirus developed naturally, as well as U.S. President Joseph Biden, who requested an inquiry on the origin of SARS-CoV-2 virus within 90 days in May 2021. We wait for the truth but it may not ever be possible to know definitely, as we experienced with many other outbreaks such as the introduction of West Nile virus to North America[7-9].

Characteristics and Pathogenesis of SARS-CoV-2

SARS-CoV-2 belongs to the coronaviridae family. It has 4 major genera: alpha, beta, gamma and delta, SARS-CoV-2 belongs to the beta corona virus 2B lineage. SARS-CoV-2 has a linear, positive sense, single-stranded RNA genome approximately 30,000 bases long. Like other coronaviruses, SARSCoV-2 has four structural proteins, known as the S (Spike) E (Envelope) M (Membrane) and N (Mucleocapsid) proteins, the N protein holds the RNA genome, and the S, E and M proteins together create the viral envelope. Coronavirus S proteins are glycoproteins that are divided into two functional parts S1 and S2 and they are responsible for allowing the virus to attach to and enter the host cell respectively.

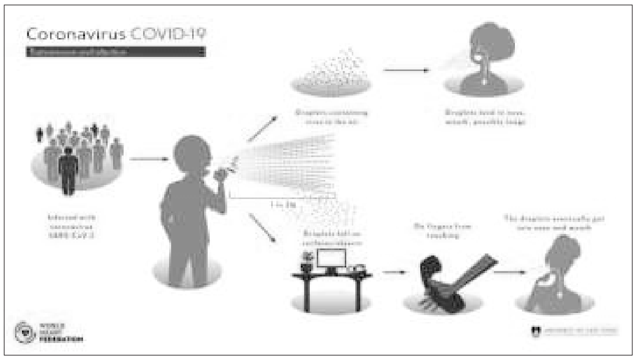


Courtesy: *J Biomedical Structural Dynamics*

SARS-CoV-2 is thought to infect a human host cell by binding to ACE-2 receptors that are present on tissues throughout the body, including epithelial cells of the airway, lungs, intestines, kidneys and blood vessels. The virus replicates predominantly in the tissues of the upper respiratory tract. The precise dose of SARS-CoV-2 required to cause an infection is still unknown, however animal studies and modelling experiments have narrowed estimates of a median dose to between about 10 and 1000 viral particles. This virus is effectively deactivated at higher temperatures. SARS-CoV-2 can be killed at 56ºC in less than 30 minutes and in less than 5 minutes at 70ºC. However, virus can stay alive for over 14 days at 4ºC[10-12].

Transmission

An infected person can transmit the virus to others both before they show any symptoms (Pre-symptomatic) and when they are symptomatic. Peak infectivity is thought to occur about one day before symptom onset. The mean incubation period (Time between exposure to the virus and the appearance of symptoms) has been estimated to be around five days, with modelling indicating a range of two to 11 days. It is now evident that SARSCoV-2 transmits mainly from human to human and strong evidence from case and cluster reports confirms that respiratory transmission is the dominant route with close proximity being the key determinant of transmission risk.



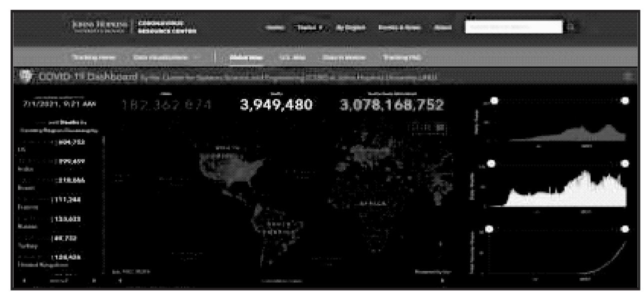
Courtesy: *World Heart Foundation and University of Cape Town*

An increased incidence of outbreaks/clusters of cases have also been seen in enclosed indoor spaces, crowded and inadequately ventilated spaces, where infected persons spend long periods of time with others, such as restaurants, choir practices, fitness classes, nightclubs, offices and places of worship. Studies also reported that indoor transmission is 18.7 times higher than outdoor transmission. Places such as ware houses with limited ventilation are thus more prone to transmission compared to well-ventilated facilities. Other routes such as direct contact or fomite transmission are presumed, however, these routes do not play a major role. Vertical transmission occurs rarely, transplacental transmission has been documented. Cats and ferrets can be infected and transmit to each other, but there are no reported cases to date of transmission from these animals to humans, minks transmit to each other and to humans. Direct contact and fomite transmission are presumed but are likely only an unusual mode of transmission. Although live virus has been isolated from saliva and stool and viral RNA has been isolated from semen and blood donations, there are no reported cases of SARS-CoV-2 transmission via fecal, oral, sexual or blood-borne routes. To date, there is a single cluster of possible fecal– respiratory transmission[13-17].

Epidemiology and Surveillance

A cluster of pneumonia cases of unknown cause was reported in the city of Wuhan, China, in the last week of December 2019 and within a week the Chinese National Institute of Viral Disease Control and Prevention had confirmed both the genetic sequence of SARS-CoV-2 and that the virus was the cause of the previously reported pneumonia cluster in Wuhan. By the 3rd week of January 2020, instances of COVID-19 disease was already being reported in Thailand, Japan and South Korea. On January 20, 2020, the US Centers for Disease Control and Prevention (CDC) activated its emergency operations centre in response to the emerging public health threat of COVID-19. On March 11, 2020, WHO reported that COVID-19 had disseminated to 114 countries and declared the COVID-19 epidemic as a pandemic and rest is history. One of the public health advancement that we have experienced is that many universities, provinces/states, countries as well major organisations such as the WHO or CDC created online dashboards showing live update of cases, deaths, vaccine status and many other vital epidemiological information. The most cited dashboard for global updates on the SARS-CoV-2 pandemic to my knowledge is maintained by Johns Hopkins University of Medicine Coronavirus Resource Center[18-20].

Using either of these sites, anyone can track the pandemic daily on a global scale as well as in individual countries. This kind of dashboard is also being maintained even at state or at province level; British Columbia is one such example[21-24].



Courtesy: *Johns Hopkins University Coronavirus Resource Center*

Laboratory Diagnosis

Laboratory testing is an essential element in diagnosing any disease. Medical literature suggests that more than 75 per cent of decision-making for patient care depends on laboratory diagnosis. For most infectious diseases, two types of tests are commonly performed in the laboratory - the antigen test and the antibody test. During this pandemic, hundreds of companies marketed tests for COVID-19.

Antigen tests look for evidence of the infectious agent by: detecting the organism under microscope, growing the microorganism under laboratory conditions or detecting the pathogens genetic materials using molecular technology. Electron microscopes are essential to define virus morphology, growing virus in laboratory requires live cells, several days and a highly specialised laboratory, which is a challenging and expensive endeavour. Therefore, the main test used to detect viruses these days is by amplifying their genetic materials in a test tube and the procedure is called nucleic acid amplification test, commonly known as polymerase chain reaction, or PCR in short. This can be achieved in a few hours and the sensitivity is much higher compared with other methods. However, in order to develop this test

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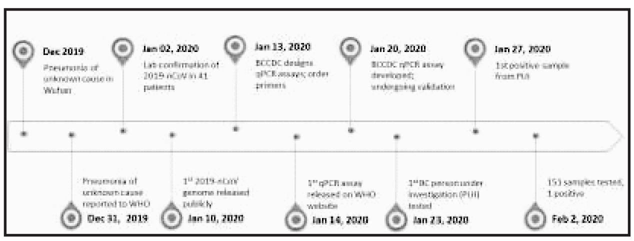
we need to know the genomic information of the organism. One of the astounding advances of this pandemic was the speed at which Chinas National Institute of Viral Disease Control and Prevention sequenced the SARS-CoV-2 genome - within a week! - and shared the sequence widely through WHO. For this, the Institute definitely deserves credit for accelerating the development of in-house RT-PCR testing. As an example, our laboratory at the BC Centre for Disease Control used that sequence information, developed the RT-PCR test, validated it and implemented within 10 days.



Timeline of SARS-CoV-2 Assay Development in BC.

Courtesy of : *Dr. Natalie Prystajecky*

Several companies developed low, medium and high volume rapid RT-PCR tests for commercial use also in record time. There are different types of PCR and the most common one being used for SARS-CoV-2 is a real-time Reverse Transcription Polymerase Chain Reaction (rRT-PCR) performed on fluid collected from nasal or throat cavity. PCR tests have to go through several steps such as sample collection, RNA extraction, genetic material amplification and data analysis in order to produce a result for physicians use.Among those molecular test devices, a few of them can be done in a limited settings and can be employed in smaller town and cities, they are, however, very expensive. Some companies have also developed rapid testing devices called rapid antigen tests, these work similarly to blood glucose or pregnancy tests and can be done in uncontrolled settings such as on the street or in the park.

The second type of laboratory test to confirm infectious disease is an antibody test. When people become infected with any microorganism, the bodys defence system tries to fight this infection and as a result, creates weapons called antibodies. Antibody tests are designed to detect these antibodies to the pathogen and not the pathogen itself, because the presence of an antibody implies that the body has been exposed to the infecting agent. Antibodies come in different types, named Immunoglobulin (Ig)A, IgM, IgG. It is now understood that for the SARS-CoV-2, IgA and IgM appear first in the blood within 5 to 7 days, followed by IgG, which needs at least 7 to 12 days. IgA test specificity has always been an issue. Given this, if IgM against SARS-CoV-2 is detected in any symptomatic individual, this can be interpreted as the most likely to have been exposed to SARS-CoV-2 very recently. Similarly, when IgG specific for SARS-CoV-2 appears in the blood, it suggests that the patient was exposed to that pathogen for a while and most likely has become immune to SARS-CoV-2.

So, antibody tests can be used for dual purposes i.e when an antigen test is not available or cannot be performed, then IgM can be used as a marker for the diagnosis of an early acute infection along with the patients clinical presentation. Furthermore, the IgG antibody test against SARS-CoV-2 can be used to see what per cent of population is exposed to COVID-19, how many of them have developed immunity, and for measuring vaccine effectiveness[25-32].

Whole Genome Sequence

The complete genomic information of any organism is the code of life and this information is centrally useful to scientists at every step of action including the development of diagnostic products, drugs and vaccines. For practical day-to-day use, the virus Whole Genome Sequence (WGS) allows epidemiologists to analyse how this virus changes over time and how new variants evolve. Primarily, WGS greatly helps the Public Health decisionmaking process. WGS information could also help to understand clinical effects, severity of illness, transmission kinetics and accurately pinpoint sources of inter-familial, community and hospital transmission. When coupled with epidemiological data, WGS offers crucial information about the number of viral types in circulation and whether new variants have arisen, which are key for public health decision to limit the spread of this disease. Monitoring of ongoing WGS results also allows us to understand how variants are spreading geographically and whether emerging variants are a cause for concern (VOC). The variants designated as VOC have one or more of the following characteristics:

i) Spread more quickly than the original strain
ii) Evade natural or vaccine-related immunity
iii) Cause more severe disease
iv) Evade detection by available tests
v) Are less responsive to treatment.

To date, there are many notable VOC. The following ones are well described in the literature and have played significant roles in transmission, severity and immune evasion: B.1.1.7 (Also known as UK variant, WHO designation Alpha) first described in the United Kingdom on September 2020 and showed higher transmissibility, severity as well as an impacts on the accuracy of molecular tests; B.1.351 (Also known as South African variant, WHO designation Beta) first documented in South

Africa on May 2020 and also exhibited more transmissibility, as well as impacted on immune escape and vaccine effectiveness, P1 (Known as Brazilian variant, WHO designation Gamma) first reported in Brazil on November 2020 and highly transmissible and showed potential impact on vaccine effectiveness. The very recent B.1.617.2 (Known as the Indian variant, WHO designation Delta) found in India on October 2020 and known as a super spreader, more virulent and potential for immune escape and vaccine effectiveness. Similar to dashboards offering epidemiology information, SARS-CoV-2 WGS information is also being tracked by different groups e.g Nextstrain SARS-CoV-2 resources[33-35].

New Drug Development and Repurposing of Old Drugs for Treatment/Case Management

To my knowledge, there are no specific antiviral therapies that have proven effective against SARS-CoV-2 in randomised clinical trials, currently. However, scientists have been working since day one with sophisticated machine learning tools and computer modeling to screens thousands of prospective chemicals in an effort to discover to new antiviral agents. Since the search results in these efforts are far from their goal, repurposing existing drugs as potential antiviral agents for SARS-CoV-2 is a practical strategy to address the urgent need to treat COVID-19. Several studies have evaluated multiple antiviral medicines, with one study screening approximately 250 existing drugs or pharmacologically active compounds for their inhibitory activities against Feline Infectious Peritonitis Coronavirus (FIPV) and human coronavirus OC43 (HCoV-OC43) a human coronavirus belonged to the family of same coronaviridae (Beta-coronavirus) as SARSCoV-2. Protease inhibitors are one class of drugs that can stop viral multiplication. Sophisticated computer modeling has been used to screen a huge library of 191678 fragments for binding against the binding cavity of SARS-CoV-2-M as potential viral inhibitor targets. However, none of the new candidate drugs is highly effective.

Other drugs which have already been used successfully against other viruses, bacteria and parasites have been investigated for whether it is appropriate to repurposed for COVID-19. One such example is ivermectin, an antiparasitic agent used to treat many types of parasitic infection; ivermectin has been examined by itself and in combination with hydroxychloroquine and the antibiotic azithromycin. However the effectiveness of this combination for treating SARS-CoV-2-infected individuals is controversial. One antiviral agent, Remdisivir, was also utilised and found effective to a certain extent in seriously infected individuals. WHO has launched a large global trial of the four most promising SARS-CoV-2 treatments: Remdesivir, Chloroquine and hydroxychloroquine, Ritonavir/lopinavir and itonavir/lopinavir and interferon-beta. More information on all SARS-Co-V related new and repurposed drugs be found at this website[36].

COVID-19 Therapeutic Development tracker and many others[37-39].

Vaccines

More than 100 known institutions and companies are now working relentlessly to come up with SARS-CoV-2 vaccines using different approaches. To develop a vaccine is a long process, requiring years, in which institutions historically needed to follow a series of steps. Briefly these steps are:

i) Exploratory stage (2-4 years): basic research, a strategy on how to construct the vaccine

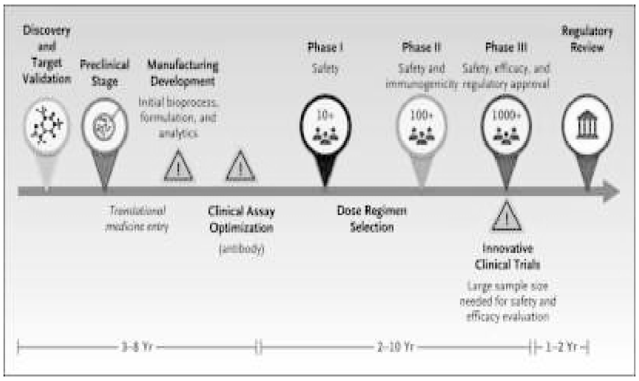
ii) Pre-clinical stage: testing whether the vaccine candidate can produce significant immunity in mammalian cells grown in laboratory or in laboratory animals

iii) Investigational New Drug (IND) application: companies or designated institutes submit applications for an IND to the US Food and Drug Administration and start phase 1 vaccine trials

iv) Phase I vaccine trials assess the safety of the candidate vaccine and determine the type and extent of immune response that the vaccine provokes, and are usually tested in a small number of adults (usually 45–100 participants in the age group of 25–60 years)

v) Phase II vaccine trials are performed in a larger group of people, usually several hundred, with an expanded age range up to 70 years.

This phase done in a randomised fashion means a half will be given the real vaccine and the remaining half will receive a similar product without vaccine. The goals of Phase II testing are to study the candidate vaccines safety, immunogenicity, proposed doses, the schedule of immunisations and the method of delivery. Successful Phase II candidate vaccines move on to Phase III trials which involve thousands to tens of thousands of people. If everything goes according to plan, the companies apply for an approval and licence for marketing. Phase IV trials are undertaken by companies to collect data on safety and efficacy even after marketing the products for a few years in order to make sure that the intended goal is achieved. Altogether, the whole process requires 10-14 years.



Courtesy: *Heaton PM, N Engl J Med 2020; 383:1986-1988*
DOI: 10.1056/NEJMe2025111.

Courtesy: *Florida Department of Education*

There is an English proverb "Necessity is the mother of invention." Need for a SARS-CoV-2 vaccine is an utmost need and scientists made that happen. Within a record time of 11 months from start to finish, over a dozen companies came up with highly effective vaccines such as those produced by AstraZeneca (UK) Pfizer –BioNTech (USA and Germany) Moderna (USA) Johnson and Johnson, Sinopharm (China) and Sputnik (Russia) to name a few. There is no doubt that in the course of the past century, vaccines proved to be one of the most powerful weapons to combat and eradicate many life-threating diseases. Small pox, polio, mumps, measles, rubella, diphtheria, tetanus and many more and SARS CoV-2 is also not an exception. We have seen the power of SARS-CoV-2 vaccines already in countries that have vaccinated 50% or more of their populations such as Israel, UK, Canada, China, USA: all these countries have seen steep declines in the number of new cases after mass vaccination. Vaccination status can be also tracked by the websites[40].

Several independent studies have shown that all available SARS-CoVvaccines are quite effective in preventing COVID-19 morbidity and mortality, with mix-and-match of first and second doses also giving equal or more protection. None of the medications currently available is without a side effect and the SARS-CoV-2 vaccine is no exception; however, the benefit is much higher than the risk projected. Among all the preventative measures this is the only method found much more effective than any other. Given this, it is a global interest and priority that all countries find a way to vaccinate their population[41-43].

Prevention

There is a universal message which we all are familiar with "Prevention is better than cure" and that is absolutely true for COVID-19 disease as well. There is one safety message which universally agreed by all experts: Wear a mask, clean your hands, keep a safe distance.

However, adherence to these key messages has varied among countries, communities and even at a personal level. Ideally, one should follow the advice of the local public health authority and adjust behaviours and routines accordingly. As we now know some variants of SARS-CoV-2 are more transmissible and severe than others so it is best to stay home as much as possible to maintain a low risk of getting infected. This is even truer when a person is suffering from COVID-19; measured are designed to prevent transmitting this virus to others knowingly or unknowingly. Limiting our daily physical interaction and trying to utilise digital platforms where possible is also advisable. It is always better to avoid closed spaces with poor ventilation and crowded places when you're with people from outside of your immediate household. Because many SARS-CoV-2-infected people can remain asymptomatic, those individuals could unknowingly infect many others when engaging in activities such as singing, shouting, close-range conversation, heavy breathing etc. This makes improving indoor air quality in shared spaces through proper ventilation extremely important. Proper ventilation may help to dilute virus particles and reduce the chances of getting infected. Maintaining good hand hygiene and respiratory etiquette are equally important. There are many resources available for hygiene etiquette on the internet.

It is not easy to adhere to public health messaging such as Wear a mask, Clean your hands and Keep a safe distance in a densely populated country like Bangladesh. However at least hand wash can be practiced religiously.

In addition to these medical issues, there are many people who have different opinions about SARS-CoV-2 / COVID-19 than the mainstream population; these anti-maskers, anti-vaxxers and COVID-19 denial groups are extremely dangerous for the community[44-45].

Infection Control

The term infection control was mostly used in hospital settings. However, COVID-19 disease also taught us to monitor community level infection control down to the grass-roots level. To contain the spread of virus, community-level infection control has been extremely important. It is critical for all health practitioners, health administrators to strictly to adhere infection control measures set out by individual clinic, hospital and any other health setting where care will be provided. Such measures include: the appropriate uses of Personal Protective Equipment (PPE) such as disposable gowns, gloves, N-95 masks or respirators; ongoing support and infection practice compliance education for health care workers and monitoring this community to reinforce best practice of PPE use and hand hygiene; continued screening processes for visitors and healthcare workers at health facility entrances before each shift to reduce the risk of COVID-19 transmission in the facility; proper ventilation measures; patient rooming density to name a few. An Interim Infection Prevention and Control Recommendations for Healthcare Personnel During the Coronavirus Disease 2019 (COVID-19) Pandemic is available on the CDC website and any country can amend these guidelines as per their local needs[46-48].

Unintended Consequences

Globally, most of the countries are exercising some level of travel restriction that impacts the movement of people during this pandemic. Restrictions vary and range from total lockdown to restricted personal movements. Most of the individuals are concerned about exposing themselves if they go out, including for the purpose of seeking medical advice, so they are hesitant about visiting their family physicians, dentist and physiotherapists. Similarly, most of the physician community have adopted an alternative approach to "seeing" their patients, using remote options such as Telehealth. As a result, follow-up medical appointments of serious diseases such as cancer, kidney disease, heart disease, diabetics, TB, and other respiratory illnesses are not consistently maintained and thousands of people have become casualties. Another frequently seen problem is a disproportionate focus on COVID-19 disease only. COVID-19 symptoms mimic many other respiratory diseases and often patients are being tested for COVID-19 by PCR. In particular, those testing negative for COVID-19 are re-tested by repeating the PCR, but in the meantime there are instances where the patients have expired and post-mortem analysis confirmed other infection origins such as Hantavirus[49-50].

Post-COVID Issues

The SARS-CoV-2 virus is quite new to us but as the pandemic continues, physicians, epidemiologists, scientists and allied health care workers have become more knowledgeable and have found new issues. Now it has become very clear that those people who were exposed to the virus and had moderate to severe disease suffer post-disease sequelae and mental health is one of the major issues. A significant proportion of those who have recovered from SARS-CoV-2 experience brain fog, depression, fatigue, shortness of breath, heart problems, diabetes development, hair loss, loss of smell, muscle and joint pain, kidney issues, sleep disturbances. We don't know whether some of those health issues are reversible or not, but they definitely impact our society[51-52].

Adoption of Technological Developments and Witnessing New Innovations

There are so many negative impacts on human lives on a personal level as well as on communal levels for SARS-CoV-2, however, if we analyse the entire SARS-CoV-2 pandemic holistically, this virus forces us to adapt to the following technological developments:

Online Shopping

Although online shopping was widely available pre-pandemic, very few people were using these services, such as online grocery shopping. The COVID-19 pandemic compelled people to be habituated to online grocery shopping as well and it went beyond what we ever imagined. Now people can buy and sell anything and everything from a single banana to entire buildings using highly secure online tools. It was a common belief that the internet and modern technology are the most easily adapted for the younger generations but the COVID-19 pandemic proved it wrong, during this pandemic older people did more online grocery shopping than the younger generation.

Online Banking

Financial institutions have been trying to motivate people to use online tools for banking because that is a profitable model for them. Prior to the pandemic, despite the wide availability of these tools people were reluctant to adopt this model. The COVID-19 pandemic accelerated the adoption of digital and contactless payments by offering a safe transaction method that made everyone comfortable. Note that most people are comfortable with activities such as depositing cheques, paying bills and checking credit card balances over the internet as well as many people now becoming accustomed to using debit or credit cards rather than cash; these practices have the benefit of not only avoiding SARS-CoV-2 transmission but also limiting the amount of cash on the person.

Working from Home

It has been reported that the use of public transit is one of the high-risk scenarios for SARS-CoV-2 transmission. Given that many office workers use public transit to travel to their workplace, many workplaces including governmental, semi-governmental, non-governmental and private offices have allowed their employees to work from home. This has resulted in the explosion in the use of virtual platforms for workplace meetings such as private networks, voice over internet protocols, enabling virtual meetings through applications such as those offered by Zooms or Google, to name a few. Initially there was some hesitancy but over time it seems that in some cases, these tools allowed workers to lead even more effective work lives, especially those have (Very) young children at home. However, remote work/working from home is not without its challenges to both employers and employees. A couple of significant factors to consider are the security of information being shared on platforms and privacy, however, with correct measures these problems can be mitigated.

Telehealth

The wide and mass adoption of telehealth has become a real gift that SARSCoV-2 or COVID 19 disease has given to us. Access to physicians is now possible from anywhere in a scheduled time and consultation can be obtained. The big winners in this scenario are remote areas, which can now benefit from health access without having to travel.

Courtesy : *Health tech magazine*

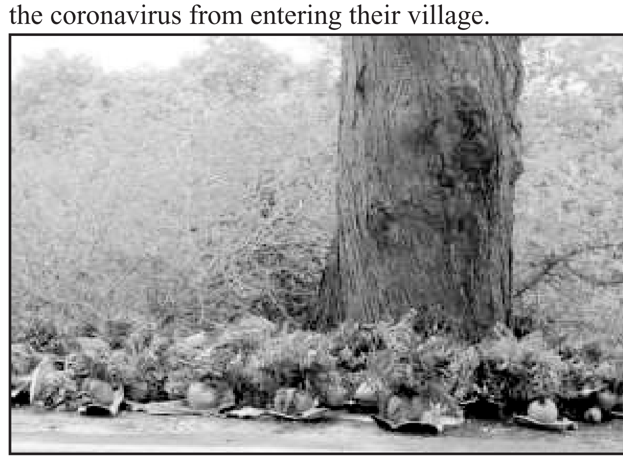
Co-ordination among different physicians for the care of a single patient is possible by sharing files with each other using available digital platforms. This area developed significantly. Diagnostic laboratories can send laboratory results, X-ray, ECG, and other results to physician's office electronically. Physicians (Upon virtual consultation via Zoom or Google Meet) can send prescriptions to the pharmacy and the pharmacy can deliver medication right to the patient's doorstep. This sequence of events requires almost no physical contact except for the patient going to the laboratory or another test centre. This not only provides efficient healthcare service but also saves considerable travel time for the patients.

Distance Learning

The spike in the number of COVID-19 cases as well as the resultant panic situation drove all in-person learning and research at academic institutions to a standstill. Although governments were obliged to close schools, colleges and universities for an indefinite time, due to the advancement of technology everyone embraced distance learning very quickly. Now, most academic institutions are running full course programs with a minimal on-campus presence. Instructors can give lectures online using various secured portals such as Zoom and Google Talk as an alternative face-to-face tool, they can also routinely mark exam papers and submit marks online. This new distance learning is happening not only within countries but inter-country and indeed inter-continentally very effectively[53-55].

Myths and Superstitions

Whenever we experience any new events of great impact to our lives, it is not without myths and superstitions. COVID-19 is no exception. Social media (e.g Facebook, Twitter) is one of the primary vehicles to generate and spread these myths and superstitions. Some people are prone to believing social media more than their primary care physicians who are more knowledgeable of their health. At the beginning of the SARS-CoV-2 pandemic there was denial of the seriousness of the situation. The public believed that this was just another cold virus and would eventually go away. Then came propaganda of several falsified medications against COVID-19, even an ex-President of USA advised injecting or spraying bleach to get rid of this virus. In India, many people believed drinking water from the Ganges River will cure COVID-19. Many also believed that if you filled coconut shells with neem plant leaves and placed these outside the village under neem trees, this would ward off evil spirit and thus prevent the coronavirus from entering their village.



Coconut shell with neem plant leaves placed under neem tree to repel COVID-19 disease

Courtesy : *Deccan Herald*

Still others advised to drink animal urine (Cow urine particularly) as well as rub animal excreta (Cow dung specifically mixed with milk and water in a specified ratio) on the body to repel the virus. Another myth in circulation is that the use of hand sanitizer will cause a more deadly form of drug-resistant bacteria to appear.

The last but not least, when vaccine became available, the propaganda surrounding them were unbelievable by any standard. The best ones I read are that the SARS-CoV-2 vaccine is used to implant microchips in billions of people to monitor their movements and that immunization causes erectile dysfunction as well as infertility. More information is available on myths and superstitions on WHO websites[56-60].

Conclusions

SARS-CoV-2 virus and COVID-19 disease originated from China and became a pandemic 6 months after first notification. As I am writing this article the globe has lost over 3.97 million people of all ages, however, mostly over the age of 60. We are travelling through a complex, winding and thorny landscape, all the while discovering a new way of living. We have wide access to a large variety of digital infrastructures, now considered to be essential when they were a luxury a year ago. It is evident that (Widespread) COVID-19 vaccination would be the primary weapon to effectively defeat this virus. SARS-CoV-2 has also forced much of the world to shut down most public life; however, human beings found a way to innovate a new way of survival without harming the person next to us or our family and friends.

Disclosure

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