

COVID-19

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CLOUD COMPUTING DURING THE PANDEMIC

By Bayley Northern

During the recent COVID-19 pandemic, maintaining critical services was imperative; despite enforced social isolation, people still required access to essential services. As a result, the use and reliance on technology to uphold these services increased dramatically over this time, with a heavy focus on cloud computing. The rapid development of this technology facilitated the communication and collaboration required to maintain a working environment, despite being compelled to work from home.

Overview

Cloud computing involves providing a network of remote computers or servers which the user can connect to using the internet and access the resources, and computing power, of these computers. This can be done remotely, if they have an internet connection, meaning it is substantially more flexible and portable. It also means that everyone doesn't require a powerful computer, since they can just use the resources of the servers instead.

Cloud computing service models

The types of cloud computing can be divided into 3 main sections: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS).

(1) These provide certain levels of access to the resources provided on the cloud. SaaS provides the least freedom, by only allowing the users to interface with the cloud using software of the company's design.

The best example of this is software like "Google Sheets". PaaS provides the user with a "platform" to develop their own applications to allow others to access the resources provided by the cloud, and IaaS gives users complete control over the resources of the servers. These form a hierarchal structure as shown. The most important service provided during the pandemic as SaaS, as it minimizes the technical knowledge required to operating it, while still allowing for users to benefit from accessing the hardware remotely.

Developments during the pandemic

One of the main uses of cloud computing during the pandemic was to provide a way for students to still learn, despite being unable to physically attend school. (2) This resulted in the development of E-learning strategies, which allowed students to collaborate and share resources online, while still being able to access lecture material from their teachers and submit their own work for assignments.

Cloud computing is essential for the development of these E-learning solutions, since it is not guaranteed that every student would have the powerful computers required to perform the tasks needed to succeed at their level of education. This would further the digital divide, meaning that those who come from a background with lower income would be unable to perform at their maximum potential during the pandemic. Cloud computing provides a solution to this problem by moving all the computational power server-side, meaning that anyone with a device capable of accessing the internet will still be able to use the computational power of a high-end device, despite not physically owning one. This led to the widespread usage of online tools such as "Google slides" and "Office" to produce the resources required for learning to continue, despite the interruptions of the pandemic.

This technology meant that the 2 million students in higher education in the UK, along with the many earlier in their education were minimally disadvantaged in comparison to those who sit the qualifications before them, which is truly a huge achievement

However, cloud computing still has a long way to go before its use can be expanded into more sectors. Research into cloud computing is increasing as a result, which will surely lead to improvements in the workflow of many students, despite online learning not being required anymore.

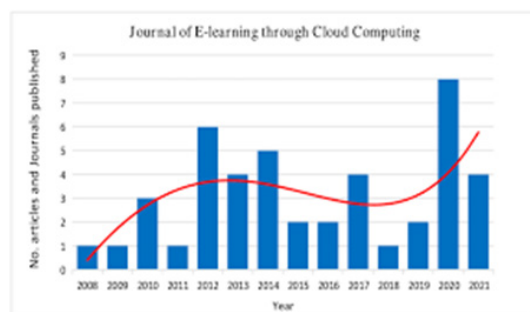


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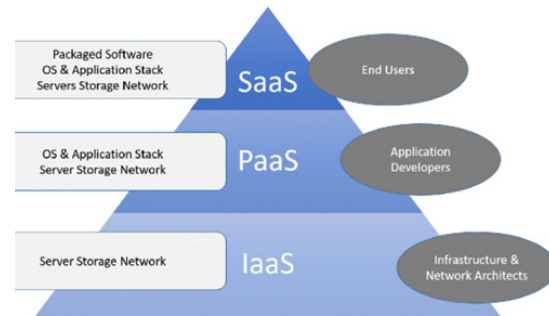


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TECHNOLOGY AND ENGINEERING
LEAD EDITOR: MIHIR KANDI

Cloud computing - the practice of using a network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer.

Collaboration - working together with a team to achieve a result.

Remote - computers being accessed using the internet, rather than the computer being physically near the user.

Hierarchal - a structure with distinct order and rank.

Hardware - physical components of a computer (e.g. CPU, RAM, etc.)

Minimally - reduced as much as reasonably possible.

THE ROLE OF BIOMEDICAL ENGINEERING DURING THE COVID-19 PANDEMIC

By Susanna Law

During the pandemic, biomedical engineering played a role in the diagnosis and investigation into COVID-19. MRI, CT scans as well as ventilators provided support for critically ill patients, while contributing to the research behind COVID-19. This article discusses the roles of medical imaging, ventilators, and the initial research behind COVID-19.

Overview

Biomedical engineering laid the foundations to support patients with Covid. Machines, such as MRI's {1} and Electroencephalograms {2} were mainly used to investigate the brain and spinal cord using imaging tests or detect abnormalities in brain waves. However, they were utilised during COVID to investigate the changes of brain waves and whether the SARS-CoV-2 infection had impact of brain-related abnormalities {3}. They were also used as an effective way to diagnose COVID-19 infection, even if the patient is asymptomatic. On the other hand, clinical machines, such as ventilators, were used to support critically ill patients with COVID-19. The machine works to get oxygen to the lungs whilst removing carbon dioxide, {4} which is essential for patients who are too sick to breathe on their own. The use of Biomedical engineering utilized technology to research COVID-19 while supporting critically ill patients.

Medical Imaging

There are several ways to detect COVID-19, most notably, a real-time reverse transcription-polymerase chain reaction (RT-PCR), commonly known as a Rapid Lateral Flow test or a PCR test. However, although these tests were cheap and affordable to mass produce, the test results may be negative despite the person already being infected. The asymptomatic infections were able spread, so there was a need for a more careful approach to diagnosis. In the initial diagnosis, medical imaging, such as the use of chest radiography, where it was used to assess the severity of a patient's condition.

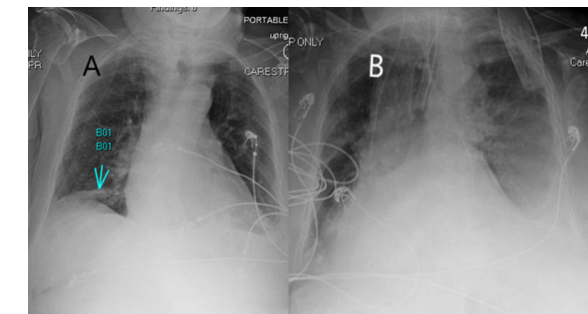


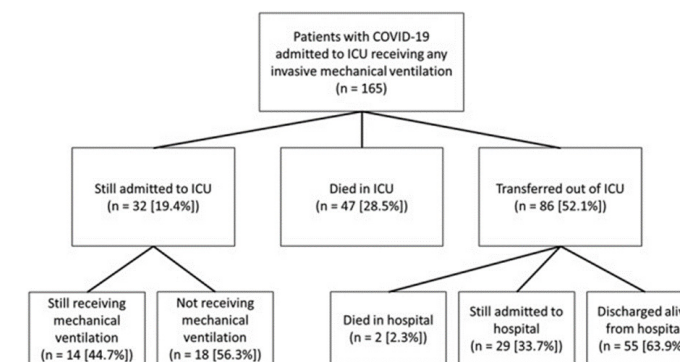
Figure 1: An 82-year-old woman presented to the emergency department with cough, shortness of breath, altered mental status. (A) X-ray showing a right lower lobe infiltrate (arrow) on day 1 and tested positive for COVID-19 using PCR. Later, due to worsening respiratory function and confusion, the patient was admitted to the intensive care unit and was intubated. (B) Image showing small left pleural effusion with worsening infiltrates.

However, the interpretation of medical images, can be challenging, and the accuracy of the diagnosis depends on the skill and experience of the radiologist. As such, machine learning algorithms are being developed to assist with the diagnosis.{5}

Ventilators

The use of ventilators supported critically ill patients as invasive mechanical ventilation had to be used to support patients within ICU. Below is a flow diagram for patients admitted to a COVID-ICU who received any invasive mechanical ventilation with the morality rate.{6} These results suggest that most patients with acute respiratory failure COVID-19 may recover, with some requiring intubation and mechanical ventilation.

Figure 2: Flow diagram for patients admitted to a COVID-ICU who received any invasive mechanical ventilation



In conclusion, Biomedical engineering supported the foundations to support patients with COVID as well as assisting in research done to diagnose and investigate COVID-19.

Abnormalities: Deviating from what is normal

Electroencephalograms: Test measuring electrical activity in the brain

SARS-CoV-2 infection: A strand of virus that caused COVID-19

Ventilators: Machine that moves air in and out of your lung

Asymptomatic: Showing no symptoms

THE ROLE OF CONTACT TRACING APPS THROUGH THE PANDEMIC

By Kohei Dunkley

Contact tracing apps played a fundamental role in the early stages of 2020, helping to prevent infection from the coronavirus, COVID-19. In September 2020, amidst a period of rising infection rates, the NHS would release the "NHS COVID-19" app, available to download from the Google Play and Apple App stores.

Overview

NHS COVID-19 was a voluntary contact tracing app, used to control the spread of COVID-19 in England and Wales. The app allowed users to log positive COVID test results and subsequently alert close contacts, check symptoms, and book COVID-19 PCR tests as required (1).

How does the app work?

The NHS COVID-19 app relies upon Bluetooth and internet connection in order to achieve full functionality. In this example, User A represents a user of the NHS COVID-19 app, who has tested positive for COVID-19.

1. Every 15 minutes, a new code is generated on User A's device. This code is completely unique and is shared to other nearby users within Bluetooth range. Codes received from other users are stored locally until no longer required. The codes from each user's device are synchronized in regular intervals to the DHSC server (Department for Health and Social Care), via an internet connection.
2. As well as sending these codes to devices within Bluetooth range, the proximity between devices is also measured in 5 minute intervals. The proximity between devices is categorised into: Close (0-2m), Medium (2-4m) and Far (<4m).
3. User A feels they have COVID-related symptoms. They enter their symptoms on the app, and the app assesses the likelihood of COVID-19. The app redirects User A to a page where they can book a PCR test at a nearby testing centre. If the test result comes back positive, User A logs this in the app.
4. Now that it has been determined User A has COVID, the DHSC will attempt to match User A's codes to other users' stored codes. If a different user has matching codes, this means they have been in close contact with User A at some point during the day. A risk level is determined based on factors such as the distance between devices and duration of close proximity between devices.
5. The NHS COVID-19 app tells User A to self-isolate as well as other "high-risk" users who have been within close contact of User A.

The shutdown of the app

The NHS COVID-19 app was shutdown on the 27th April 2023, as demand for the app dwindled. The userbase of the app started decreasing from July 2021 onwards (1), due to multiple factors, most notably the ending of government-funded COVID testing schemes resulting in less positive COVID results being entered into the app, and therefore fewer notifications being sent to "high-risk" close contacts. In addition to this, the later introduction of a vaccine reduced the severity to others significantly, allowing society to live with COVID as a part of life, just like the Flu or Common Cold.

The effectiveness of the app

Leading scientists at Oxford University and Warwick University released research in 2021, showing that for every 1% increase in app users, the number of COVID-19 cases in the population was reduced by 2.3% (4). This was followed up in 2023 in a separate paper, estimating that the NHS COVID-19 app prevented roughly 1 million cases, 44,000 hospitalisations and 9,600 deaths during its operation in the first year alone (5).

The NHS COVID-19 app has proven to be a groundbreaking success and, while no longer in operation, provides a benchmark to be built upon in future, readying the United Kingdom for any potential future pandemics.

Bluetooth - a wireless technology for short-distance data exchange between devices

Server - a central computer responsible for providing services and communicating to other devices

Proximity - nearness or closeness

Dwindled - gradually decrease in size or amount

Government-funded testing schemes - PCR tests and home testing kits provided free-of-charge by the government to allow for testing of COVID-19

Groundbreaking - new and a big change from other similar things

Benchmark - a very good example of something, which other things can be compared to

A QUANTUM VIEW ON THE COVID-19 PANDEMIC

By Sheli Patel

COVID-19 was the largest pandemic of the modern era. Technology and systems healthcare organisations were using had not been designed assuming a pandemic of this scale would occur. Many problems were caused in the recent pandemic: bad distribution of resources, extra hours of health workers, long databases, and, above all, overload of patients. So, how could these problems be reduced?

Overview

A classical computer uses binary logic, where a bit is represented as either 0 or 1, true or false. Quantum computers, on the other hand, use principles from quantum mechanics, such as superposition and entanglement. This means that a bit in a quantum computer (known as a qubit) can exist in a superposition of states, where it can be 0, 1, or both 0 and 1 simultaneously to some extent. Quantum algorithms use this property to perform complex calculations with greater accuracy and efficiency than classical algorithms can. These algorithms have the potential to significantly improve various fields, including healthcare

Potential Applications of Quantum Algorithms during the pandemic

1. Drug Discovery and Development

Developing effective drugs and vaccines is crucial in managing a pandemic. Classical approaches to this are time-consuming and complex. Quantum algorithms are capable of processing vast amounts of data, searching through potential drug options at incredible speeds. Quantum algorithms can simulate molecular interactions far more accurately than classical ones. This results in accelerating the discovery of treatments against pathogens. [1]

2. Epidemiological Modelling

Epidemiological modelling refers to the use of mathematical and computer-based simulations to understand the spread of diseases. Understanding and predicting the spread of a virus is important in controlling a pandemic. Quantum algorithms can process intricate calculations involved in epidemiological models that test several variables at once. Hence, such precise predictions will ensure a higher probability of the prediction being accurate, so governments would be more well-equipped to take timely and effective virus-containment measures. [2]

3. Resource Allocation Optimization

Ventilators, masks, and vaccines—these are only some of the most critical medical supplies required during a pandemic. Quantum algorithms excel at optimization problems, which involve finding the best solution from a vast number of possibilities. They ensure that resources are used effectively to help minimise shortages and improve patient outcomes. [3]

4. Quantum-Enhanced Imaging and Diagnostics

Quantum Technology will increase the accuracy and speed of diagnosis in medical science. For instance, Quantum sensors will give rapid identification of small biological changes that can trigger the early and accurate diagnosis of COVID-19 and allow for quick isolation of infected individuals to reduce the transmission rate of the virus. [4]

Conclusion

While quantum algorithms have increasing potential, current quantum technology is still in early youth. In terms of practicality, there are only a few significant quantum computers; although, substantial research and development efforts are being invested to make these solutions a reality. Modern day technology is advancing everyday, and we are inching towards a quantum future.

Bit (Binary Digit) - the smallest form of data on a computer.

Superposition - a condition in which a quantum system can exist in multiple states at the same time. For example, true and false.

Classical Computer - a traditional computer where data is stored as 0 or 1.

Optimisation - making the best or most efficient use of a resource.

Diagnostics - identifying an illness or problem by examining carefully.



HOW TO SLOW DOWN A PANDEMIC: THE MEASURES TAKEN TO REDUCE THE SPREAD OF COVID-19

By Kanthika Bandara

During the COVID-19 pandemic, several measures were implemented to slow the spread of the virus. While it would ultimately be the vaccine that achieved this, the non-pharmaceutical interventions implemented beforehand were essential in lowering both case rates and casualty rates, thus reducing the pressure on the health service so they were not as overwhelmed with severe cases.

COVID-19 is spread from person to person in airborne droplets, which are exhaled by infected people and then inhaled by susceptible people (1). As with many other diseases, close contact increases the rate of transmission (2), and so many of the measures employed to reduce the rate of transmission necessitate reducing contact between people.

To this end, one of the most commonly used interventions to reduce COVID-19's spread was quarantine. Employed as early as the 14th Century, quarantines have long been known to reduce the rate of transmission of communicable disease outbreaks, and COVID-19 has been no exception. It has been observed that effective quarantine measures during COVID reduced cases by up to 81%, and deaths by up to 61% (3). Similarly, lockdown, possibly one of the most enduring legacies of the COVID era, has been demonstrated to quite significantly slow the rate of disease spread. According to one study, delays in implementing lockdown caused large increases in casualty rates (4). However, it cannot be denied that lockdown, as implemented during the COVID-19 pandemic, had severe adverse effects on the population's physical and mental health, the full effects of which may take years to fully comprehend (5,6).

Another important measure to calm the virus's spread was the promotion of good hand hygiene. SARS-CoV-2, the virus that causes COVID-19, spreads due to coughing and sneezing, and it was thus essential that during the pandemic, a number of hygiene measures were promoted to the general public. Covering one's mouth when coughing and sneezing with a tissue was encouraged by the CDC, U.S. Centers for Disease Control and prevention, in order to minimise the spread of droplets in the air (7). Meanwhile, organisations such as the NHS doubled down on the promotion of proper hand washing techniques, informed by research demonstrating the role of hands as a vector for microorganisms (8). Additionally, the cleaning of frequently touched surfaces was also promoted, as such surfaces could potentially serve as vectors for the virus also(9).

A number of other measures were taken in order to minimise the spread of the virus in droplets. A review of the UK Government's social distancing policy during the pandemic highlighted several risk factors that increased the risk of transmission of the virus. In addition to hand-washing measures, this report reaffirmed support for the UK's existing "two metre rule" on social distancing, based on research that demonstrated the reduced risk of transmission at this distance. Furthermore, it was also recommended that measures be taken to improve ventilation in indoor areas. This would reduce the concentration of droplets carrying the virus in the air, thus minimising the risk of transmission (10).

Additionally, the use of masks was promoted by health agencies worldwide in order to minimise the emission of droplets by infected people. The use of facemasks was initially somewhat controversial,

as it took several months after the start of the pandemic for scientific research to support their use. As such, it was not until the end of July 2020 that the UK Government mandated the wearing of face masks indoors (11). It should be noted that contrary to some misconceptions, the wearing of a facemask does not protect one from catching COVID-19. Rather, its primary function is to minimise the risk of others catching the virus from oneself (12).

In summary, numerous public health interventions were implemented by governments worldwide to slow the spread of the virus. While it was ultimately the vaccine that catalysed the end of the pandemic, by producing herd immunity among the population, these public health interventions ensured that the healthcare system could be sustained before vaccines were developed and widely implemented.

Pandemic - an outbreak of a disease spreading over a whole country or the world at a particular time

Quarantine - restriction on the movement of people, animals, and goods which is intended to prevent the spread of disease or pests. Comes from Italian "quarantena", meaning 40 days, which was the duration of time ships arriving in Venice were required to be isolated during the Black Death.

Respiratory disease - disease that affects the lungs and other parts of the respiratory system. If caused by pathogens, transmission is usually airborne.

Vector - carrier of a disease-causing agent from an infected individual to a non-infected individual or its food or environment.

Virus - infectious agent that can only replicate within a host organism, consisting of only a short nucleic acid chain surrounded by a protein shell (capsid)

Transmission - the passing of a pathogen causing communicable disease from an infected host individual or group to a particular individual or group.

Pathogen – microorganism that causes disease.

HOW THE COVID-19 LOCKDOWNS IMPACTED DEPRESSION IN ADULTS AND CHILDREN

By Daniel Imade

The COVID-19 Pandemic resulted in the introduction of lockdowns to the general public, which strongly impacted the mental health of both adults and children. This resulted in increased depression worldwide, namely due to the restrictions that the lockdown implemented, the increasingly stressful environment, and the prevention of social interactions.

The spread of the Coronavirus, a highly infectious disease caused by SARS-CoV-2, led to governments implementing national lockdowns [1]. Many lockdown measures resulted in bans on gathering, movement, and business restrictions, which impacted people's daily lives leading to increased depression in adults and children [5]. Depression is established as a mental health condition described by a persistent lack of interest in previous hobbies and a long-term bleak mood that lowers the quality of life, interfering with day-to-day functioning [2].

The treatment or prevention of depression is often implemented through talking therapies and social interactions [3]. During lockdown, both became more difficult to enact as restrictions prevented people from interacting in a group or leaving their homes for anything regarded as unnecessary. A meta-analysis identified that following the COVID-19 pandemic, children and adolescents experienced worsening symptoms of depression [4]. Likewise, it was identified that COVID-19 lockdowns resulted in a 25% increase in anxiety and depression globally [5]. This striking figure highlights the significance of the situation, although most research focuses more specifically on depression and anxiety levels in adults rather than children.

In children, depression is more difficult to identify and is often described as a mental illness that makes a child sad, agitated, or despairing. It could impact their social interactions, eating habits, or sleep; however, due to children often having mood swings and being more unpredictable, depression is more easily identified by an extensive period of these negative emotions. In daily life, it might hinder a child from engaging in activities they used to like, such as sports, school, or hobbies. More extremely, severe depression in children may result in suicidal thoughts [6]. Lockdown caused a rise in child depression, with increased feelings of loneliness and sadness being reported by them [7]. This is evidently due to issues like online schooling in which children lost in-person education, reducing their social interactions.

Additionally, due to the closure of schools and restrictions on movement and gatherings, many children could not interact with friends and family, resulting in weaker attachments formed by children and less developed social skills. Due to this, many children have become less able to express themselves, beginning to feel isolated, and lacking interest in activities they were restricted from carrying out [8]. Furthermore, younger children lack an understanding of the importance of lockdown measures and, in turn, found it unfair and cruel, which adds to the emotional turmoil.

In adults, depression is identified as a frequent and severe mental illness that harms one's feelings, thoughts, behaviour, and perception of the outside world [9]. Here, there is a focus on symptoms such as suicidal ideations or weight reduction, as these are more identifiable. For adults, lockdown restrictions impacted individuals' livelihoods to a greater extent as they more commonly rely extensively on in-person interactions, which reduced as of April 2020 with 82.2% of businesses in the arts and entertainment sectors being forced to close [10]. This resulted in many individuals experiencing economic uncertainty, and this increasingly stressful financial situation took a toll on people's mental health. Furthermore, adults were significantly impacted by the social isolation and changes in routines that the COVID-19 lockdowns brought. Due to the lockdown preventing social gatherings, many people had to cancel events such as weddings, trips, and funerals. Without being able to attend these, many people found themselves isolated and alone, and alongside limitations with booking in-person therapists or being able to see sick or vulnerable family members, many people found themselves developing depressive disorders [3]. By early 2021, it was identified that 21% of adults suffered from depression, a 10% increase from pre COVID-19 times [11].

To conclude, in both adults and children, depression has significantly increased due to the impact of the COVID-19 lockdowns which reduced social interactions and increased economic stresses for many. The disruption of education and socializing specifically stunted the development of children's social skills and further resulted in individuals becoming more isolated and depressive. In the future, further studies will be required to assess the long-term implications of this.

Meta-analysis: Combining results from multiple studies to find overall trends.

Prevalence: How common a condition is within a population at a specific time.

Suicidal ideations: Thoughts or plans about suicide.

Economic uncertainty: Unpredictable financial future causing stress.

In-person interactions: Face-to-face communication and engagement.

Emotional turmoil: Great emotional disturbance or confusion.

Suicidal thoughts: Thinking about ending one's own life.

Mental illness: Disorders affecting mood, thinking, and behaviour.

Mental health condition: Disorders affecting emotional and psychological well-being.

Pervasive: Widespread and persistent across various aspects of life.



LIFE SCIENCE
LEAD EDITOR: JASMINE CAMPION

COULD MICROORGANISMS SURVIVE ON VENUS?

By Caitlyn Beacall

Covid-19 is a virus that would cause moderate to significant respiratory distress to those infected. It brought the world to a standstill in 2020 and continues to have a global effect. We can see how the virus thrived on Earth, being transmitted through airborne droplets from coughing and sneezing of infected people and a combination of the temperatures, pressures and radiation present on Earth allowed the virus to survive. So, can other microorganisms survive in different conditions they have had the chance to evolve in; such as the dryness of the Martian surface, or the extreme coldness of Pluto. In this article, I will discuss the logistics of microorganisms surviving in the upper atmosphere of Venus.

We know that life has evolved on Earth throughout its 4.5 billion years, starting as single-celled prokaryotes, with the earliest known fossils having origins of roughly 3.7 billion years ago. These life-forms survived by feeding on either carbon compounds or energy from the sun. This evolution has continued to take place into life as we know it, and will persist for billions of years to come. Earth has grown to be life-sustaining due to a few factors, such as the abundance of water, which was estimated to be anywhere from 70 to 100 percent of the Earth's surface 3.5 billion years ago and a presence of key elements to support life as we know it. These elements include: carbon, hydrogen, nitrogen, oxygen and phosphorus, and when combined with specific conditions, such as extreme heat and acidity in volcanic vents early into the Earth's lifecycle allowed for extremophile bacteria to form. (1). Throughout the rest of this article, I will be looking into the possibility of extremophile bacteria being able to survive on Venus, as these specific microorganisms would be most likely to survive the harsh conditions of the Venusian atmosphere. Scientists can comfortably conclude that the Covid-19 virus would not be able to withstand conditions of this severity.

Through difficult and tedious research, astronomers have calculated that there is very little difference in certain aspects of both planets. Venus is only 320 kilometers smaller in radius, 1.1x10²⁶ kilograms lighter in mass, and 0.28 g/cm³ less dense when compared to Earth. While these variations may seem colossal, when compared to the sheer size and magnitude of the universe, are not very far apart.

However, when looking at surface temperature and pressure there becomes a striking contrast between the conditions that we know can sustain life. The surface of Venus is 464°C, 450°C hotter than Earth, and a surface pressure is 9,300 kilopascals (Kpa), this is 9,199 KPa more than Earth's surface pressure of 101 KPa. Although, when considering upper atmosphere of Venus, these drastic conditions begin to emulate those of Earth, which we know has been able to sustain life for so long. (2)

Recent climate modelling from NASA has revealed that there may have been a time when Venus had a stable atmosphere, containing liquid water on the surface for roughly 2 billion years (3). As the first known life-forms took less than 1 billion years to form on Earth, it implies that single-celled organisms, that were strong enough to withstand conditions unique to Venus, could have evolved during this time. However, we would need to consider that liquid water is no longer present on the Venusian surface, which could have eradicated these early life-forms due to a lack of time to adapt to the changing conditions. Another factor to consider is that Venus is closer to the sun, therefore experiencing much stronger solar radiation, which could make it difficult for upcoming life to develop and become stable.

However, recent studies indicate that there could be developing life-forms in the upper atmosphere. The Russian Venera space probes detected particles 1 micrometer in length in the upper atmosphere. This is roughly the same size as a bacterium on Earth and astrobiologists have hypothesised that rings of sulfur present in the clouds could provide potential bacterium with a coating that would protect them from the sulfuric acid and high UV. These probes also detected a UV absorbing feature to these 'particles', making it increasingly likely that there is indeed life on Venus. (4). As well as this, team of scientists at Cardiff university raised awareness of phosphine gas found in the clouds, roughly 31 miles up. This was extremely significant as phosphine gas is a strong biosignature and although this discovery was heavily disputed at the time of its publishing, the James Clark Maxwell Telescope has since uncovered the same gas even closer to the Venusian surface. The combination of this evidence and the knowledge that at these heights, the conditions strongly simulate an Earth-like environment peaks scientists' interests into the possibility of life on Venus. (5)

Unfortunately, technology is not at the point where we can overcome the heat and pressure that would come with sending probes to Venus, for the sole purpose of collecting samples to bring back to Earth for testing. Spacecrafts can only survive mere hours on Venus due to the conditions and getting the samples back to labs would provide immensely difficult. Scientists would also have to consider potential contamination if these samples were found to contain undiscovered life-forms, which is yet another challenge to add to the list. Due to a combination of these factors, the question of life on Venus remains a mystery until technology can advance enough for a mission to take place, however hopefully we may have an answer to this question in the future.

ATMOSPHERE ON VENUS



PHYSICAL SCIENCE
LEAD EDITOR: CAITLYN BEACALL

Glossary

- Prokaryotes** – a type of cell with no nucleus, often a bacterium
- Carbon compounds** – chemical substances containing the element carbon
- Extremophile** – a microorganism that survives in extreme temperatures, pH or concentrations
- Kilopascals** – a measurement of pressure that is 1000 pascals
- Stable atmosphere** – no extreme events that would disrupt the atmosphere massively
- Micrometer** – a unit that is equivalent to one millionth of a meter
- Astrobiologist** – a branch of biology that focuses on the possibility of life on other planets
- Biosignature** – a characteristic or substance that indicates the presence of life

HOW HAS X-RAY CRYSTALLOGRAPHY AIDED US TO DEVELOP THE COVID-19 VACCINE?

By Ishaan Amata

Salutations reader, thank you for taking the time out of your day to read this! With this article, I intend to grant insight into the purpose of x-ray crystallography, its origins and valuable role in science. More importantly, the article aims to demonstrate the development of the Covid-19 vaccine and showcase how dire the situation would have been without its development. If the treatment hadn't been formulated as fast as it was, the number of fatalities would've gravely increased, causing extreme emotional despair to the victims and families of this ruthless pathogen.

As we are all aware, Covid-19 was a tragic era of human history that will become a continuing discussion for the upcoming generations since it came with a staggering death-toll of 7 million worldwide. A pandemic of this vast scale hasn't been witnessed since the 1918-1919 Spanish Influenza with a fatality range between 24.7 – 50 million people, therefore it's demonstrated that these viruses can efficiently and effectively disrupt human life with adverse effects. Since we have all experienced the tribulations of Covid-19 as it halted the world to a standstill for roughly 2 years, causing businesses to spiral into debt as cash inflow froze, and the mental health of thousands to decline. We can confidently determine that the impacts of anything occurring similarly to this in the future will be devastating, however x-ray crystallography may be the answer to prevention and treatment. As this is a difficult topic, I recommended that you watch the video, located in the wider reading section, on diffraction.

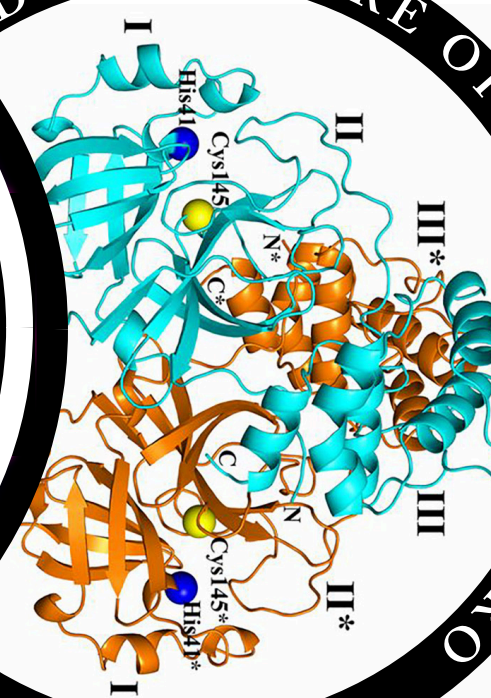
X-ray crystallography's purpose is to discover the atomic and molecular structure of mainly crystals or biological/chemical structures. This technique was developed 100 years ago by a father and son in the north of England by using a clean crystal of salt and shining x-rays into it. This produced a mesmerising pattern on the photographic paper placed behind it, due to diffraction, albeit simple, this method revolutionised how scientists would study molecules for decades to come as a more refined version was created by scientists; notably a person named Bragg. He realised that the image produced on the photographic paper held information on the salt's molecular structure. He created a formula (Bragg's Law), which allowed him to determine the arrangement of sodium and chloride ions. This matches with the modern-day model of chemical structures notably the ball and stick representation where the balls are atoms or ions, and the sticks are the bonds holding them together.

So, x-ray crystallography's purpose is to determine the structural information of molecules; but the methodology is complex as initially protein crystallization occurs, which creates a structured, ordered lattice for complex macromolecules, the production of a diffraction pattern and the analysis of this pattern produces an electron density map, a 3D plot of where the electrons are located within a space in the crystal. This creates a map of the protein structure. Since the most difficult process is having a perfect crystal to analyse, the position of the electrons must be mapped extremely accurately, therefore it's imperative the crystal's structure is flawless.

Furthermore, when the diffraction pattern is formed on the screen via the x-rays being absorbed by the crystal, it leaves behind dark diffraction spots and the electrons density (the probability of finding an electron in a specific location around an atom or molecule) is dependent on the interference between the diffracted electrons at each point, therefore the spots can accurately represent the electron density which can be mapped. Then, the analysis of the data can be undertaken to convert the data into a 3D representation of a molecular structure. The reason why this has an extremely important role in science is its application i.e. the formulation of the double-helical structure of DNA by Franklin, Watson, and Crick which then allowed scientists to identify specific genes, and other important molecular structures, including: Vitamin B12, insulin, and penicillin. This has greatly benefitted society as these various molecules are now used to save lives and treat chronic diseases. This demonstrates that X-ray crystallography has served an important role in the progression of science, but how has it been a factor for the development of the Covid-19 vaccine?

The research to formulate the vaccine was done at various beamlines (an assembly of components used to produce and maintain a high energy electron beam in a closed loop) including the BESSY II synchrotron (which is a source that produces extremely bright X-ray light). Due to their prior knowledge of the coronavirus protein because of its similarity to the Middle East Respiratory Syndrome (MERS) virus which became widespread in 2012, scientists were able to distinguish the coronavirus protease (enzymes involved in the breakdown of proteins) with efficiency, this discovery allowed scientists to administer dosages to potential drug candidates. Finally, structural biologists used x-ray crystallography to observe the behaviour of small drugs (molecules that can alter the activity of proteins when binding to macromolecules) and to identify inhibitors for the Covid-19 protease. This led to the discovery of 66 small molecules having the ability to bind to the protein. Therefore, the technique of x-ray crystallography has become the origin for the step to the discovery of the vaccine and especially the salvation of humanity.

3D STRUCTURE OF SARS-COV-2 MPRO



Glossary

- Chronic** - continuing or occurring again and again for a long time
- Interference** – the combination of 2 or more waves colliding with one another
- Imperative** – very important
- Adverse** - harmful
- Vast** – great in size, extent, degree or number
- Tribulations** – a cause of suffering
- Diffraction** – waves spreading out as they enter a narrow gap or around obstacles
- Albeit** – another word for 'though'
- Crystallization** – thickening a liquid until it becomes a solid with the atoms being highly organised
- Macromolecule** – a large molecule
- Lattice** – an arrangement of atoms

WHAT DOES THE FUTURE HOLD FOR NHS DENTISTRY AFTER THE UPCOMING ELECTION?

By Tanya Arion

BDA chairman Eddie Crouch says, "We're probably at the worst point of NHS dentistry that we've ever seen." With the UK gearing up for the next general election on July 4th, as announced by Prime Minister Rishi Sunak, the state of NHS dentistry has become a major concern. Recent surveys show that dentistry is now the least accessible NHS service in the country. The ongoing issues have only gotten worse recently, pushing the NHS crisis to the top of public and political discussions because millions of people don't have any options for dental care. The NHS, created in 1948, aimed to provide free, comprehensive healthcare to all UK residents, no matter their financial situation. But lately, the NHS has been struggling to keep up with increasing demands and limited resources, a situation made worse by the COVID-19 pandemic.

This upcoming election is a key moment to address these issues, especially for dentists dealing with an outdated NHS dental contract, a problem that's been around for nearly 20 years. The root of these problems goes back to the 2006 NHS dental contract, which set up a system where dentists are paid based on Units of Dental Activity (UDAs). In this system, treatments are grouped into three bands, each with a specific number of UDAs. However, the different durations of procedures mean that whether an NHS patient needs one filling or ten, a dentist gets the same amount of UDAs, regardless of the effort or expense involved. This system doesn't motivate dentists to work in deprived areas where patients have high levels of dental disease and need complex treatments. As a result, dental practices in these areas struggle to recruit dentists, and patients struggle to find NHS dentists. This leads to horror stories of patients pulling out their own teeth or fixing their dentures with super glue. It's clear why dental practices find it more financially viable to focus on private patients.

There have been several proposed plans to tackle these issues.

The Conservative Party plans includes a "Smile for Life" initiative offering advice to parents on oral care for baby gums and milk teeth, a water fluoridation programme, new payments for NHS dentists to treat around a million new patients who haven't seen an NHS dentist in two or more years, "dental vans" in rural areas to reach isolated communities and raising the minimum NHS activity value from £23 to £28. These measures aim to provide millions more NHS dental appointments and make it easier and faster for people across the country to get the care they need.

Despite these efforts, some in the dental profession feel that the plans don't go far enough. The Labour Party prefer a focus on prevention, with proposals to introduce a supervised toothbrushing scheme for three- to five-year-olds, as tooth decay remains the number one reason for young children's hospital admissions. This issue places a huge burden on the NHS and affects children's lives by contributing to poor health and lower economic prospects.

The Liberal Democrats plan to increase funding to ensure that everyone can access an NHS dentist within a reasonable timeframe. There are also plans to reduce the bureaucratic burden on dental practices, allowing dentists to spend more time with their patients. Improving the current dental contract to better reflect the time and effort required for different treatments is also a key point, aiming to make the system fairer for both dentists and patients.

The Reform Party have yet to publish their plans for the future of NHS Dentistry. NHS dentistry is a critical topic right now, and whoever wins the July election must prioritise improving access to NHS dental care. It's not in the spirit of the NHS Constitution for patients in severe pain to struggle to find a dentist for basic care. It's in the country's best interest to find a solution quickly

Glossary

Covenanted: To undertake an agreement.

Deprived: Suffering a severe lack of basic material and cultural benefits.

Incentivise: To encourage someone to do something.

Fluoridation Programme: The controlled addition of fluoride to public water supplies to reduce tooth decay.

BDA: British Dental Association.

UDAs: Units of Dental Activity.

THE INTERLINK BETWEEN SCHIZOPHRENIA AND COVID 19

By Niruja Suthesabasharan

The outbreak of Covid 19 had been one of the most pivotal moments within modern medicine, particularly due to the tumultuous effects it caused as well as the myriad of individuals effected. The viral contagious infection would display flu-like symptoms affecting primarily the respiratory system. However more serious instances required further medical attention with some cases resulting in death. But due to the novelty of the disease, there is still very limited knowledge regarding the influences and ramifications that may arise beyond the noticeable consequences. A recently hypothesised theory suggests that Covid 19 may have caused an increase in incidences of Schizophrenia and Schizophrenic patients are at higher risk of contracting Corona Virus.

Schizophrenia is a neurological disorder, typified by the splitting of psychological functions. The chronic psychosis results in the inability to distinguish between reality and idealism, consequently affecting the autonomy and wellbeing of individuals. The most common symptoms appear in the form of thought disorder but also entails episodic hallucinations, delusions, lack of motivation and the void of emotions. Despite the disorder being present for numerous years, the origin of the illness still remains unknown. A common ideal which is reinforced by evidence and statistics is the idea that environmental factors increase the risk of the disorder. This explains why the rise of Covid-19 has created a distressing environment which may have acted as an influence or trigger.

Many studies utilise the diathesis-stress hypothesis to strengthen their argument that there is an interlink between Schizophrenia and Corona Virus. This theory rejects the ideal of stress levels being independent to the activity of the brain but instead advocates the idea that distress acts as a catalyst for the development of neurological disorders. An idea reinforced by the facts that common symptoms of anhedonia, which Schizophrenic patients display, correlate with the behaviour of those under distress or anxiety; this again enhances how the environment created by the pandemic may have affected the activity of the brain.

Additionally, further evidence has been found that Covid-19 patients may experience neurological symptoms due to increase levels of cytokine and a state of intensified inflammation. Moreover, studies have documented that there are higher levels of deaths caused by Covid-19 patients in those that have been diagnosed with Schizophrenia (Toubasi, 2021). An MR framework was used to demonstrate the interlink, and results determined that Covid-19 hospitalisation increased the risk of Schizophrenia by 11% . Furthermore, another study completed by A Rahman highlighted the possible connection. The study elaborated that COVID-19 positive patients consistently showed a higher risk of developing schizophrenia regardless of severity of illness, compared to ARDS and COVID-19 negative patients. The risk was 4.6 times higher from 0-21 days after infection, 2.9 times higher from 22-90 days after infection and 1.7 times higher beyond 90 days after infection. These results combined with the known fact about how the strain SARS- CoV- 2 affects the brain, emphasises how the impact of the virus is not limited to the immune system, but can cause mental strain and lead to neurological impacts - notably the incidence of Schizophrenia.

Glossary

Psychosis – A collection of symptoms which affect the mind.

Anhedonia – The inability to feel pleasure.

Chronic – Long term effects.

Thought disorder – Disorganised manner of thinking which can result in the inability to express oneself properly.

Psychological – Effects upon the mind and brain.

Cytokines – Small proteins which are important in cell signalling.

Tumultuous – Something that causes great reaction, confusion or fear.

SARS-CoV-2 – A strain of Covid 19.

Diathesis – A predisposition of developing a mental disorder.



MEDICINE
LEAD EDITOR: KAYAN RANINA

COVID-19'S ROLE IN SHAPING VIRTUAL HEALTHCARE

By Lackshana Jude Clenny

Covid-19 has led to the rapid adoption of virtual healthcare, to ensure that healthcare professionals would still be able to provide patients with continuous care; despite the limitations and restrictions that were put in place due to Covid-19 to reduce the risks of transmission. This article will discuss how virtual healthcare first evolved, how it helped control the flow of patients during the pandemic, and how it can still be used in the future.

'The 2019 coronavirus pandemic has forced healthcare systems to balance the risk of Covid infection with the potential negative impacts of delaying care.' (1) Consequently, the NHS had to rapidly change their strategies to accommodate as many patients as possible, leading to the growth of virtual care services. Virtual healthcare refers to the alternative to face-to-face appointments, where patients can get medication from the photos and videos they provide of their condition, therefore this includes the delivery of clinical services between the healthcare provider and the patient remotely. (2)

Although telemedicine has become more apparent due to Covid-19, it has been around for many years. Initially the application of telemedicine evolved from the invention of telegraphs in 1844, 'the telegraph found a use by Union Army in the Civil War to communicate troop casualties, coordinate patient transport, and request medical supplies.' (3) Telehealth improved at an incredible pace during Covid-19 with the need to adapt the way healthcare was provided to the patients due to the implementation of physical distancing measures and restrictions. In March 2020 guidance was issued to primary care providers stating that patients needed to be triaged before an appointment and that remote appointments needed to be used where appropriate to reduce the risk of infection due to Covid-19. 99% of GP practices used remote consultation platforms before offering appointments depending on their particular needs. Prior to the pandemic 80% of GP appointments were conducted in person which states to the extent which Covid-19 had shaped virtual healthcare. (4) There were many more advantages that virtual health care provided during the pandemic including increased access to care as people living in remote areas were able to benefit from virtual healthcare which would have been difficult to otherwise reach. Patient satisfaction also increased, scoring 9/10 on a scale of 0-10 and clinicians' satisfaction also increased despite the drawback of telehealth. (5)

However, the sudden growth in virtual healthcare had many challenges and limitations associated with it. As the UK has an ageing population, the elderly would have found it more challenging to adapt to the new systems as they weren't very familiar with how to use the technology, compared to the younger people. There were also smaller obstacles, such as technical issues due to inadequate internet access, which prevented patients from getting the proper care that they needed. Privacy and security concerns also emerged as there were concerns about confidentiality of patient information. (5) In addition, primary healthcare providers wouldn't have been able to access everyone properly as their sense of touch would have been limited, with eventually having to call patients into the clinic to access them properly.

Covid-19 made it clear to healthcare professionals how effective virtual healthcare can be, therefore following Covid-19 people with less urgent issues and problems are given medication and advice over the phone. Studies have also found out that telehealth is more sustainable than face-to-face consultations due to the reduced greenhouse gas emissions released through. (6)

In conclusion, Covid-19 has been a catalyst for the development of virtual healthcare, as it enabled healthcare professionals to provide continuity of care throughout the pandemic. Telehealth will continue to grow and find ways to reduce the challenges and limitations that it currently faces.

Glossary

Triaged: conduct a preliminary assessment of (patients or casualties) to determine the urgency of their need for treatment and the nature of treatment required.

Consultations: a meeting with an expert or professional, such as a medical doctor, to seek medical advice.

Telemedicine: the remote diagnosis and treatment of patients by means of telecommunications technology.

Implementations: process of putting a decision or plan into effect – execution.

COVID & THE PSYCHE

By Tafara Fair

The human mind craves stimulation and social interaction. During our time spent with others, a series of chemicals are released, namely oxytocin and dopamine. These are essential for overall contentment and fulfilment for human life. So, what happens when we are deprived of such pleasures and are left to the constraints of our own mind? What is the effect of such large-scale isolation? Not only on an individual basis but for the larger community and consequently the NHS. The COVID-19 pandemic profoundly affected global health, not only through direct viral infection but also through the psychological repercussions of prolonged isolation and social distancing measures. These effects have posed significant challenges for psychiatric care, particularly within the NHS.

Quarantine particularly affected vulnerable groups, including the elderly, those living alone, and individuals with pre-existing mental health conditions. The lack of social interaction and support exacerbated feelings of loneliness, which is closely linked to depressive symptoms and anxiety. A survey conducted by the Office for National Statistics (ONS) in the UK reported that the proportion of adults experiencing some form of depression doubled from around 10% pre-pandemic to 20% during the pandemic. Factors such as fear of infection, grief over the loss of loved ones, financial strain, and the disruption of daily routines were identified as key contributors to this increase in mental health issues. Prolonged isolation can lead to significant psychological stress, manifesting in symptoms such as sleep disturbances, cognitive decline, and increased substance abuse as individuals seek coping mechanisms. A less researched area of interest is the decline in mental health for NHS staff. Frontline healthcare workers faced immense pressure and trauma, leading to higher rates of PTSD. The continuous exposure to critically ill patients, high mortality rates, and the stress of working in high-risk environments have taken a substantial toll on their mental health.

These factors, among many others, placed unprecedented demands on psychiatric care services within the NHS, necessitating rapid adaptations and innovations in service delivery. This surge highlighted the need for more funding and resource allocation in the psychiatric sector. There was an increase in emergency psychiatric interventions, including hospitalizations and crisis support, as individuals more frequently, experienced acute mental health crises.

To mitigate the challenges posed by social distancing, the NHS rapidly adopted telepsychiatry as a means to continue providing care. This shift enabled patients to access psychiatric services remotely, ensuring continuity of care while minimising the risk of virus transmission. While telepsychiatry had expanded access to care and provided convenience, this mode of delivery also posed challenges. Not all patients had access to the necessary technology, or the privacy needed for confidential consultations. Additionally, some clinicians expressed concerns about the limitations of virtual assessments, particularly for patients with severe mental illnesses who require more comprehensive evaluations - this is especially true for patients on the spectrum. Virtual interactions made it harder to pick up on nonverbal cues, which are important in psychiatric evaluation. In the worst cases, this could lead to misdiagnosis and a general sense of distance between doctor and patient.

To conclude, the COVID-19 pandemic and the resulting isolation measures have had profound effects on mental health, significantly impacting psychiatric care within the NHS. The surge in mental health issues has necessitated rapid adaptations, including the adoption of telepsychiatry and the implementation of other innovative support models. Moving forward, sustained investment in mental health services and continued innovation will be crucial to address the long-term psychological consequences of the pandemic and to ensure that individuals receive the care they need.

Glossary

Oxytocin- Often called the "love hormone". It helps promote trust, empathy, and bonding in relationships.

Dopamine- Known as the "feel-good" hormone, dopamine is a neurotransmitter that's an important part of your brain's reward system. It's associated with pleasurable sensations, along with learning, memory, and more.

Quarantine- A restriction on the movement of people, animals, and goods which is intended to prevent the spread of disease or pests.

PTSD- post-traumatic stress disorder is an anxiety disorder caused by very stressful, frightening or distressing events.

Cognitive decline- Cognitive decline refers to the difficulty with a person's thinking, memory, concentration, and other brain functions beyond what is typically expected.

Telepsychiatry- A subset of telemedicine that concerns the use of telecommunications technology to deliver psychiatric care remotely for people with mental health disorders



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