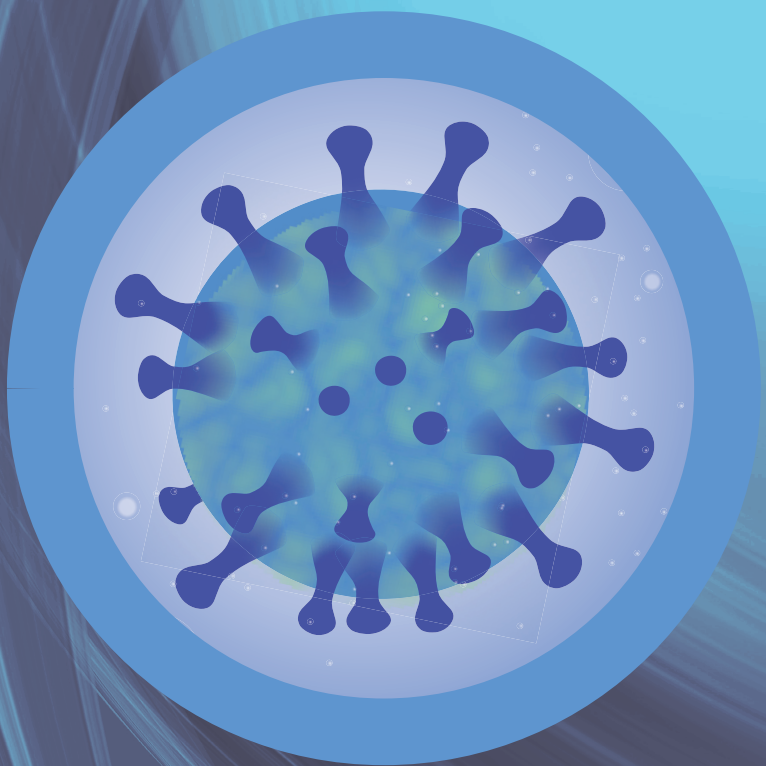
ISSN 0036-679X (print)
0972-5061 (online)

School Science

A Quarterly Journal of **SCIENCE EDUCATION**

Vol. 58 Nos. 3 & 4 **Sept. - Dec. 2020**



Thorny crown-like appearance of Coronavirus

* This issue is printed in February 2024

ISSN 0036-679X (print)
0972-5061 (online)
Vol. 58 Nos. 3 & 4 Sept.-Dec. 2020

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EDITORIAL

The detection of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) in Wuhan, China, in December 2019 and its subsequent spread throughout the world marked the beginning of havoc, chaos, disruption, and despair as it caused the deadly disease, Coronavirus Disease 19 (COVID-19). With people dying in the hundreds and thousands worldwide from COVID-19, governments became proactive; borders were closed, lockdowns were imposed, all kinds of guidelines were issued, every public institution came to a standstill. While common people were terrified of contracting and spreading the disease, the healthcare sector—hospitals, medical practitioners, healthcare workers, scientists, researchers, pharmaceutical industries stood out to address the challenges. Scientists and researchers geared up their study about the nature and spread of SARS-CoV-2, providing the much-needed input for the pharmaceutical industries to develop vaccines and other possible ways of treatments for COVID-19. The impact of COVID-19 was felt by one and all. The education sector was not spared; in fact, it was one of those hardest hit not just because of the closure of schools and colleges but because of the impact it had on the students' and teachers' mental health. We had to immediately transition into the online mode of teaching-learning, which was a challenge for all stakeholders—curriculum developers, teachers, students, parents, etc., either due to lack of devices, lack of knowledge of handling devices or use of online resources, internet connectivity issue, etc. The high possibility of SARS-CoV-2 having made its way from the wild has taught us that we can no longer afford to play with nature.

Considering the above-mentioned devastating impacts of SARS-CoV-2 on our lives, a special issue is being brought out. The special issue will be in two series, each containing ten articles. In the first series of the special issue, we have included articles related to SARS-CoV-2, mental health, drug repurposing, online teaching-learning, community participation, COVID-19 appropriate behaviour, and the importance of effective communication.

In addition to the articles, this issue also contains Science News.

We welcome your valuable suggestions. Happy reading and happy learning!

COVID-19: WHAT SHOULD WE KNOW?

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The Coronavirus Disease 2019 (COVID-19) following its first outbreak in Wuhan, China has rapidly spread all over the globe as a pandemic with unprecedented morbidity and mortality. Majority of this explosive spread have occurred by human to human transmission through aerosol route with a minor element of transmission through contaminated surfaces. This brief review article describes in a simplified manner the basic understanding about the virus, the pathobiology of infection, modes of transmission and preventive measures to avoid the infection.

Keywords: SARS-CoV-2, COVID-19, ACE2, fomite

What is COVID-19?

An outbreak of new type of RNA virus infection causing severe acute respiratory syndrome was reported in the city of Wuhan, China in December 2019. This disease was described as Coronavirus Disease 2019 or COVID-19. In February 2020, the International Committee on Taxonomy of Viruses (ICTV) announced the name of the new virus as "severe acute respiratory syndrome Coronavirus 2 (SARS-CoV-2)" because of its predominant clinical presentation affecting respiratory system in humans.[1] This virus belongs to a large group of viruses which has a covering of spikes forming a crown like thorns (Fig. 1). The Latin word for crown is *corona* which is the source of the name of this virus.

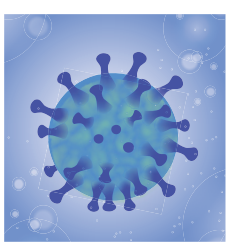

Fig. 1.Thorny crown-like appearance of Coronavirus

Why is it called "Novel" Coronavirus?

The RNA viruses with presence of corona (Coronavirus group) cause infections in mammals and birds mainly affecting respiratory tract; with symptoms ranging from mild self-limiting to severe lethal disease. The mild disease results in symptoms like "common cold" whereas severe disease results in "Severe Acute Respiratory Syndrome" (SARS). The COVID-19 or SARS-CoV-2 has several unique features in its transmission and pathobiology of the disease in humans which are not seen in earlier infections with other types of coronaviruses. That is why it is called as a "Novel Coronavirus" by many experts. These unique features of the virus are described in this article.

Where did COVID-19 come from?

The Coronavirus infection was first noted in the city of Wuhan, China. Several experts

felt that the virus infection was transmitted to human beings from bats as there was significant structural similarity between the bat coronavirus and the coronavirus causing COVID-19. It was believed that the large open-air wet market in the city of Wuhan which sells fish, meat and other products from large variety of domestic and wild animals kept in poor hygienic conditions, might have led to the animal to human transmission. However, selling of bat meat at Wuhan could not be documented during the outbreak of infection. Therefore, another theory was proposed which advocated its transmission from Pangolin which also harbors similar virus. However, unlike previous coronavirus infections in human in the form of SARS (2002) and MERS (2012) which are described below, a definite proof of animal origin of the virus or intermediate animal host is yet to be established. Nevertheless, whatever may be the exact source of the current novel virus, it is spreading rapidly through human-to-human contact.

What is the history of Coronavirus infection in humans?

Reviewing human infections reveals that till date there are seven coronaviruses which can infect humans.[2] In 1965, the first human coronavirus infection was identified causing common cold-like symptoms. A coronavirus infection causing SARS was then detected in south China in 2002 spreading to 28 countries causing death of 774 individuals. Similar outbreak of SARS was noted in the Middle East countries in 2012 killing 858 people which was called Middle East Respiratory Syndrome (MERS). The latest infection of human coronavirus is COVID-19 which has spread in 220 countries across the world involving all continents infecting more than 57 million people with more than 1.3 million deaths. As on 16th January 2021, total number of cases in the world was 94,418,097 leading to the death of 2,020,165 patients. The number of infections per million population was highest in the United States of America (72,592) whereas it was significantly low (7,600) in India. However, considering the large population of about 138 crores India was the second country in the world in terms of total number of infections.[3] The total number of infection on the above mentioned date was highest in USA (24,104,425) followed by India (10,543,659)3.

How does COVID-19 spread?

Understanding the mode of transmission of coronavirus is very important to identify the preventive measures and stop the spread of infection. The virus is transmitted through one of the following modes as described in WHO scientific brief[4]:

(a) Contact and droplet transmission – It can spread by direct, indirect and close contact with an infected person through their secretions like saliva and respiratory droplets. Shaking hands with an infected person can lead to the spread of infection to other persons by direct contact. The droplets, respiratory secretions in the size range of 5 to 10 µm diameter, are released from the body through nose and/or mouth via coughing, sneezing, spitting, singing and even talking. The respiratory droplets equal to 5 µm diameter and smaller are termed as droplet nuclei or aerosol. The respiratory droplets containing virus from the infected

person can infect other person through the mouth, nose, eyes or in close contact within a distance of 1 metre. The respiratory droplet can also stick to surfaces of nearby objects and can be transmitted to others which is described in detail below as fomite spread.

(b) Airborne transmission – The air drop nuclei or aerosol (size less than 5 µm) because of their smaller size can remain suspended in the air for long time in a closed space and it can affect people staying at a distance more than 1 m. In crowded and closed places, there is a higher chance of aerosol and droplet-mediated transmission.

(c) Fomite transmission – Secretions from infected person can contaminate surface of objects like furniture, cloth, utensil, etc. The virus can stay alive on the surface for different period ranging from a few hours to few days depending on the nature of the surface, humidity and temperature.

(d) Faecal transmission – Few cases have reported presence of virus in the faeces of infected person highlighting a possibility of faecal transmission.

How does infection occur with development of symptoms?

Any person can inhale the respiratory droplet/ aerosol discharged from an infected person. Once the SARS-CoV-2 virus enters the nasal cavity and throat of the individual, they come in contact with Angiotensin Converting Enzyme 2 (ACE2) receptors in the lining cells and binds with them. The virus enters the cells through this receptor, hijacks the cell's machinery making large number of copies of itself and invades new cells. This is the reason for taking nasal and throat swab while diagnosing the infection. The virus multiplies in the infected cells and the person may shed it in large number in the secretions and respiratory droplets in the first few days when he/she may be asymptomatic but can infect another person.

After contracting infection, the person develops variable symptoms after 7 to 10 days. The usual symptoms are sore throat, fever, dry cough, loss of smell and taste, tiredness and breathing difficulties. In persons with weak immune system, especially in old age or with other systemic diseases like hypertension, diabetes, chronic respiratory diseases, malignancy, etc., there is a higher risk of infection. In severe cases, the virus affects the lower respiratory tract where the lining epithelium is rich in ACE2 receptor causing pneumonia and acute respiratory distress syndrome (ARDS). Other vital organs like brain, liver, heart, kidney, gastrointestinal tract can be affected by the virus less commonly with and without blood coagulation abnormality.[5]

What is the basic structure of SARS-CoV-2?

The SARS-CoV-2 virus has a lipid envelope with spike surface glycoprotein (S), small envelope protein (E), matrix protein (M), and nucleocapsid protein (N) containing RNA in the core with a size of 70 – 90 nm (Fig. 2). The spike protein enables the virus to infect cells through ACE2 receptor (Wadman, et al., 2020).

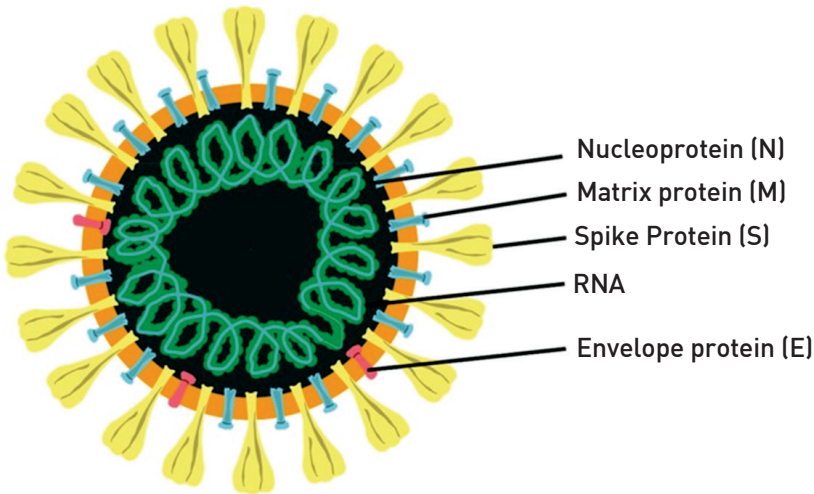

Fig. 2. Schematic diagram of the SARS-CoV-2 virus

What are the organs affected following SARS-CoV-2 infection?

As shown in Fig. 3, the major organs involved in the infection includes lungs, heart, blood vessles, liver, kidney, brain, eye, nasal track and intestine. The symptoms develop in patients according to the pathology of the organ involved.

What are the diagnostic tests for SARS-CoV-2?

The detection of specific viral nucleic acid by Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) is the primary mode of diagnosis. RT-PCR method includes the reverse transcription of SARS-CoV-2 RNA into complementary DNA (cDNA) strands, followed by amplification of specific regions of the cDNA (Udugama, et al., 2020). According to the recommendation of Indian Council of Medical Research, the other test useful for screening of the disease is Rapid Antigen test which can be done quickly as a point of care diagnosis. The detection of specific antibody in the serum is also indicative of earlier infection.[6]

How can we prevent the spread of infection and protect ourselves?

At present there is no highly effective antiviral drug for treatment of COVID-19. Several vaccines are now available for immunization and protection against the infection. Considering the large population in India it will take several months to year to vaccinate the majority of individuals. So, till we can complete vaccination of the majority of our population or get an effective drug for fighting this devastating infection, we should know how we can protect ourselves and prevent spread of this infection. None of the vaccines currently available can protect 100% infection. During infection the virus can mutate and some of the mutants may partially evade the immune response. So even after

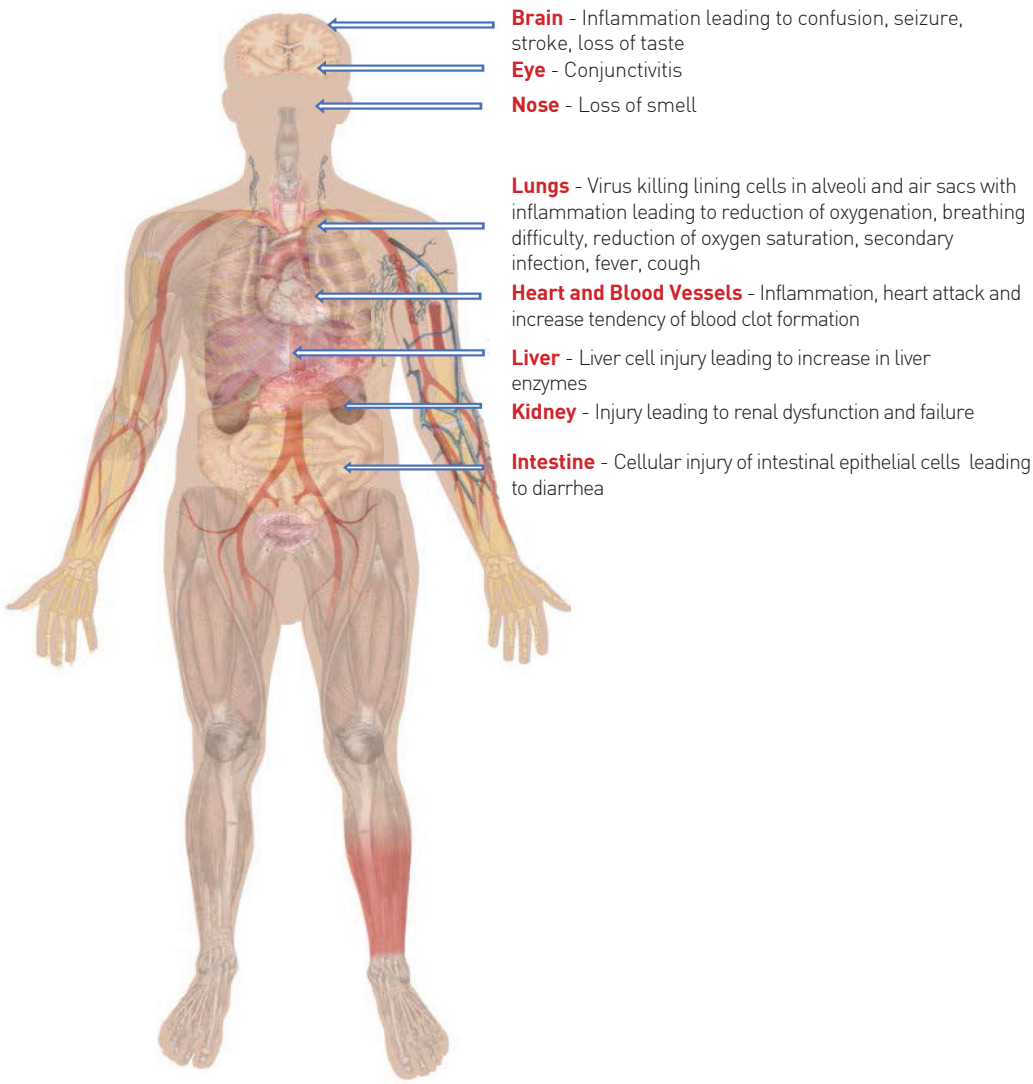

Fig. 3. The schematic diagram showing the involvement of different organs following SARS-CoV-2 infection

vaccination all of us have to continue to take appropriate measures to avoid spread of infection caused by mutant virus. At present, most of the students are studying from home through online classes. Understanding the logistics and principles of protection will be very important when the rate of infection will reduce to prevent its next surge. The different preventive measures are discussed as follows:

(a) *Mask*: Wearing a mask properly covering both mouth and nose is the most important mode of prevention. It prevents entry of respiratory droplet from the infected person. Also, it will prevent spread of droplet by the infected person who may be symptomatic or asymptomatic. The mask should be worn for all the time when a person is outside the home. Students should wear the mask in the class as well as during all other activities. In situations, when it has to be taken out, like during eating, the person should avoid sitting with other person in close distance. One should avoid touching exterior surface of the mask and soil it. The mask should be disposed properly in the designated container. The reusable mask should be washed in soap water and dried before next use.

(b) *Social Distancing:* Maintaining social distancing more than 1 metre significantly reduces the chance of inhaling a respiratory droplet from another person. This distance should be maintained in the class as well as during all other activities outside home. Any sport or other recreational activities which need close contact must be avoided. Going to crowded places should also be avoided.

(c) *Hand washing and sanitization:* Frequent hand washing with soap is one of the best measures to avoid spread of infection from the contaminated objects or fomites which has been described earlier. The soap wash should be done for a duration for 20 seconds or more to deactivate the virus. In case, hand washing is not possible, hand sanitizers with 70% ethyl alcohol should be used. The students should realize that even mobile phones used by multiple persons can carry the infection.

(d) *Surface sanitization of furniture and other objects:* The surface sanitization should be done for furniture, floor and other objects by antimicrobial agents which are easily available in the market. For indoor surface sanitization, mopping is a good method whereas for outdoors, spraying can be done for treating large surfaces.

(e) *Ensuring circulation of outside air:* The windows should be kept open for circulation of outside air which can reduce accumulation of aerosol and droplets in the closed environment.

(f) *Improving self-immunity:* Good immunity is the most important weapon to fight this infection at present. Nutritious food with adequate protein, vitamins and minerals, regular exercise and good sleep are essential requirement for good immunity. Fresh vegetables, fruits, spices like *haldi* (turmeric), *jeera* (cumin), *dhaniya* (coriander) and *lahsun* (garlic) are helpful to boost immunity. Indoor exercise is encouraged. For outdoor exercises, all precautions must be taken as mentioned above.

Conclusion

The COVID-19 infection has disrupted our normal life. Though, the online classes and social media-based technology have

helped to support our learning activities, they cannot replace direct interaction between students and teachers in the schools. Also, the interaction between friends in the schools, in and outside classrooms, and in the playground cannot be replaced by social media. Reopening of school with normalisation of activities can be done gradually in a stage-wise manner provided we can prevent spread of the infection and significantly reduce the infection rate. Even after vaccination, reinfection can occur in few individuals with a mild course of illness. So, all of us have to follow the preventive norms sincerely and honestly to win the fight against COVID-19.

References

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it

https://science.thewire.in/environment/coronavirus-zoonotic-infectious-diseases-antimicrobial-resistance-one-health/

https://www.worldometers.info/coronavirus/

https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

https://www.sciencemag.org/news/2020/04/how-does-coronavirus-kill-clinicians-trace-ferocious-rampage-through-body-brain-toes

https://www.icmr.gov.in/pdf/covid/strategy/Testing_Strategy_v6_04092020.pdf

Udugama, B., Kadhiresan, P., Kozlowski, H. N., Malekjahani, A., Osborne, M., Li, V. Y. C., Chen, H., Mubareka, S., Gubbay, G. B., and Chan, W. C. W. 2020. Diagnosing COVID-19: The Disease and Tools for Detection, *ACS Nano*, Vol.14, No.4, pp. 3822-3835. DOI: 10.1021/acsnano.0c02624

Wadman, M., Couzin-Frankel, J., Kaiser, J., and Matacic, C. A. 2020. A Rampage through the Body. *Science*, Vol. 368. No. 6489. pp. 356–360.

COVID-19 APPROPRIATE BEHAVIOUR – WHY DO WE DO WHAT WE DO?

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Nonpharmaceutical Interventions (NPIs) are actions that people and communities can take to help slow the spread of diseases. These measures aim to reduce transmission, thereby delaying the timing and reducing the size of the epidemic peak, and buying time for preparations in the healthcare system. During the current COVID-19 pandemic, the NPIs are in place, and invariably, every citizen has been practising appropriate behaviours such as hand washing with soaps—solid or liquid, using appropriate mask, maintaining social distancing, etc. However, majority of the populations are not aware of why and how such practices help. This paper sheds light on the scientific and historical context of such COVID-19 appropriate behaviours.

Keywords: COVID-19, SARS-CoV-2, nonpharmaceutical interventions, quarantine, isolation.

Introduction

Coronavirus (COVID-19) is a contagious disease caused by a newly discovered coronavirus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2). Most individuals infected with this virus will experience mild to moderate respiratory illness and recuperate without requiring special treatment. However, older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop severe illness. This virus is widely postulated to have originated from animals implicating zoonotic transmission and is well supported by genomic comparative analysis between the human SARS-CoV-2 sequence and beta-CoV RaTG13 of bats (Rhinolophusaffinis) with high homology of 96 per cent (Cascella, et al., 2020). Further, human-to-human transmission results from exposure to infectious respiratory fluids containing the virus. As the world grapples to contain COVID-19, efforts are being made from every possible dimension ranging from Nonpharmaceutical interventions (NPIs) like Covid appropriate behaviours to pharmaceutical measures like drugs and vaccinations.

Non-pharmaceutical Interventions

Non-pharmaceutical Interventions (NPIs) are actions that people and communities can

take to help slow the spread of diseases like COVID-19. NPIs are also known as community mitigation strategies. Because this pandemic caused by coronavirus is new, the human population has little or no immunity against it. This allows the virus to spread quickly from person to person worldwide. During a pandemic as this, a vaccine or a therapeutic drug is not immediately available for treatment; hence, personal NPIs and community NPIs become some of the most important ways individuals can protect themselves and others until herd immunity is achieved. NPIs are broadly divided into two:

(i) Personal NPIs are everyday preventive actions undertaken by individuals, apart from pharmaceutical interventions such as getting vaccinated and taking medicines to help keep ourselves and others from getting and spreading respiratory illnesses. Preventive measures like staying home when sick or when exposed to a family or household member who is infected go a long way in helping individuals and stopping transmission.

(ii) Community NPIs are policies and strategies, apart from pharmaceutical interventions such as vaccination and medical treatment delivery methods, that organizations and communities put into place to help slow the spread of illness during an infectious disease outbreak. Closures of child care centres, schools, universities, places of worship, banning sporting events, concerts, festivals, conferences, and other settings that attract a large conglomeration of people are some of the other community NPIs.

During this COVID-19 pandemic, the NPIs are in place, and invariably, every citizen has been practising appropriate behaviours such as hand-washing with soaps—solid or liquid, using appropriate mask, maintaining social distancing, etc. Such practices are not random ideas or norms set up by the whims and fancies of a set of authorities, organisations, or governments but are based on science and scientific findings. That said, majority of the populations, including the educated lot, are not aware of why and how such practices help. This paper sheds light on the scientific and historical context of the practice of social distancing, quarantine measures for suspected and infected individuals, wearing masks, and hand hygiene.

Social Distancing

Social distancing or physical distancing means keeping a safe distance between ourselves and others who are not from our household in outdoor settings and indoor settings. Social distancing can prevent contact and droplet transmission. Transmission of SARS-CoV-2 can occur through direct, indirect, or close contact with infected people through secretions such as saliva and respiratory secretions or their respiratory droplets, which are expelled when an infected person coughs, sneezes, talks, or sings. These secretions are widely classified based on their size. For example, respiratory droplets are more than 5 μm in diameter, whereas droplets less than 5 μm in diameter are referred to as droplet nuclei or aerosols. Respiratory droplet transmission can occur when a person is in close contact (within 1 metre) with an infected person who has respiratory symptoms (e.g., coughing or sneezing) or who is talking or singing; in these

circumstances, respiratory droplets that carry the virus can reach the mouth, nose or eyes of a susceptible person and can result in infection.

Studies have acknowledged that both infected people with symptoms and those without symptoms are equally likely to spread the infection. In such a scenario, we do not know who is infected and who is not; it is best advised to stay at a considerable distance from people of another household (Centers for Disease Control, 2020). So, what distance is safe? How far is far enough to limit the spread? The math to arrive at the calculation for social distancing is somewhat complex and challenging as it depends on many variable influencing factors. There is no absolute answer for this problem. But four key factors must be considered (Ciric, 2020).

(a) **Respiratory droplets:** When we breathe, talk, cough, and sneeze, thousands of droplets are expelled from our mouth and nose. However, the size and the number of droplets are different and become essential for studies. The larger droplets contain more virus particles, and the higher the number of droplets, the higher the virus particles. Also, larger droplets settle more quickly because of gravity. Smaller droplets, carrying fewer particles, can remain suspended in the air for hours. The number and proportion of droplets released by the person vary depending on the activity that he/she indulges in. A cough produces more droplets overall, and a more significant proportion of them are larger. Breathing produces fewer droplets overall, and the droplets are also generally smaller. The speed with which the droplets leave our mouth and nose also influences how far they travel—sneeze droplets travel furthest.

(b) **Viral load:** Viral load refers to the number of copies of the virus in a sample. The number of virus copies in the respiratory samples of COVID-19 patients can vary from a few thousand to hundreds of billions per millilitre. The viral load varies from one person to another and depends on the patient's stage of the illness. Knowing the viral load in respiratory droplets allows us to calculate how many virus particles people may be exposed to and whether this might be enough for them to become infected.

(c) **Infectious dose:** The infectious dose is the number of copies of the virus that our body needs to be exposed to develop an infection. When it comes to calculating a safe distance, the closer we are to an infected person, the more likely we are to be exposed to the infectious dose by breathing in virus-laden droplets. The infectious dose for influenza strains varies from thousands to millions of copies. We do not yet know this number for SARS-CoV-2. Further research on the virus and comparisons to other viruses will help to hone this number. In any case, we can be sure that the infectious dose will vary between different people.

(d) **The environment:** Whether we are indoors or outdoors, in school, at work, on public transport, or in the supermarket, the flow of air, ventilation, temperature, and humidity

all these circumstances will influence what happens to respiratory droplets.

These factors are not absolute but will give us a fair idea for calculation. A study funded by WHO across 16 countries and six continents, with no randomised controlled trials and 44 relevant comparative studies in health-care and non-health-care settings (n=25 697 patients) found that transmission of viruses was lower with the physical distancing of 1 metre or more, compared with a distance of less than 1 metre; protection was increased as the distance was lengthened. The ideal distance was found at two metres but becomes practically non-implementable at many smaller infrastructural settings finding it challenging to accommodate even a few people (Chu, et al., 2020). Change in relative and absolute risk with increasing distance is provided in Figure 1.

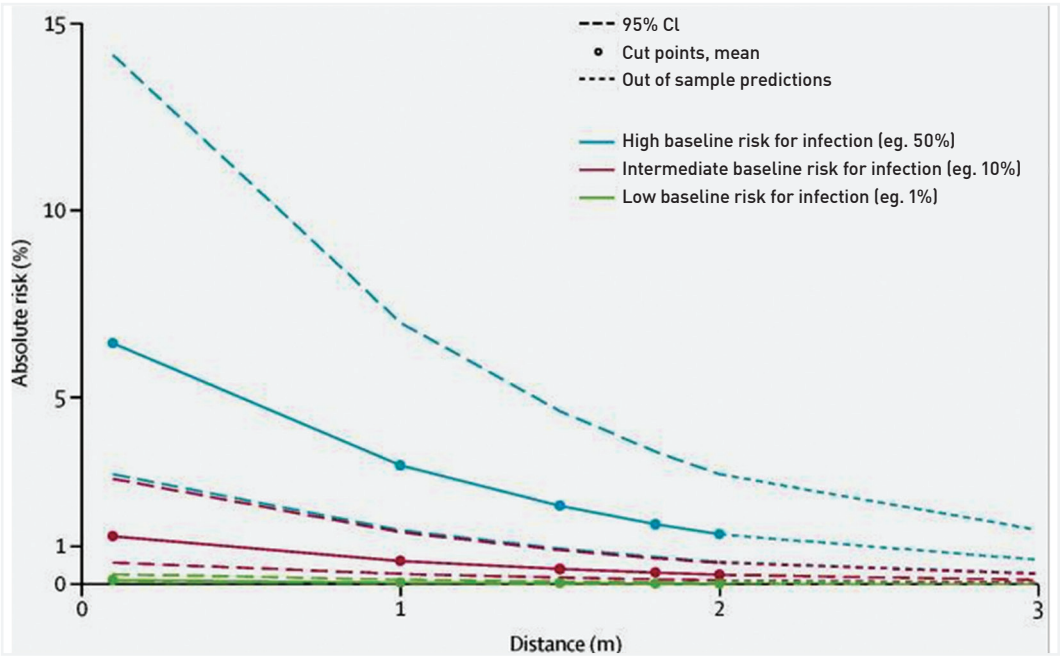

Fig. 1. Change in relative risk with increasing distance and absolute risk with increasing distance [Reproduced from: Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis (Chu et al., 2020)]

Quarantine/ Self Isolation

The term 'quarantine' is derived from the Italian number *quaranta*, or 40, and the practice originated in 1347-1348 when the 'Black Plague' was sweeping across Europe. Venice founded the first quarantine island, Lazzaretto Vecchio, Santa Maria di Nazareth Island, and became the first city to close its ports to incoming ships to slow

the spread of disease. When a successive wave of the plague hit in 1485, the same Italian city required all vessels coming from infected ports to be detained for 40 days. For COVID-19, health officials recommend that people in a city or region with a high number of positive cases or who have come in contact with infected individuals should go into 14 days of self-quarantine.

But what is the science behind 14 days? Why not 6, 10, or even 20 days? The answer comes down to the virus' incubation period, i.e., the time between exposure to the virus to the time when symptoms begin to show. Incubation periods vary from virus to virus (Fig. 2). People also start to develop symptoms at different rates. Health agencies like WHO and CDC (Centers for Disease Control) use data on a virus's incubation period to set their guidelines for quarantine periods. SARS-CoV-2 most commonly has an average incubation period of five days. In addition, about 97 per cent of people who contract the virus will show symptoms within 11 days. That means most people who have been infected with the novel coronavirus will likely show symptoms within 11 days. By setting 14 days for the self-quarantine period, officials allow extra time for people to be certain they have not been infected and cannot spread the virus to others (breakthroughs.com). Social distancing and self-isolation measures must be started as close to the time of disease onset as possible and sustained throughout the peak of disease trajectory in local communities to be most effective. In recent years, these NPI measures have been effective in reducing the impact of H1N1 and containing the 2003 outbreak of SARS-CoV.

Masks

Reducing the transmission of COVID-19 requires two factors: limiting contacts of infected individuals via physical distancing and other measures and reducing the transmission probability per contact. Mask wearing reduces transmissibility per contact by reducing transmission of infected respiratory particles in laboratory and clinical contexts, public settings. Masks create a

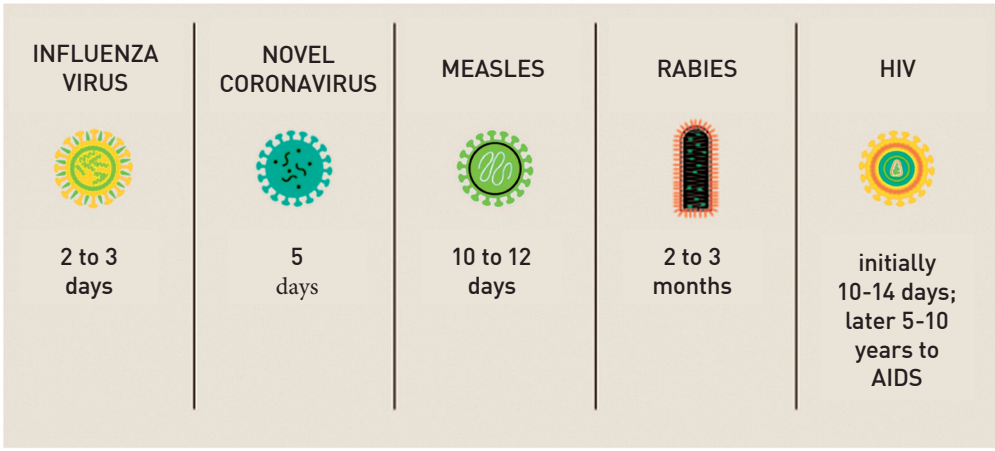

Fig. 2. The incubation period of various viruses

physical barrier that catches these droplets and prevents them from spreading as far into the surrounding air as they usually would. Masks can be used to protect healthy persons or prevent onward transmission (source control) because they can prevent larger expelled droplets from evaporating into smaller droplets that can travel farther (Bai, 2020). Facemasks reduce aerosol exposure by combining the filtering action of the fabric and the seal between the mask and the face. The filtration efficiency of the fabric depends on a variety of factors: the structure and composition of the fabric and the size, velocity, shape, and physical properties of the particles to which it is exposed (Davies, et al., 2013). Although any material may provide a physical barrier to an infection, if, as a mask, it does not fit well around the nose and mouth, or the material freely allows infectious aerosols to pass through it, then it will be of little benefit. Masks become even more critical because a significant proportion of people who get COVID-19 either do not exhibit symptoms or there is a delay before symptoms show up. The use of face coverings can help limit the spread of the disease by these asymptomatic and pre-symptomatic individuals. The virus itself is only about 0.1 µm in diameter. However, because viruses do not leave the body independently, a mask does not need to block particles that small size to be effective. Masks block particles a little larger than 1 micrometre. Pathogen-transporting droplets and aerosols range from about 0.2 µm to hundreds of micrometres across. As a reference, it may be mentioned that an average human hair has a diameter of about 80 µm (Peeples, 2020).

1. How to test the efficiency of the mask?

Determining face mask efficiency is a complex topic that is still under the active field of research. This is made even more complex in the case of COVID-19 because the infection pathways are not yet fully understood and are further complicated by many other factors such as route of transmission, correct fit, and usage of masks and environmental variables. Recently, Fischer, et al. (2020) have come out with a low-cost measurement of face masks efficiency for filtering expelled droplets during speech, cough, and sneezing. A schematic and demonstration image of their experiment is reproduced in Figure 3. In brief, an operator wears a face mask and speaks or coughs or sneezes in the direction of an expanded laser beam inside a dark enclosure. Droplets that propagate through the laser beam scatter light, which is recorded with a cellphone camera. Analysis of the videos is performed with the simple algorithm 'Mathmathica' (Wolfram Research) and is used to count the droplets in the videos. Other methods to evaluate efficiency include air sampling techniques like forcing aerosol particles through different masks and calculating their efficiency. Viruses or bacteria will behave predominately in the air as a result of their physical characteristics rather than their biological properties; that is, virus particles will travel in the air in the same manner as particles of equivalent size and therefore become easy to study and corroborate (Davies et al., 2013).

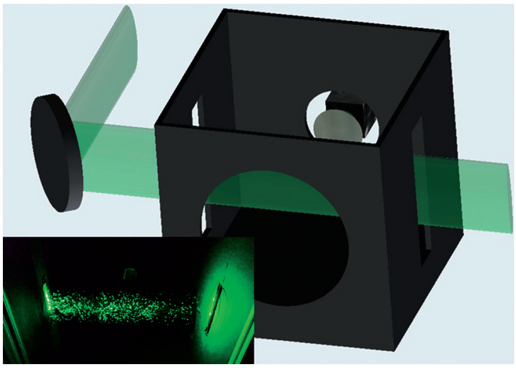

Fig. 3. Schematic image of the experimental setup. A laser beam is expanded vertically by a cylindrical lens and shined through slits in the enclosure. The camera is located at the back of the box, with a hole for the speaker in the front. The inset shows scattering for water particles from a spray bottle with the front of the box removed. [Reproduced from: Low-cost measurement of face mask efficacy for filtering expelled droplets during the speech (Fischer et al., 2020)]

2. Categories of masks

There are broadly three types of masks in use. They are briefly discussed below.

(i) *N95 respirators*

An N95 respirator is a respiratory protective device designed to achieve a very close facial fit and efficient filtration of airborne particles. The edges of the respirator are designed to form a seal around the nose and mouth. N95 respirators can protect against smaller respiratory droplets. These respirators made by different companies have different filtration efficiencies for the most penetrating particle size (0.1 to 0.3 microns), but all were at least 95 per cent efficient at that size for NaCl particles. Above the most penetrating particle size, the filtration efficiency increases with size; it reaches approximately 99.5 per cent or higher at about 0.75 microns (Qian, et al., 1998). N95 respirators have two benefits over other masks like plain fabric or surgical masks; they are more than 95 per cent effective in removing 0.3 µm molecules (less than the 5 µm size of broad droplets produced through speech, coughing, and sneezing that commonly spread influenza) and are checked to ensure contagious droplets and contaminants do not leak across the mask (Dhivyadharshini, Somasundaram and Brundha, 2020). Wearing a loose-fitting respirator will not offer the same protection to the wearer as a poor seal may allow small particles to get inside the mask through the sides.

(ii) *Medical Masks*

Medical masks (also known as surgical masks) are composed of 3 layers of synthetic nonwoven materials, configured to have filtration layers sandwiched in the middle. These are available in different thicknesses. Medical masks may not be as efficient as N95 respirators because they do not filter out smaller aerosol particles as small as 0.3 µm. Apart from this, another disadvantage is that air leakage also occurs through the sides of the mask as we inhale. Although much less is known about the exact efficiency of surgical masks, in a review of observational studies, an international research team estimates that surgical masks are 67 per cent effective in protecting the wearer (Peeples, 2020).

(iii) *Homemade masks*

Several household materials can be used for making household masks and are found to have the capacity to block bacterial and viral aerosols. Even a cotton T-shirt can block half of the inhaled aerosols and almost 80 per cent of exhaled aerosols measuring 2 µm across. Once we get to aerosols of 4–5 µm,

almost any fabric can block more than 80 per cent in both directions.

Multiple layers of fabric have been found to be more effective, and the tighter the weave, the better. Another study has found that masks with layers of different materials—such as cotton and silk, could catch aerosols more efficiently than those made from a single material (Peeples, 2020). However, when compared to other masks, homemade masks should only be considered as a last resort to prevent droplet transmission from infected individuals, but it would be better than no protection (Davies et al., 2013).

Hand-hygiene and Fomites

Fomites consist of surfaces or objects that can become contaminated with pathogenic microorganisms and serve as vehicles in transmission. During and after suffering from COVID-19, SARS-CoV-2 viruses are shed in large numbers by respiratory secretions. Fomites become contaminated with the virus by direct contact by hands of the infected person, contact with the aerosolized virus (large droplet spread) generated via talking, sneezing, coughing, or vomiting, or contact with the airborne virus that settles after disturbance of a contaminated fomite (i.e., shaking a contaminated blanket). These fomites containing the SARS-CoV-2 virus can be found on surfaces for hours or even days, depending on environmental conditions, and can be detected of their presence by RT-PCR testing. Once a fomite is contaminated, the transfer of infectious virus may readily occur between inanimate and animate objects or vice versa, and between two separate fomites (if brought together) (Boone and Gerba, 2007). While we do not have the numbers for SARS-CoV-2, a study recovered 3 to 1,800 PFU of rhinovirus from the fingertips of volunteers who handled contaminated doorknobs or faucets (Pancic, Carpentier and Came, 1980). A plaque-forming unit (PFU) is a measure used in virology to describe the number of virus particles capable of forming plaques per unit volume. Using coliphage PRD-1 as a model, Rusin, et al. (2002) demonstrated that 65 per cent of the virus could be transferred to uncontaminated hands. Virus survival on fomites is influenced by intrinsic factors, including fomite properties or virus characteristics, and extrinsic factors, including environmental temperature, humidity, etc. If viruses remain viable on surfaces long enough to come in contact with a host, the virus may only need to be present in small numbers to infect the host. The longest survival (6 days) of severe acute respiratory syndrome coronavirus (SARS-CoV) on surfaces was done by placing a very large initial virus titer sample (107 infectious virus particles) on the surface being tested. However, a real-life situation is better represented in the work of Dowell, et al. (2004) in which a viable virus was found on fomites for only a few hours.

After contact of fomite with the host is achieved, viruses can gain entry into the host systems through portals of entry or contact with the mouth, nasopharynx, and eyes. Hands are the main pathways of germ transmission between fomites and individuals. Hand-hygiene is, therefore, the most critical measure to avoid the transmission of harmful germs. We discuss in brief here the role of soaps and sanitizers in hand-hygiene. It is also a piece of common sense advice that people should try to touch surfaces, if unavoidable, with their non-dominant hands

rather than dominant hands. We have trained for years unconsciously that the dominant hand comes in contact with the mouth, nasopharynx, and eyes. Hence transmission can be avoided to some extent by touching surfaces with a non-dominant hand.

Hand Washing

Soap is a common word for what chemists call 'amphiphiles'. These are molecules that have dual nature. One end of the molecule is attracted to water and repelled by fats and proteins. The other side of the molecule is attracted to fats and is repelled by water (Fig. 4). It is this dual-nature chemical construction that makes soap so effective. Any conventional soap that we buy consists of a mixture of these amphiphiles. And they all do the same thing.

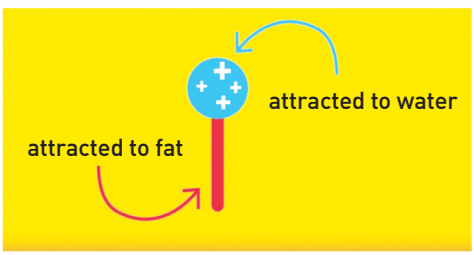

Fig. 4. The dual nature of soap molecules

Coronaviruses, simply put, are like a bag made out of oil/ fat: bits of genetic information—encoded by RNA—surrounded by a coat of fat and protein. The soap takes care of the virus much like it takes care of the oil in the water. One side of the soap molecule (the one that is attracted to fat and repelled by water) buries its way into the virus's fat and protein shell. Fortunately, the chemical bonds holding the virus together are not very strong, so this intrusion is enough to break the virus's coat. Soap pulls the virus apart and makes them soluble in water, and they disintegrate. And when we wash with water, the leftover innocuous bits and pieces of virus get flushed down the drain. Soap will also wash away bacteria and other viruses that may be a bit tougher than coronavirus and harder to disintegrate. But it takes a little time to happen, and that is why we need to spend at least 20 seconds washing our hands. First off, our skin is wrinkly, and it takes time for the soap to penetrate into all the tiny folds and demolish the viruses that lurk within. Then the soap needs a few moments to do its chemical work. We need a bit of time for all the soap to interact back and forth with the virus particle. Twenty seconds should do the trick just fine.

Hand Sanitisation

To understand how hand sanitizers work, let us understand the structure and make-up of viruses. Viruses are relatively simple structural, infectious agents with a minimum of two structural components. First, they contain genetic material, such as DNA or RNA. The genetic materials inside viruses are either single-stranded (ssDNA or ssRNA) or double-stranded (dsDNA or dsRNA). The strands are also either positively or negatively sensed. In order to protect and encapsulate the genetic material, all viruses also contain a protein coat called a capsid (Fig. 5). The novel coronavirus, for instance, is an enveloped virus surrounded by a fat layer/protein layer as mentioned earlier.

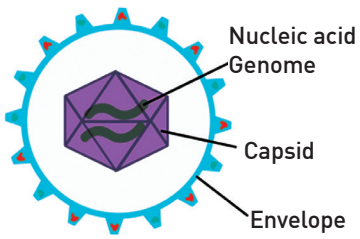

Fig. 5. Structure of Virus

There are two broad categories of hand sanitizers. (1) alcohol-based hand sanitizers (ABHS) and (2) non-alcohol-based hand sanitizers (NABHS).

1. Ingredients and Action of ABHS

Hand sanitizer preparations containing alcohol can include ethanol, isopropyl alcohol, n-propanol, or a combination of these, water, as well as humectants and excipients. Solutions containing alcohols between 60 per cent and 95 per cent in the volume are most prevalent and effective. Water is necessary to increase the penetration of alcohol. That is why 100 per cent pure alcohol-based sanitizers are less effective than solutions containing 60-95 per cent alcohols. Humectants are included to prevent skin dehydration as in commercial lotions, and excipients help stabilize the product and prolong the time needed for the evaporation of alcohol, thereby increasing its biocidal activity.

Alcohol kills viruses through a simple chemical process known as denaturation. Denaturation is the term used for any change in the three-dimensional structure of a protein that renders it incapable of performing its assigned function. Denaturation occurs when alcohol molecules bond with the fat membrane encasing a virus or bacteria cell. As the fat membrane is broken down, the inside of the cell—including all of its critical components—becomes exposed. Given that all these components are necessary for the viral life cycle (e.g., attachment, penetration, biosynthesis, maturation, lysis), and thus critical for its ability to transmit to another host, it can be presumed that altering the structure or function of any of the components as mentioned earlier or dissolving will typically render the virus ineffective. These components start to dissolve, and the cell quickly dies.

Ethanols have a broader and more potent virucidal activity than propanols. A high concentration of ethanol has shown to be highly effective against enveloped viruses and thus is effective against the majority of clinically relevant viruses. It is also interesting to note that adding acids to ethanol solutions can increase its efficacy against viruses more resistant to ethanol alone.

2. Ingredients and Action of NABHS

The most common primary active ingredient of NABHS is benzalkonium chloride (BC), quaternary ammonium, and is a commonly used disinfectant. The lipid envelope of either bacteria or viruses is a critical structure for BC's effectiveness. The cationic 'head group' of BC is progressively adsorbed to the negatively charged phosphate heads of phospholipids in the lipid bilayer, and as a result, increase in concentration. The consistent increase of BC concentration results in reduced fluidity of the membrane and thus the creation of hydrophilic gaps in the membrane. In addition, the alkyl chain 'tail' component of BC further perturbs and disrupts the membrane bilayer by permeating the barrier and disrupting its physical and biochemical properties. Protein function is

subsequently disturbed, and the combination of the effects mentioned above results in the solubilization of the bilayer constituents into BC/phospholipid micelles. BC also interrupts intercellular targets and compromises the conformational behaviour of DNA.

However, when comparing hand washing and hand sanitization, the former is recommended (CDC, 2020, 2021). Such endorsement of hand washing stems from various factors, such as eliminating a broader spectrum of pathogens and chemicals and removing bioburden on soiled hands. Hand sanitizers work by killing germs on your hands, while washing your hands with soap and water removes germs from your hands. Hand washing will remove all types of germs from your hands, but hand sanitizers are not able to kill all types of germs or remove harmful chemicals like pesticides and heavy metals.

Conclusion

We have discussed the science behind COVID-19 appropriate behaviours such as social distancing, quarantine/self-isolation, masking, hand hygiene and fomites, hand-sanitization, and how practising such NPIs can significantly reduce the spread of SARS-CoV-2 and buy scientists and the government more time to tackle the pandemic. However, practising NPIs is not the ultimate solution. We will still need effective vaccines and drugs to subdue the virus completely and end the pandemic.

References

Bai, N. 2020. Still confused about masks? Here's the Science Behind How Face Masks Prevent Coronavirus, University of California San Francisco. https://www.ucsf.edu/news/2020/06/417906/still-confused-about-masks-heres-science-behind-how-face-masks-prevent

Barker, J., Stevens, D., and Bloomfield, S. F. 2001. Spread and prevention of some common viral infections in community facilities and domestic homes. *Journal of Applied Microbiology*, Vol. 91, No. 1. pp. 7–21. https://doi.org/10.1046/j.1365-2672.2001.01364.x

Boone, S. A., and Gerba, C. P. 2007. Significance of fomites in the spread of respiratory and enteric viral disease. *Applied And Environmental Microbiology*, Vol. 73, No. 6, pp. 1687–1696. https://doi.org/10.1128/AEM.02051-06

Breakthroughs.com. 2020. The Science of the 14-Day Quarantine. https://www.breakthroughs.com/foundations-science/14-Day-Quarantine-Incubation-Period

Cascella, M., Rajnik, M., Aleem, A., Dulebohn, S. C., and Di Napoli, R. 2022. Features, Evaluation, and Treatment of Coronavirus (COVID-19). In *StatPearls*. StatPearls Publishing.

CDC (Centers for Disease Control and Prevention) (Updated October 14, 2020). Frequent Questions about Hand Hygiene. https://www.cdc.gov/handwashing/faqs.html

CDC (Centers for Disease Control and Prevention) (updated June 11, 2021). How to Protect Yourself and Others. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/social-distancing.html

Chu, D. K., Duda, S., Solo, K., Yaacoub, S., and Schunemann, H. 2020. Physical Distancing, Face Masks, and Eye Protection to Prevent Person-to-Person Transmission of SARS-CoV-2 and COVID-19: A Systematic Review and Meta-Analysis. *Journal of Vascular Surgery*, Vol. 72, No. 4, pp. 1500. https://doi.org/10.1016/j.jvs.2020.07.040

Ciric, L. 2020. One meter or two? The science behind social distancing. https://theconversation.com/one-metre-or-two-the-science-behind-social-distancing-139929

Davies, A., Thompson, K. A., Giri, K., Kafatos, G., Walker, J., and Bennett, A. 2013. Testing the efficacy of homemade masks: would they protect in an influenza pandemic? Disaster Medicine and Public Health Preparedness, Vol. 7, No. 4, pp 413–418. https://doi.org/10.1017/dmp.2013.43

Dhivyadharshini, J., Somasundaram, J., and Brundha, M.P. 2020. Composition and uses of N95 masks — a review. *European Journal of Molecular and Clinical Medicine*, Vol. 7, No.1, pp. 1529-1540.

Dowell, S. F., J. M. Simmerman, Erdman, D. D., Juinn-Shyan, J. W., Chaovavanich, A., Javadi, M., Yang, J. Y., Anderson, L. J., Tong, S., and Ho, M. S. 2004. Severe acute respiratory syndrome coronavirus on hospital surfaces. *Clinical Infectious Diseases*, Vol. 39, No.5, pp. 652-657.

Fischer, E. P., Fischer, M. C., Grass, D., Henrion, I., Warren, W. S., and Westman, E. 2020. Low-cost measurement of face mask efficacy for filtering expelled droplets during speech. *Science Advances*, Vol. 6, No. 36, eabd3083. https://doi.org/10.1126/sciadv.abd3083

Pancic, F., Carpentier, D. C., & Came, P. E. 1980. Role of infectious secretions in the transmission of rhinovirus. *Journal of Clinical Microbiology*, Vol. 12, No. 4, pp. 567–571. https://doi.org/10.1128/jcm.12.4.567-571.1980doi:10.1128/jcm.12.4.567-571.1980

Peeples, L. 2020. Face masks: what the data say. *Nature*, Vol. 586, No. 7828, pp. 186–189. https://doi.org/10.1038/d41586-020-02801-8

Qian, Y., Willeke, K., Grinshpun, S. A., Donnelly, J., and Coffey, C. C. 1998. Performance of N95 respirators: filtration efficiency for airborne microbial and inert particles. *American Industrial Hygiene Association Journal*, Vol. 59, No. 2, pp. 128–132. https://doi.org/10.1080/15428119891010389

Rusin, P., Maxwell, S., and Gerba, C. 2002. Comparative surface-to-hand and fingertip-to-mouth transfer efficiency of gram-positive bacteria, gram-negative bacteria, and phage. *Journal of Applied Microbiology*, Vol. 93, No. 4, pp. 585–592. https://doi.org/10.1046/j.1365-2672.2002.01734.x

DRUG RE-PURPOSING: A RAPID RESPONSE MECHANISM TO COMBAT COVID-19 PANDEMIC

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COVID-19, a viral disease caused by the SARS-CoV-2 virus, has affected a large population across the whole world. On 11th March 2020, WHO declared this viral outbreak a pandemic. The affected individuals may show multiple symptoms or may even be asymptomatic. It is a novel and highly contagious disease with no specific treatment available. Since then, the whole world has started working together to develop an effective vaccine to curb the pandemic. In addition, the entire scientific community is trying to develop alternative treatment methods to save lives and reduce disease transmission. Drug re-purposing is one of them which is being employed to manage this present emergency. This article gives a step-wise comparison of drug re-purposing to the traditional drug development process and its benefits. There is a brief description of SARS-CoV-2 with its mechanism of replication and possible drug targets. Some of the important on-going clinical trials for drug re-purposing using different drug targets in the coronavirus replication cycle have been discussed. A global initiative taken by the WHO named 'SOLIDARITY' to rapidly perform multiple clinical trials in collaboration with many different countries has been mentioned. In the end, an attempt has been made to draw attention to the broader perspectives of drug re-purposing, such as ethical issues for emergency use. Some of the ethical considerations regarding reliable data collection, accuracy and integrity of clinical trials, maintenance of randomized evidence, and voluntary consent of the participants need unbiased monitoring.

Keywords: Drug re-purposing, SARS-CoV-2, solidarity.

COVID-19 pandemic spread throughout the world by a novel SARS-CoV-2 virus for which there is no available cure as of now. Countries have started developing the vaccine against this virus, with many of them entering the clinical trials within few months. However, till the vaccine is developed and labelled for its safety and efficacy, the existing therapeutics are the saviours. The whole scientific community—the scientists, medical professionals, and pharmaceuticals from many countries, including India, in collaboration with international labs, have started large-scale pre-clinical and clinical trials to identify potential drug candidates individually or in combination with the existing approved drugs.

Drug Re-purposing or Repositioning is a strategy to use the existing licensed drugs for new therapeutic purposes. It is an approach to reuse the already approved (de-risked) drugs used to treat other similar kinds of infections or diseases, thus reducing the overall time and cost of development (Singh, et al., 2020). The Emergency Use Authorization (EUA), an authority of FDA, US allows the use of unapproved medical products, or unapproved uses of approved medical products, to diagnose, treat, or prevent serious or life-threatening diseases when certain criteria are met in the absence of adequate, approved, and available alternatives during a public health emergency. In India, the Drug Controller General of India (DCGI) has the

authority to approve such drugs amidst an emergency like a pandemic.

Stages in Drug Development—A Comparison between Traditional Process and Re-purposing

The US Food and Drug Administration (FDA) lays down five major steps in the Traditional Drug Development process as described in figure 1.

Step 1: Discovery and Development: Involves Target Discovery, Target Validation (Elimination of wrong targets), Lead Generation, and Refinement to generate candidate molecules.

Step 2: Pre-clinical Research: Conducting *"in vitro"* and *"in vivo"* studies using computational and biological experiments.

Step 3: Clinical Research: Determination of effective dosage, single and multiple dosage studies, combined dosage studies. This stage is further divided into three different phases (Table 1).

Step 4: FDA drug review, approval, and registration

Step 5: FDA post-market drug-safety monitoring.

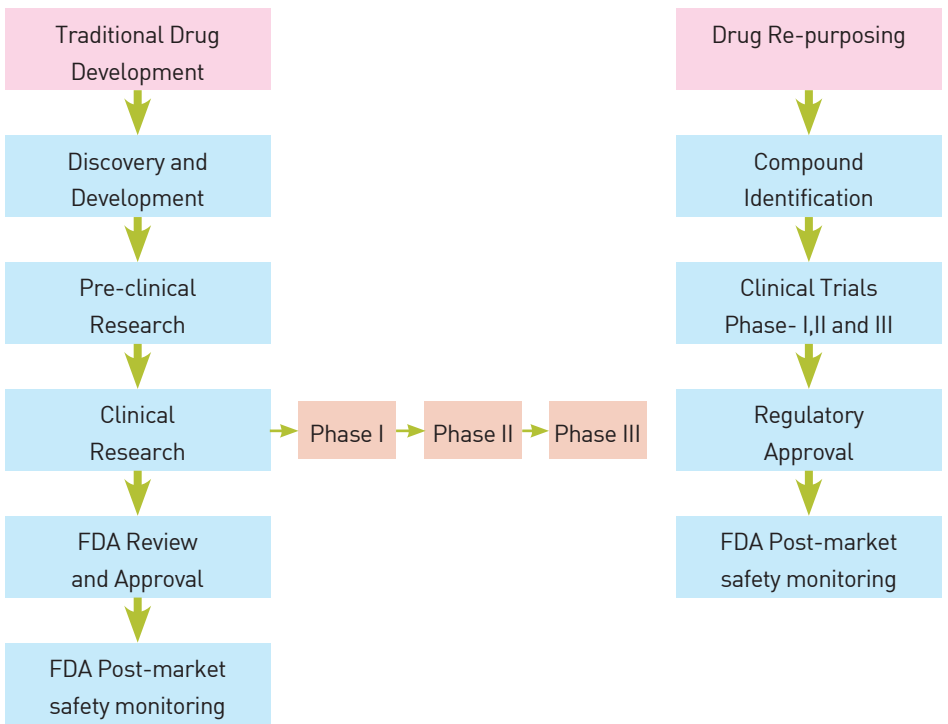

Fig. 1. Different stages in Traditional Drug Development and Drug Re-purposing Processes

Table 1- Phases of Clinical Trials for Drug Development

Phase	Study Participants	No. of Participants	Length of Study	Purpose
I	Healthy volunteers	Less than 100	Several months	Safety and dosage
II	Volunteers with disease	Several hundred	Months to 2 years	Efficacy and side effects
III	Volunteers with disease	Several thousand	1 to 4 years	Efficacy and monitoring of adverse reactions

Thus, it takes a minimum of 7-10 years to develop a new safe and effective drug. Drug re-purposing saves this time and money to address the diseases quickly since the drug is already approved and available for human use. Also, their safety is established, and the side effects profile is known.

Drug Repositioning

Step 1: Identification of a suitable licensed drug candidate. For a microbial infection, we require detailed information about the causative agent such as its phylogeny, morphological characteristics, genome organization, replication cycle, pathogenesis, and any other specific information about that organism.

Step 2: Testing the drug candidate for the proposed treatment using various data-driven and experimental approaches. To accomplish this, multiple batches of experiments are conducted for standardization of formulation, dosage, combination, and delivery of the drug candidate for different test groups. Data is collected and carefully analyzed for its safety, efficacy, and side effects, if any.

Step 3: A standard protocol of testing the drug safety and efficacy for various study groups is developed, modified from time to time as per the need to generate reliable data about the clinical, laboratory, and safety outcomes.

Step 4: The re-purposed drug undergoes various technological and regulatory approvals before commercialization.

Step 5: Once the drug is approved for public use, it is still under FDA post-market surveillance. The purpose being safety monitoring, effectiveness among the varied population, ensuring drug quality control and assurance (Fig.1).

SARS-CoV-2—Causative agent of COVID-19 pandemic

Viruses are primarily classified based on their structure, chemical composition of nucleic acid, and replication site. Morphologically they may have helical symmetry, icosahedral symmetry, or are complex structured. The viral genome is composed of viral nucleic acid, which contains genetic information. The nucleic acid may be DNA or RNA, both single-stranded or double-stranded, linear or circular. The nucleic acid may exist as a

single molecule or be divided into different segments. Viruses can either replicate in the host cytoplasm or enter the host cell nucleus for its multiplication.

Coronavirus belongs to the family of Corona viridae of order Nidovirales (Phadke, et al., 2020). There are four coronaviruses: alpha and beta coronaviruses infect mammals, gamma coronaviruses infect birds, delta coronaviruses infect both birds and mammals. SARS-CoV-2 is a beta coronavirus. It has a large (27–32 kb) positive single-stranded RNA genome, the largest group of RNA viruses. The virus is enveloped with its genome packed inside a helical capsid. The virus has four structural proteins: membrane protein (M), an envelope protein (E), spike protein (S), and nucleocapsid protein (N). The spike (S) protein forms large protrusions on the viral surface, giving it a crown-like appearance and hence, the name corona. S protein has S1 and S2 subunits. S1 subunit has a large receptor-binding domain (RBD) and can combine with host cell receptor ACE2 while S2 forms the stalk of the spike. It is a critical determinant of viral host range and tissue tropism and a major inducer of host immune response. ACE2 enzyme acts as a cellular doorway for SARS-CoV-2 virus. It plays a vital role in the breakdown of Angiotensin I to Angiotensin II. Angiotensin II causes damage to the epithelium by vaso-constriction, inflammation, fibrosis, haemorrhage, and leaky vessels leading to oxidative stress.

The treatment options for drug re-purposing can target the following stages in the coronavirus replication cycle:

1. Attachment

Spike (S) protein binds to the host cellular receptor angiotensin-converting enzyme 2 (ACE2). ACE2 is on the alveolar cell membrane, and itself acts as a receptor for SARS-CoV-2 and allows it to infect cells.

2. Penetration

The host cell protease primes the S protein, which is then recognized by the cellular receptor. The human serine protease TMPRSS2 is responsible for priming the S protein of both SARS-CoV and SARS-CoV-2. This leads to a conformational change in the S protein and facilitates viral envelope fusion with the cell membrane through the endosomal pathway.

3. Uncoating

SARS-CoV-2 releases its RNA into the host cell.

4. Translation and RNA Replication

Coronaviruses have a positive single-stranded RNA genome, which can directly produce proteins and more RNA strands in the host cytoplasm. The virus synthesizes its own RNA-dependent RNA polymerase. Using this enzyme and the positive single-stranded RNA as a template, the negative strand of RNA is synthesized. This negative-strand helps in further replication of new positive-strand RNA. It also serves as a template to transcribe smaller sub-genomic RNA (guide RNA), which is used to synthesize structural proteins and non-structural proteins.

5. Assembly and Release

Viral proteins and RNA genome are subsequently assembled into virions in the ER and Golgi. These are then transported via vesicles to the cell membrane and released out of the cell.

Experimental Treatments by Targetting Different Stages in the Coronavirus Replication Cycle

Presently there are two broad categories of therapies being used. The first one directly targets the viral entry and replication process (Fig. 2). The other approach is to activate the innate and adaptive immune response against these viruses. Drugs designed for modulation of the human immune response, such as preventing cytokine storm, will inhibit the inflammatory responses causing lung injury. In March 2020, the World Health Organisation launched an international clinical trial called 'SOLIDARITY' across the globe to find a drug or drug combination as an effective treatment for COVID-19 (WHO, 2020).The strategy was to compare four experimental therapies against the standard of care to assess their relative effectiveness against COVID-19. Solidarity being a global initiative, aimed to conduct multi-country trials to rapidly identify whether any of the existing drugs or drug combinations slow down the disease progression or reduce the fatality, and also, other drugs to be added based on emerging evidence through laboratory animal, and clinical studies.

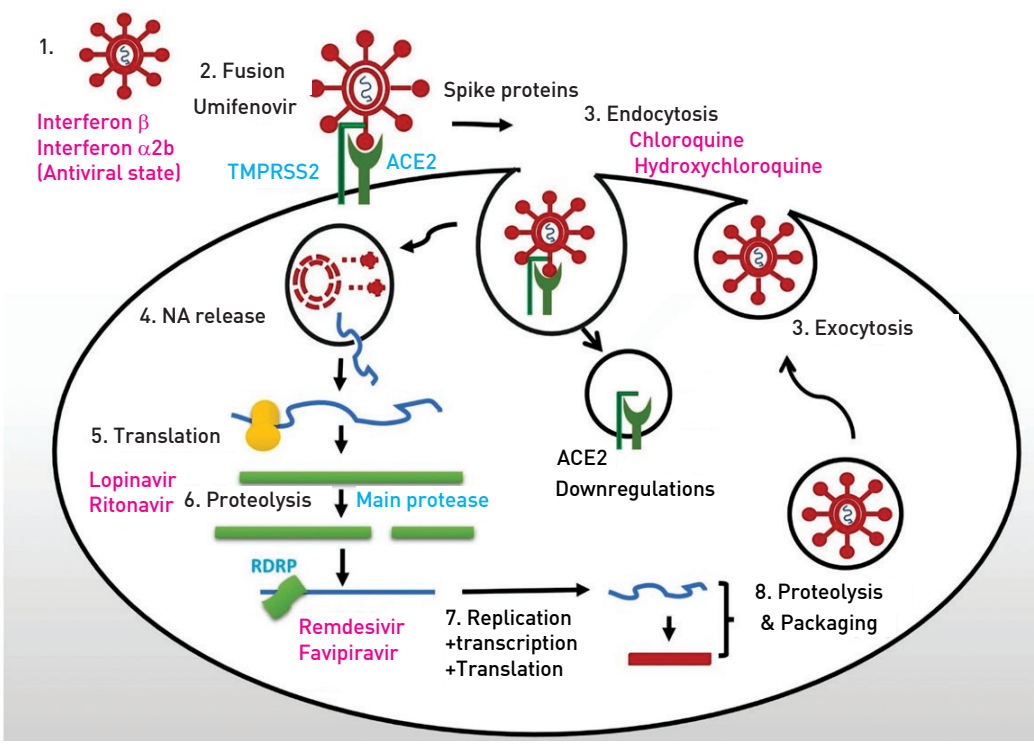

Fig. 2. Therapeutic targets of the currently considered drugs for re-purposing against COVID-19

Some on-going Clinical Trials

Remdesivir

Remdesivir is an antiviral drug originally developed by Gilead Sciences against the Ebola virus. Although it did not show its effectiveness against Ebola in trials but proved safe for humans; thus, it was immediately allowed to enter clinical trial since COVID emergency. Remdesivir is a pro drug with a structural resemblance to adenosine (Tu, et al., 2020). This enables it to incorporate into nascent viral RNA and further inhibit the RNA-dependent RNA polymerase leading to premature termination of the viral RNA chain. The replication of the viral genome is then shut down. In the past, it has also shown good results both in *in vitro* and *in vivo* studies for Middle East Respiratory Syndrome (MERS-CoV) and Severe Acute Respiratory Syndrome (SARS-CoV), thereby making it a favourable drug candidate for trials (Guy, et al., 2020).

Favipiravir

It is a modified pyrazine initially approved for its antiviral activity against the influenza virus. Favipiravir has a structural resemblance to endogenous guanine, by which it competitively inhibits the RNA-dependent RNA polymerase enzyme of the virus (Tu, et al., 2020). This greatly interferes with the viral replication machinery. This drug was discovered by a Japanese chemical manufacturing company called Toyoma Chemical Co. Ltd. Many countries, including India, are conducting clinical trials on its effectiveness against SARS-CoV-2. In June 2020, the Drug Controller General of India approved the emergency use of favipiravir only in patients with mild to moderate COVID-19 infections.

Umifenovir

It is an antiviral drug against influenza viruses and arboviruses. When administered orally, it targets the hemagglutinin (HA), a surface glycoprotein on the influenza virus, and inhibits its fusion with the host cell membrane (Tu, et al., 2020). This prevents endocytosis of the virus into the host cell. Thus, both the viral infection and replication are suppressed. In India, the CSIR-CDRI (Council of Scientific and Industrial Research-Central Drug Research Institute (CDRI) got the approval to carry out Phase- III clinical trials of Umifenovir for COVID-19 treatment.

Chloroquine and Hydroxychloroquine

These are well-known anti-malarial drugs that increase the endosomal pH in the host cell. Endosomes are the cellular compartments that ingest outside material, paving the way for viral entry into the host cell. An increase in pH inhibits membrane fusion between the virus and host cell endosome blocking the viral infection (Tu, et al., 2020).Though these anti-malarial drugs have shown some activity against SARS-CoV-2 in non-randomized cell culture studies, they demonstrated high doses with serious toxicities in clinical trials (Guy, et al., 2020). Lack of larger randomised studies, in sufficient evidence, high dose, and toxicities; the WHO discontinued this arm of Solidarity trial.

Ritonavir/Lopinavir

This drug combination is used for the treatment of HIV infections. Lopinavir specifically inhibits the protease of HIV, which is an enzyme that cleaves a long chain of polypeptides into short peptides during the virus assembly (Tu, et al., 2020). Lopinavir is

susceptible to our proteases; therefore, it is combined with low levels of Ritonavir, another protease inhibitor that increases the stability of Lopinavir. This combination of the antiviral drug is a protease inhibitor of coronaviruses. The combination showed its effectiveness against SARS and MERS in several in vitro, animal, and clinical studies. However, little benefit was observed when clinical trials were performed against SARS-CoV-2 in patients having mild to moderate symptoms. No benefits were observed in patients with severe COVID-19 infections beyond the standard care. Thus, the Solidarity trials for this drug combination were interrupted in July 2020 with immediate effect.

Ethical Considerations while Re-purposing of Drugs

Drug re-purposing has recently become a popular strategy to find the treatment of diseases within a short time frame reducing the preliminary stages of traditional drug development. The entire process is economical and possesses lower risk as compared to a novel drug. Three broad approaches used are—computational, biological experimental, and mixed approaches. A mixed approach which is the combination of the other two is widely used wherein the initial results of the computational approach are validated by biological experimentation and clinical trials. This leads to rapid and effective drug repositioning in times of emergency. Overall, this process proves to be advantageous over the traditional drug development process in terms of time, safety, cost, and labour involved. However, it is important to address some ethical issues that may occur during this process. Compound identification by a virtual or computational screening of drug candidates forms the first step in drug re-purposing. One must analyze the available data regarding its target, mechanism of action, safety, effectiveness, and side effects over a large sample population. The drug candidate must pass through an adequate number of pre clinical and clinical trials for the purposed disease before its approval. Even in case of emergency, the tests must follow proper standard protocols. It is important to carry out multiple tests or studies to understand the drug's kinetics and dynamics in humans. This step should comprise extensive data collection, close monitoring of all the test samples or participants, and complete data analysis. These must be performed carefully to attain accurate and reliable information regarding the test drug candidate's safety, efficacy, and possible side effects. During emergencies, ethical issues such as maintaining proper evidence level and integrity of the clinical research performed need proper attention (Ino, et al., 2020). For the rapid accumulation of ethically and scientifically valid evidence, both quality and quantity of data are of utmost importance. This can be achieved through global collaborations for data and resource sharing.

References

Deshpande, S. 2020. Drug repurposing and its growing significance in India. *Express. Pharmacia*. http://www.expresspharma.in/latest-updates/drug-repurposing-and-itsgrowingsignificance-in-india

Guy, R. K., DiPaola, R. S., Romanelli, F., and Dutch, R. E. 2020. Rapid repurposing of drugs for COVID-19. Science, Vol. 368, No. 6493, pp. 829–830. doi:10.1126/science.abb9332.

Ino, H., Nakazawa, E., and Akabayashi, A. 2020. Drug Repurposing for COVID-19: Ethical Considerations and Roadmaps. *Cambridge Quarterly of Healthcare Ethics: CQ : The International Journal of Healthcare Ethics Committees*, Vol. 30, No. 1, pp. 51–58. https://doi.org/10.1017/S0963180120000481

Phadke, M., and Saunik, S. 2020. COVID-19 treatment by repurposing drugs until the vaccine is in sight. *Drug Development Research*, Vol. 81, No. 5, pp. 541–543. https://doi.org/10.1002/ddr.21666

Singh, T. U., Parida, S., Lingaraju, M. C., Kesavan, M., Kumar, D., & Singh, R. K. (2020). Drug repurposing approach to fight COVID-19. *Pharmacological Reports: PR*, Vol. 72, No. 6, pp. 1479–1508. https://doi.org/10.1007/s43440-020-00155-6

Tu, Y. F., Chien, C. S., Yarmishyn, A. A., Lin, Y. Y., Luo, Y. H., Lin, Y. T., Lai, W. Y., Yang, D. M., Chou, S. J., Yang, Y. P., Wang, M. L., and Chiou, S. H. 2020. A Review of SARS-CoV-2 and the Ongoing Clinical Trials. *International Journal of Molecular Sciences*, Vol. 21, No. 7, pp. 2657. https://doi.org/10.3390/ijms21072657

World Health Organisation 2020. https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---18-March-2020

PROBLEMS FACED BY THE SCHOOL TEACHERS OF UTTAR PRADESH IN THE TRANSACTION OF ONLINE CLASSES DURING COVID-19 LOCKDOWN

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The dreaded Coronavirus created a panic situation globally, and most of the countries across the world declared total lockdown. In India also, shutdown of activities was declared across the country, which included educational institutions too. The teaching-learning process was disrupted due to educational institutions' closure, and online learning therefore was resorted to. The sudden shift of classes from physical to virtual mode impacted almost all education stakeholders, especially teachers, students, and parents. During online classes, the role, teaching style, timing, and norms also have been changed. A traditional classroom where no phones were allowed has now shifted to smartphones. The parents criticizing the demand of smartphones by children previously have purchased or given their own phones/tablets/laptops to their children to attend the classes. This haphazard shifting of classes from offline to online mode created chaos initially as guidelines were not clear. Some other issues were faced by the teachers at the commencement of the classes. The present paper explores the problems that Uttar Pradesh's school teachers faced during online classes. A descriptive survey method was used in the study, and responses of 156 school teachers were collected.

Keywords: Online classes, online educational platforms, gadgets.

Introduction

In future, the year 2020 will be remembered as a year of disasters. The year has witnessed all of them, be it geographical, hydrological, climatological, biological, geopolitical, and economical disasters. A year which started with the tragic bushfire of Australia (though bushfire was started in December 2019, it remained till January 2020) and followed by other natural/human-made disasters as devastating floods in Indonesia, and some parts of India (Assam, Bihar, Maharashtra), a volcano eruption in the Philippines, earthquakes in many parts of the world, locust swarms in East Africa, and Asia, cyclones as Nishagra and Amphan in Bangladesh and India, forest fires in Uttarakhand, India, green snow of Antarctica and topping it all, the dreaded Coronavirus.

The outbreak of COVID-19 affected the entire world. People across the globe encountered an unseen problem. This novel disease originated in Wuhan, China, initially as an epidemic but spread rapidly within a few days. The World Health Organization (WHO) declared it a pandemic in March 2020 and issued safety measures and preventions to deal with this precarious spread. The whole world was under lockdown, including educational institutes from pre-primary to higher education. According to a UNESCO report, during March 2020, 150 countries

around the globe closed their educational institutes that affected more than 80 per cent of students. This sudden lockdown put everyone under pressure, including stakeholders of education, and the virtual or online classes came as an alternative for the in-person classrooms.

In the lockdown period, online teaching-learning has become a buzzword in education, finding no other alternatives for providing education to the students in the real classrooms. Online learning is not a new concept. It was part and parcel of some schools in the country with recent changes and innovations but not all schools. Online learning is a way of instruction that uses the internet, intranet, and multimedia (Hall, 2003; O'Neill, Singh and O'Donoghue, 2004). There are several benefits to online classes, such as accessibility, affordability, flexibility, learning-pedagogy, life-long learning, etc. (Dhawan, 2020). However, organised online classes during COVID-19 were not always a blessing to all the learners (Alam, 2020) due to the different problems associated with it, such as limited resources, network issues, poor technology literacy, time management, etc.

All educational institutes in the country were closed since March 2020 due to COVID-19. Despite its shortcomings in such a situation, online learning emerged as the only solution to save students' academic loss. The decision taken to save students' time was welcomed, which provided learning opportunities to the learners under their teachers' guidance even though they were outside the traditional classrooms. In times of pandemics like COVID-19, when every public place was closed, online classes did not allow students to get away from the teaching-learning process because of its immense features that allow learners to learn in accordance with their pace and place (Jindal and Urvashi, 2020). However, at the same time, online classes are not within the reach of everyone. Gadgets like a smartphone or computer with internet facilities are prerequisite of online education. According to the National Statistical Office (NSO), Government of India (2019), only 8 per cent of all households with members aged between 5 and 24 years have a computer with an internet connection. About 66 per cent of the Indian population lives in the villages, and among them, only 15 per cent of the population had access to internet facilities. For the urban population, this was 42 per cent. NSO has found this difference based on caste, gender, region, and states. Such a situation puts a question mark on the success of online classes.

Apart from the required facilities/gadgets, teachers faced other problems like non-cooperation from the side of parents/students, lack of guidelines from the government and school authorities (Li and Lalani, 2020), unavailability of supportive material to teach children with special needs (CWSN), etc. (Jindal and Urvashi, 2020). In this sudden shift of the classes, the teachers with little or no knowledge of online teaching were under pressure, and the whole scenario is like an alien situation, and anyhow they were trying to deal with it (Alam, 2020).

Review of the Related Studies

The world has been exposed to a pandemic like COVID-19 only a few months back, and measures like lockdown have been taken from February or March, so the studies related to the problems which the stakeholders are facing are very few, but the

investigator has made an effort to mention those studies here.

Alam (2020) found that students and teachers had no prior experience in online classes. Other problems found by the investigator in online classes were poor and interrupted internet signals even in some urban places and complete lack of the same in rural areas, technical issues while handling computer and smartphones, no prior experiences of handling apps, the problem of time management, and difficulty for the teachers to get individualised feedback as well as engaging the students with the material.

The All India Forum for Right to Education (AIFRTE) has said that the government and private agencies are trying to promote distance teaching, learning, and evaluation in virtual mode during COVID-19 lockdown (Ref. 2). It was instructed to the teachers to complete the syllabus by organising virtual classes. It states that the COVID-19 pandemic has exposed deep structural imbalances in the country regarding digital learning. With the current digital divide and inequality prevailing in education, the rush to expand online education will only deny access to learning for most previously disadvantaged and marginalised children.

Jindal & Urvashi (2020) discussed the effectiveness of online classes for CWSN while shifting from offline to online. They discussed several benefits of online classes as comfort of working from home, no unnecessary traveling which saves time and increases productivity, and keeps safe from the deadly disease. However, they added that it is not beneficial in the same way for everyone. Online classes are exclusionary for the CWSN. CWSN, as per their disability, are struggling in different areas in online learning. Even SWAYAM classes that started on D.D channels did not take into consideration the needs of CWSN. Virtual learning is only within the reach of children who have good financial resources. Furthermore, the gender of the student also influences its reach. Girls get only half of the chance to attend the class compared to the boys.

Lall & Singh (2020) studied students' perception of online classes taken during lockdown due to COVID-19 and found maximum students were in favor of studying through online classes. Still, they complained about the lack of co-curricular activities in the online mode of classes.

Li & Lalani (2020) discussed that COVID-19 has resulted in a shutdown of schools worldwide, and over 1.2 billion children are out of the classroom globally. Students who have no reliable internet access or other technical issues struggle to participate in digital learning. This gap was visible across countries (developed and underdeveloped) and within countries (different income brackets).

Loeb (2020) in the article regarding online and offline classes wrote that online classes cannot take over offline classes because students' informal social interactions cannot occur in online classes. In-person classes are, on average, more effective. Further, he suggests that, whether synchronous or asynchronous, the teacher is supposed to provide students with opportunities to engage thoughtfully with the subject matter in both conditions. Students, in most cases, are required to interact with each other virtually. Online classes require a strong curriculum and pedagogical practices. Teachers should

realize the needs of students. Online classes are not as effective as in-person classes, but these are undoubtedly better than no classes.

The relevance of the study

The switching of classes from offline to online mode in the interest of education was commendable. However, the sudden lockdown and then haphazardly shifting to the online classes created problems for all the stakeholders. Online classes are not part of the course of most Indian schools. In such a situation, stakeholders' traditional roles changed, and they were not very much aware and comfortable with their new role. Additionally, even after starting the online classes, no feedback was taken by the government from stakeholders, and this communication gap exacerbated the problems. The All India Forum for Right to Education (AIRFTE) states that India's government is only dictating to the teaching community and not taking their insight, suggestions, and not using their real-life experiences to tackle the crisis (AIRFTE, 2020). It also says that e-learning is a substitute for formal classroom learning and shifts the individual's burden of education. In this situation, it is required to take the teachers' feedback and know their problems.

During online classes, teachers are struggling on different fronts. No training for online classes, ignorance of new technology, lack of resources, technical and safety issues, connectivity issue in the remote areas, insufficiency of internet data, indiscipline of students, non-cooperation from the side of parents/guardian, excessive household chores, are some of the problems which the school teachers are facing (Li and Lalani, 2020). With no treatment available for a disease like COVID-19, this problem can persist for a long time. In such a situation, schools may remain closed for an extended period. In this condition, online learning is the only way to keep students connected to the teaching-learning process to go to the next class with the required knowledge of the class and without losing their academic year. The success of online classes relies on teachers. In such a situation, isn't it necessary to know whether teachers face any problems in online classes? If yes, how can these problems be resolved? If such a situation appears again, the stakeholders can take proper measures to address the issue. Apart from this, Indian classrooms are very crowded, and there is a need to reduce class-load. According to agencies such as AIFRTE, the government is planning to reduce load of offline classrooms by shifting students to online classes. The study's findings may help resolve online learning issues, and with adequate steps, some classes may be shifted from offline to a smooth-functioning online class.

Uttar Pradesh was selected for the study. The primary reason for the selection of this state was the population size. Uttar Pradesh is the largest state in India in terms of population. The second reason was the status of ICT in the state before the lockdown. As per Unified District Information System for Education (UDISE) database 2018-2019, only 12.53 per cent of schools had computers, and only 10.88 percent of schools in the state had an internet connection. Condition of government schools in terms of computer and internet facilities was worse than the private schools, especially at primary and upper primary level. However, efforts were made by the central and state government to avoid the educational loss of

students, and teachers were advised to take proper steps for it. However, whether these decisions and actions were equally supportive for the teachers or teachers faced any issue in the classes' conduction through online mode is the study's aim. The study's findings will also help address the problems faced by the state's teachers with the largest population in the country, which lacks in terms of computer-related infrastructural facilities so that appropriate measures can be taken. This study may help address the problems the country's teachers face in online classes.

Objective of the Study

To explore the problems of school teachers in organizing online classes during the lockdown due to COVID-19

Limitations of the Study

It has been tried by the investigator to be scientific and objective while conducting this study; however, the study contained the following limitations;

1. Due to constraint related to time and limited use of technology by the teachers, it was not possible to conduct this study with a large sample size of school teachers. Though it was planned to collect data from 250 school teachers of Uttar Pradesh as some teachers did not fill in the questionnaire, there was no time to send the questionnaire to more school teachers, so the study's sample size was reduced automatically.
2. Due to the lockdown, it was impossible to collect the teachers' data physically. Thus, the data has been collected through a virtual medium.
3. Due to the limitations of sampling technique, it was not possible for the investigator to include teachers of each of the district of Uttar Pradesh in the study. However school teachers from 30 districts of the state were covered.

Methodology

Method

The investigator employed a descriptive survey method to determine school teachers' problems in conducting the online classes.

Population

The population of this study consists of all the school teachers of Uttar Pradesh.

Sample and Sampling Method

The investigator adopted a purposive sampling method to collect the data. There is a total of 75 districts in Uttar Pradesh. Out of these 75 districts, 30 districts were selected by the investigator for the study. The investigator prepared a list of districts in descending order based on the literacy and further 15 districts that had the highest literacy rate and 15 districts with the lowest literacy rate. A balanced status of problems related to online learning could be found in the state. The questionnaire developed by the investigator was sent to 250 school teachers (6-10 school teachers from each selected district) on different platforms like Facebook, WhatsApp, and Gmail by using Google Forms, and the response of 156 teachers (4-7 school teachers from each selected district) was received. The details of the samples are given in Table 1.

Table 1
Description of the sample selected for the study

Gender		Location		Type of Management of the school	
Male	Female	Rural	Urban	Government	Private
54	102	70	86	53	103

Tools Used

The investigator developed a questionnaire, and due to the constraints of time and availability of respondents, only the content validity was established. The tool with the study's objective was shared with ten teacher educators/school teachers for validation, and modification in the tool was done as per the their suggestions. The final draft of the tool had 21 items.

Findings of the Study

- All the school teachers reported that they were taking classes online at the time of lockdown. Teachers were taking classes through multiple modes. Forty-one teachers reported they used on the go recordings, 83 used audio/video conferencing apps, 47 teachers used YouTube videos of others, 39 teachers used PPT or PDF documents, eight teachers made modules/adopted modules on different teaching points and shared with students, three teachers made notes and shared images of that with students. Twenty-six teachers stated they were using some other mediums (as calling one student each day and discussing the teaching points where students were facing difficulty, sending voice notes) to conduct online classes during lockdown due to COVID-19.
- Proficiency in handling gadgets is a prerequisite to conducting online classes, and it was found that most teachers (75.64%) were proficient in handling gadgets.
- Teachers' preference regarding the effectiveness of online/offline classes was taken. In the response, most school teachers (91.66%) considered traditional or face-to-face classes more effective than online classes. The rest of the school teachers favoured online classes and marked them as more effective.
- School teachers used multiple apps to conduct online classes. The majority of the teachers were using apps like WhatsApp (99), Google Meet (85), Zoom (34), Google Classroom (19). Other apps such as Google Classroom, Facebook, Go to Webinar, Cisco Webex Meet, Next Learning Platform (NLP), Diksha app were also used by some school teachers to conduct classes and other academic activities.
- School teachers used online platforms to take formal classes and organise multiple activities such as giving an assignment, assessing the learning of students, interacting with parents, and sending the reading materials.
- Lack of gadgets from the students' side was also an issue in online classes'

successful conduction. The majority of the school teachers (58.33%) accepted that their students had no gadgets for attending the online classes. This finding is similar to the findings of Alam (2020) and Li and Lalani (2020).

- Online classes cannot be possible without desktop/laptops/smartphones. It is a precondition to run an online class. It was found that majority of school teachers (94.87%) had their gadgets.
- Majority of the teachers own a gadget. However, 55.13 per cent of school teachers have reported that they share their gadgets with the household, especially schooling members of the family who depend on the adults in the family for the gadget to attend their online classes. This dilemma becomes another challenge for the teachers to deliver online classes.
- The majority of school teachers (66.67%) conducted an online examination to assess students' learning.
- The majority of the school teachers (72.44%) faced problems during the conduction of online examinations. The problems they faced mostly were inappropriate materials by students, internet connectivity, internet speed, technical difficulties, security issues, lack of support system, lack of required question bank, communication issues during the assessment, etc.
- The majority of the school teachers advocated that online classes cannot be as effective as traditional classes because there is no scope for face-to-face interaction, verbal communication, peer interaction, practical work, and eye contact, which are essential for better learning.
- Multiple modes of involvement and representation are essential in the classroom for children with special needs, which was lacking in online classes. The majority of the teachers (55.13%) agreed that online classes are ineffective for the CWSN. A similar result has been found by Jindal and Urvashi (2020).
- There is a safety issue with the software/apps used for online classes, which is one of its hindrances. The majority of the teachers (62.18%) said there is a safety issue with the software/apps used for online classes. When it was analysed further, this issue was mostly with the female school teachers.
- The network and the technical issue were also major problems for the teachers. The majority of school teachers (86.54%) accepted that they face many technical issues while conducting online classes.
- During the lockdown, the salary was a big issue for the teachers. In response to this question for the majority of the teachers, the salary was an issue. 92 (58.97%) teachers informed regarding salary problems that they faced during the COVID-19 lockdown. For the rest of the 64 school teachers, the salary was not an issue.

- When investigated further, 57 school teachers said they received a full salary for those months when schools remained closed due to COVID-19. Simultaneously, 99 school teachers reported they did not receive a full salary for the months in which schools were closed. When it was analyzed further, all the teachers who reported the salary issues were from private schools, confirming that private schools did not pay full salary to the teachers during lockdown time.
- It also asked teachers regarding their mental readiness to take online classes. Out of 156 school teachers, 125 (80.13%) responded they were prepared for the online classes; at the same time, 31 school teachers were not prepared for the online classes.
- Some people call online classes monotonous. The majority of the school teachers (62.18%) reported online classes are monotonous for the teachers and students, and for 37 school teachers, it was not monotonous for both. Other teachers said it is monotonous either for students and or for teachers.
- Teaching-learning includes teachers as well as learners in the process. It was asked to the teachers what problems they faced from the students' side during online classes' conduction. The prevalent problem which the teachers faced to conduct the online classes was the unavailability of gadgets with students. 125 teachers reported that students had no required gadgets to attend online classes. The next issue was interrupted network from the students' side, and 87 school teachers reported it. The teachers' other issues were sending inappropriate material to the class group and inappropriate activities by students during class. However, at the same time, some school teachers said that there was no issue from the students' end. The teachers also said that taking instant and individualized feedback is not possible for them. The result is consistent with the findings of Alam (2020).
- Teachers were also asked regarding the problems faced by them. The teachers discussed multiple issues that they faced during online classes. 55 (35.26%) school teachers reported that long hours of sitting before desktop/laptop/smartphones were problematic. 84 (53.85%) school teachers reported that interrupted internet connection was the biggest trouble for them. During the lockdown, no movement was allowed, and because of this, teachers were also battling with their domestic responsibilities like household activities and tutoring their children. 44 (28.21%) school teachers said the excessive household workload was also one hurdle in online classes' conduction. Lack of technical knowledge, long hours of preparation for online classes, boredom, the anxiety of completion of the syllabus, and shortage of gadgets were other problems in the conduction of online classes.

Discussion

Due to the unexpected announcement of the lockdown and the nonexistence of online classes in most of the schools' education system and curriculum, the teachers and students were not fully prepared for the online classes. For the online classes, it is necessary for the teachers and students both to have gadgets and uninterrupted internet connections, which is one of the impossible things for the students studying in government schools and attending schools for a meal. Having gadgets like smartphones or laptops and expensive mobiles and additional subsequent costs to attend classes is not possible for people living below the poverty line. Most families in India have more than one child. Below-poverty-line and lower-middle-class families cannot provide gadgets to each child to attend classes in such a situation. The same applies to teachers also. In the case of the availability of single gadgets in the family, a teacher with issues/wards may have difficulty in organizing online classes.

This study's findings reveal that all the school teachers organised online classes for their students, and various mediums such as on the go recordings, audio/video conferencing apps, PPT/PDF files, YouTube videos, modules, images, etc., were shared with students. As the government directed it, the proper steps to conduct the online classes were taken by the school teachers to avoid any type of academic loss of the students, but multiple hurdles came in the way. The majority of the teachers informed their students had not owned gadgets which are indispensable to attend an online class. This problem was especially reported by teachers teaching in government schools. This situation reveals that not all students got the benefits of online classes. This will double the problems of teachers at the time of reopening of the school because there will be at least two groups of students in the classroom; one who has attended online classes and whose syllabus has been completed to some extent and the other group which could not attend the online classes due to lack of facilities, and whose syllabus is not covered at all. Dealing with these two groups in the same classroom at the same time will be challenging for the teachers, and despite the conduction of the proper classes during the lockdown, the non-involvement of some students will put an extra burden on the teachers.

For any success, it is necessary to have a positive mindset. The results obtained from the study reveal that teachers prefer traditional/offline classes over online classes. The argument given by the school teachers in favour of offline classes in comparison to online classes were no room for verbal communication or lack of face-to-face interaction in online classes. However, the absence of a positive mindset among teachers was still a barrier to successful conduction of online classes.

In the absence of resources, the concept of online classes can never be successful. The success of these classes demands full access to the resources of all teachers and students. The obtained result shows that not all students and even teachers had full access to these resources. The majority of the teachers shared their gadgets with other family members, so it was not easy to easily organise online classes. Along with classes, the teachers also conducted examinations, and it was found that school teachers faced difficulties in conducting online examinations

as in the case with online classes. The primary reason was the absence of students from the assessment process, and the cause of their absence was the same as online classes—lack of resources. The school teachers' other problems while conducting the examination were communication problems, technical issues, safety issues, use of inappropriate materials, and lack of proper question banks. During the pandemic, organized online classes must be inclusive for everyone. The primary benefit of online class is allowing the learners to learn at their own pace. But massive exclusion has been formed by these online classes between privileged and unprivileged based on accessibility of facilities. The majority of the teachers reported that the online classes were not equally supportive for the CWSN, and the main reason is that they overlook these students' academic needs (Jindal and Urvashi, 2020).

The next problem which the teachers encountered was the salary during the lockdown. The majority of the school teachers reported that their salary was not regular at the time of lockdown. Also, they did not get their full salary for the lockdown period. When the data was further analyzed, it was found that mainly this problem was faced by private school teachers. Approximately 97 per cent of private school teachers reported irregular and comparatively less salary. Studies show that private school teachers get very less salary (Rao and Khadar, 2004; McGrath and Princiotta, 2015; Kingdon, 2017), and in the situation of this pandemic, when all the essential items became expensive, the less and irregular salary might have multiplied their problems and reduced the motivation to take the classes. Studies indicate that online classes require a significant amount of self-motivation and discipline (Golladay, et al., 2000; Serwatka, 2003), but teachers faced problems like indiscipline among students, lack of motivation, monotonousness of online classes for teachers and students, excess of household tasks, technical problems, lack of technical knowledge, interrupted net connection, etc. which worked as a barrier in the success of online classes. Because of playing multiple roles, the condition of female teachers with issues was more challenging.

Based on the study's findings, it is the government's responsibility to take suggestions and feedback from school teachers for the smooth organisation and functioning of online classes without hassles.

Conclusion

The COVID-19 pandemic has resulted in schools shutting down across the world. It is no different in India as COVID-19 brought India to a halt under a severe medical crisis. Educational institutions have moved their academic activities to online platforms and this sudden move has been a drastic change for the stakeholders. Before the COVID-19 crisis, online teaching was not a part of mainstream education. The sudden shift now poses a challenge as stakeholders learn to adapt to the new system. This study indicates that the school teachers have taken the required steps to teach in the digital classroom and yet face many challenges. The challenges faced by teachers have been associated with inadequate and insufficient infrastructural facilities, technical difficulties, lack of practical work, lack of interaction, socio-economic status of students, discipline-related issues,

etc. To ensure the effectiveness of online classes, upgraded infrastructure facilities, assistance from the government, and support from school authorities are needed. Training and orientation programmes for all the stakeholders in regards to the tools, techniques, and strategies of teaching, learning, and assessment need to be organised on regular basis.

References

Alam, A. 2020. Challenges and possibilities of online education during Covid-19. Preprints. doi:10.20944/preprints202006.0013.v1.

AIFRTE. 2020. All-India Forum for Right to Education. (nd.). GOI moves towards Online Learning. https://indianculturalforum.in/wp-content/uploads/2020/08/AIFRTE-Report-on-OnlineLearning-10th-August-2020.pdf

Dhawan, S. 2020. Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems*, Vol. 49, No.1, pp. 5–22. https://doi.org/10.1177/0047239520934018

Golladay, R., Prybutok, V. and Huff, R. 2000. Critical success factors for the online learner. *Journal of Computer Information Systems*, Vol. 40, No. 4, pp. 69-71

Hall, B. 2003. FAQs about e-learning. HYPERLINK "http://www.brandonhall.com/public/faqs2/faqs2.htm"www.brandonhall.com/public/faqs2/faqs2.htm

Jindal, N., and Urvashi, S. 2020. Schools must ensure that moving online won't disadvantage children with special needs. https://thewire.in/rights/virtual-learning-children-with-special-needs

Kingdon, G.G. 2017. The Private Schooling Phenomenon in India: A Review. IZA – Institute of Labor Economics. Bonn: http://ftp.iza.org/dp10612.pdf

Lall, S., and Singh, N. 2020. CoVid-19: Unmasking the new face of Education. *International Journal of Research in Pharmaceutical Sciences*, Vol. 11, pp. 48-53. "http://dx.doi.org/https:/doi.org/10.26452/ijrps.v11iSPL1.2122"https://doi.org/10.26452/ijrps. v11iSPL1.2122

Li, C., and Lalani, F. 2020. The COVID-19 pandemic has changed education forever. This Is How. https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning

Loeb, S. 2020. How effective is online learning? What the research does and doesn't tell us. https://www.edweek.org/ew/articles/2020/03/23/how-effective-is-online-learning-what-the.html

McGrath, D. J., and Princiotta, D. 2015. Private school teacher turnover and teacher perceptions of school organizational characteristics. United States Department of Education. National Center for Educational Statistics. https://nces.ed.gov/pubs2005/2005061.pdf

O'Neill, K., Singh, G., and O'Donoghue, J. 2004. Implementing eLearning programs for higher education: A review of the literature. *Journal of Information Technology Education:* Research, Vol. 3, pp. 313–323. doi:10.28945/304

Rao, D. B., and Khadar, S. A. 2004. *Problems of Private School Teachers*. Discovery Publishing House, New Delhi

Serwatka, J. 2003. Assessment in on-line CIS courses. *Journal of Computer Information Systems*, Vol. 43 No. 3, pp. 16-20.

A PSYCHOLOGICAL STUDY OF INCREASING SUICIDAL TENDENCY IN PRESENT SCENARIO OF COVID-19 CRISIS

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In this medical emergency of COVID-19, increasing suicidal tendencies all over the world can be considered a mental health emergency. The speed at which suicide cases shoot up is alarming. Now COVID-19 will not be just a medical phenomenon. Day by day, it is adversely affecting people not only physically but also mentally as well as emotionally. Maybe its impact and consequences vary from person to person, but we cannot deny that, due to this outbreak, everybody is feeling stressed and having anxiety. In this situation, when a person is already emotionally unstable negative thoughts can dominate him easily. Mental health can be ensured when we are vigilant about the emotion, thought, and behaviour of others and ourselves. The present study aims to provide a picture of increasing suicidal tendencies among individuals in the present scenario of the COVID-19 crisis.

Keywords: Suicidal tendency, mental health emergency.

Introduction

Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus strain. The virus is now known as the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). In March 2020, the World Health Organization declared the COVID-19 outbreak a pandemic. Coronavirus is zoonotic, that means they pass from animal to human. Researches show that there are a number of coronavirus circulating in animals. Some of them had infected humans, but some have not yet done so.

We can see some common signs of infection with this virus as cough, running nose, stuffing nose, sore throat, fatigue, headache, body ache, fever, breathing problems, sore, pink eye, some less common symptoms as vomiting, diarrhoea, rashes on the body, etc., and some severe symptoms or consequences as lungs infection, Pneumonia, severe acute respiratory syndrome, kidney failure, and even death. Older people and people who have some chronic medical conditions like cancer, heart disease, kidney problems, weakened immune system, etc., have a higher risk of serious illness.

Along with medical and physical problems, the COVID-19 pandemic caused many mental health-related problems like anxiety, depression, mood disorders, etc. It has brought several changes in our lives, like our daily routine, work style, financial pressure due to loss of a job, social isolation, etc. As this situation is full of negativity and uncertainty, people are worried about how long this condition will continue. The feeling of helplessness in this scenario is leading them towards fear for their future.

The active cases, especially death cases due to this disease, are continuously spurting up worldwide at a very high speed, and some misinformation about this disease is getting spread at even higher speed. In this condition, people with low willpower cannot cope with their fear and anxiety about the pandemic. It is increasing suicidal thoughts and the risk of committing suicide for many people.

Suicidal thoughts are as poisonous and dangerous as doing suicide itself. Once depressive and suicidal thoughts start striking one's mind, he/she needs intensive psychological care and emotional assistance. In the absence of the same, the depressive and suicidal thought can capture an individual's mind in a multiplying way that will lead them towards conclusions like: "My life is worthless." "I am helpless". "Nobody likes me". "Why to live such an unsuccessful life? " I am not fortunate". "There is no other option left except suicide to get rid of problems of my life". There is no light of hope for continuing life". "The circumstances have been completely changed, so no hope is left in favour of me," "My life is only a burden for others and me as well," ... and so on.

Increasing number of reported suicide cases worldwide during this pandemic crisis shows that COVID-19 will not be just a medical phenomenon. It is not only taking lives but also killing our willpower and enthusiasm towards life. In many of us, this fatal thought process is affecting us like a slow poison and, day by day, decreasing our mental, emotional, and physical strength and is working as life-threatening and death-dealing.

Some Reported Incidents of Suicide due to COVID-19

We can see several examples of death during this present scenario, not because of contagious disease but because of fear from this disease. There are several examples of suicide cases just because of the trepidation of being infected with the coronavirus. For example, an Italian nurse, aged 34, who was working at the intensive care ward, was under heavy stress, and then she committed suicide after testing positive for coronavirus. She was deeply upset by what she had seen on the front lines of the battle against the virus (Rome, N.K., *The Telegraph*, 25 March 2020).

An Indian father of three children, aged 50 years, who belonged to the state of Andhra Pradesh, took his own life, convinced that he had contracted coronavirus. He was terrified of infecting his family. According to his son, he watched coronavirus-related videos most of the time for many days prior to taking his own life (Sandeep Raghavan, *The Times of India*, 11 February 2020).

A 35-year-old man, suspected to be a coronavirus patient, committed suicide by jumping from the 7th floor of Safdarjung hospital, Delhi. He had returned from Sydney, Australia, and had complained of a headache. (*India Today*, 18 March 2020).

Finance Minister of Germany, aged 54, died by suicide. He was reportedly concerned about the coronavirus pandemic and its effect on the economy. "...after becoming deeply worried over how to cope with the economic

fallout from the coronavirus, State Premier Volker Bouffier said Sunday. He had been working day and night to help companies and workers to deal with the economic impact of a pandemic" (*The Economic Times*, World News, 30 March 2020).

An IRS officer, aged 56, reported drinking an 'acid-like' substance in his car in Delhi (India). The suicide note found in his car showed his fear that he might spread COVID-19 to his family (*India Today*, 15 June 2020).

A coronavirus patient aged 50 years (India) jumped off a hospital building (Sharan Poovanna, 27 April 2020: live mint e-paper-paper).

An Italian manager, 28, murdered his girlfriend aged 27 after he suspected her being infected with coronavirus (*The Jerusalem Post*, 02 April 2020).

A 36-year old man in Bangladesh committed suicide due to social avoidance by neighbours and moral conscience to ensure not to pass on the virus to his community (Mamun and Griffiths, 2020).

A girl aged 21 years in Imphal east district, Manipur (India) was tested positive for COVID-19. She ended her life on the last day of home quarantine (*The Hindu*, 29 June 2020).

A journalist aged 37 years who was undergoing treatment for COVID-19 at AIIMS, Delhi, killed herself by jumping off the hospital's fourth floor (*India Today*, 06 July 2020).

The cases mentioned above are just a few examples. It is mentioned in *Business Insider India* news (27 June 2020) "...mental health experts say the pandemic has triggered panic attack among those who tested positive for the virus, causing bouts of depression and even driving some to the brink of suicide".

Why Suicide Cases are Escalating? — A Psychological Analysis

The question arises why it is going on? Why is this physical disease turning or affecting mentally? Why are we panicking? What will be the long-term consequences of this pandemic on mental and emotional health? Reasons are many; all are interconnected and making the situation more complex. The cause behind these COVID-19 suicide cases can be over-thinking. In most examples, those who committed suicide were analysing the situation in an extremely negative way. Guilt feelings, a pessimistic approach towards their present condition, hopelessness, and helplessness forced them towards suicide. Probably, a person commits suicide, not because of his detachment from life; rather, in my opinion, he loves his life so much that imagining life captured by a horrible disease is his main concern that he opted for such a horrible step.

Behind this dreadful act, other reasons may be fear of being infected, fear of social avoidance, social boycott and discrimination, social isolation, financial issues due to unemployment and poverty, depression and anxiety, lack of on-call-counselling or mental health awareness, withdrawal tendency, less emotional support from family, etc.

"However, most vulnerable are those with existing mental health issues like depression and older adults living in loneliness and isolation. Such people are self-judgemental, have extreme suicidal thoughts." (Thakur and Jain, 2020). Suicidal thoughts and behaviours

are associated with social isolation and loneliness (Van Orden, et al., 2010).

Withdrawal tendency and fear of death can be seen in coronavirus patients. One patient illustrated the psychological toll of COVID-19 symptoms when he told his clinician, "I feel like (you) send me home to die." (*CBS News*, 19 March 2020).

Decreased religious supports may also cause frequent suicidal cases during this medical crisis all over the world. "The effects of closing churches and community centers may further contribute to social isolation and hence suicide" (Reger, et al., 2020).

Economic downturns are usually associated with higher suicide rates than periods of relative prosperity (Oyesanya, et al., 2015). Because of COVID-19, many sectors have faced adversity, and people are losing their jobs and facing economic stress and emotional disturbances.

Steps for Enhancing Mental and Emotional Strength

Nowadays, along with frontline corona warriors, medical and emergency services staff, mental health professionals' role is also essential and foremost. We must be vigilant about distorted mindset before it becomes poisonous or fatal for our physical and emotional system. We need to divert our negative and self-destructive energy towards positiveness, optimism, and willpower.

We have to realise that stress and anxiety is a normal reaction to the current pandemic crisis and we do not have to let it dominate our emotions and thought process. What we all need to do is strengthening our physical immunity as well as mental immunity by a positive approach toward life. It is not always a negative story; there is always a positive side as well. As it is mentioned on the website of the University of California, San Francisco (2020), "Our anxiety is helping us cope, bond together from a physical distance, and slow the spread of the virus. Therefore, our anxiety, though uncomfortable, is a good thing right now. Simultaneously, we must effortfully prevent panic contagion by engaging our attention in normal daily activities. Seize opportunities to share lightness and humor".

According to Lt Col. N.T. Ranjan, director of Chennai-based Mastermind Foundation (2020), "From the psychological perspective, we do not find a single human being who is not feeling some degree of stress or anxiety due to coronavirus. The intensity and impact vary from person to person. The situation is serious. There should be counselling at three stages—on coping with a virus, how to face it if tested positive and how to face life once treated and discharged from the hospital".

According to Mitch Prinstein (1 June 2020), Professor of Psychology and Neuroscience, University of North Carolina, Chapel Hill, "This is a time when we need to be hyper-vigilant about suicidal thoughts and behaviours. Our most serious attention should be on those with prior emotional and behavioural difficulties."

In the article titled, 'Are we facing a post-COVID-19 suicide epidemic? Is the current pandemic putting more people at risk for suicide?' author Romeo Vitelli (2020) mentioned, "...Finding real solutions will not be easy, especially as the coronavirus pandemic drags on. Even with video conferencing and social media to help people

avoid feeling isolated, enhanced suicide prevention services will still be needed along with public education to ensure that people in crisis are aware of what resources are available to them."

The present time demands to educate our society about the suicide safety plan or techniques so that during the crisis, everybody who is feeling emotional trouble or disturbances due to whatsoever reasons can be optimistic and able to search for things worth living for, in their life.

Conclusion

It is clear from the above discussion that COVID-19 pandemic crisis is resulting in a long-term mental health crisis. It is leaving several people vulnerable to mental and emotional health problems. In this scenario, efforts must be made to mitigate probable undesired consequences on mental and emotional well-being. The speed at which the suicide cases are shooting up due to frustration, economic pressure or fear of social isolation, etc., in the COVID-19 crisis is alarming. Thus, this is the time to reconnect and strengthen social relations so that by sharing experiences, we can support each other emotionally. For this purpose, technology (via video conferencing) might be helpful. We should be ready to take action, backed by vigilance and social connectedness, keeping in mind that withdrawal or suicidal thought is not the solution.

References

Business Insider India. 27 June 2020; Covid-19 triggering panic attacks, depression, and suicides, says experts. https://www.businessinsider.in/india/news/covid-19-triggering-panic-attacks-depression-and-suicides-say-experts/articleshow/76656305.cms

Clay, R. A. 2020. COVID-19 and suicide. *Monitor on Psychology*, Vol.51 No.(4). https://www.apa.org/monitor/2020/06/covid-suicide

Coronavirus disease 2019 (COVID-19). https://www.mayoclinic.org/diseases-conditions/coronavirus/symptoms-causes/syc-20479963

India Today 18 March 2020. Suspected Coronavirus patient commits suicide by jumping off the 7th floor of Safdarjung hospital. https://www.indiatoday.in/india/story/delhi-patient-commits-suicide-by-jumping-off-7th-floor-of-safdarjung-hospital-1657149-2020-03-18

India today 15 June 2020: Delhi IRS officer commits suicide over the fear of spreading covid-19 to family. https://www.indiatoday.in/india/story/irs-officer-commits-suicide-fear-spreading-covid19-to-family-1689091-2020-06-15

India Today 06 July 2020: 37 years old Covid-19 positive journalist kills self by jumping off 4th floor at AIIMS Delhi. https://www.indiatoday.in/india/story/covid19- coronavirus-positive-journalist-suicide-aiims-delhi-july-6-1697634-2020-07-06

Mamun, M.A. and M.D. Griffiths. 2020. First Covid-19 sucide case in Bangladesh due to fear of covid-19 and Xenophobia: possible suicide prevention strategies. *Asian Journal of Psychiatry*, Vol. 51, No. 102073.

Oyesanya, M., Lopez-Morinigo, J., and Dutta, R. 2015. Systematic review of suicide in economic recession. *World journal of psychiatry*, Vol. 5 No. 2, pp. 243–254. https://doi.org/10.5498/wjp.v5.i2.243

Ranjan N.T. 2020, Covid-19 triggering panic attacks, depression, and suicides, say experts: *The Tribune*, Voice of the people, posted on 27 June 2020. https://www.tribuneindia.com/news/nation/covid-19-triggering-panic-attacks-depression-and-suicides-say-experts-105222

Reger, M. A., Stanley, I. H., and Joiner, T. E. 2020. Suicide Mortality and Coronavirus Disease 2019-A Perfect Storm?. *JAMA psychiatry*, Vol. 77. No. 11, pp.1093–1094. https://doi.org/10.1001/jamapsychiatry.2020.1060

Rome, N.K. 2020. An Italian nurse commits suicide as another 683 people die from coronavirus: *The Telegraph* news website of the year. https://www.telegraph.co.uk/news/2020/03/25/italian-nurse-commits-suicide-another-683-people-die-coronavirus

Romeo Vitelli. 07 June 2020: 'Are we facing a post-covid-19 suicide epidemic? Is the current pandemic putting more people at risk for suicide?'; *Psychology Today*. https://www.psychologytoday.com/us/blog/media-spotlight/202006/are-we-facing-post-covid-19-suicide-epidemic

Sandeep Raghavan. 11 February 2020, Andhra Pradesh; fearing to have contracted Coronavirus, 50-year-old commits suicide in Chittoor district: *The Times of India*, City. https://timesofindia.indiatimes.com/city/vijayawada/andhra-pradesh-fearing-he-had-contracted-coronavirus-50-year-old-commits-suicide-in-chittoor-district/articleshow/74085748.cms

Sharan Poovanna. 27 April 2020: One patient commits suicide, another loses battle to Covid-19 in Karnataka; *Live Mint* e-paper-paper. https://www.livemint.com/news/india/coronavirus-patient-commits-suicide-in-bengaluru-11587967046440.htm

Thakur, V., and Jain, A. 2020. COVID 2019-suicides: A global psychological pandemic. *Brain, Behaviour*, and Immunity, Vol. 88, pp. 952–953. https://doi.org/10.1016/j.bbi.2020.04.062

The Economic Times, World News 30 March 2020: German Minister commits suicide after 'virus crisis worries. https://economictimes.indiatimes.com/news/international/world-news/german-minister-commits-suicide-after-virus-crisis-worries/articleshow/74877039.cms

The Hindu. 29 June 2020: COVID-19 The Imphal girl in-home quarantine ends life. https://www.thehindu.com/news/national/other-states/covid-19-imphal-girl-in-home-quarantine-allegedly-commits-suicide/article31942784.ece

The Jerusalem Post. 02 April 2020: Italian man allegedly murders girlfriend; says she gave him Covid-19. https://www.jpost.com/OMG/Italian-man-allegedly-murders-girlfriend-says-she-gave-him-with-COVID-19-623359

University of California, San Francisco: site; Department of Psychiatry and Behavioural Sciences (2020): Emotional well-being and coping during Covid-19. https://psychiatry.ucsf.edu/coronavirus/coping https://psychiatry.ucsf.edu/coronavirus/coping

Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., and Joiner, T. E., Jr. 2010. The interpersonal theory of suicide. *Psychological Review*, Vol. 117 No. 2, pp. 575–600. https://doi.org/10.1037/a0018697

COMMUNITY PARTICIPATION IN COMBATING COVID-19 PANDEMIC: ROLE OF LOCAL CLUBS IN MANIPUR

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The COVID-19 pandemic presents an unrivaled global crisis affecting countries and territories across the world. It has affected every aspect of our livelihood. India, with the second-largest population, is at a huge risk of the COVID-19 pandemic. It requires cooperation and collective preparedness from all strata in society. The transmission of COVID-19 could be reduced by a joint effort of the government and the community. In Manipur, local clubs play a vital role in the social well-being of the community. These voluntary and service-oriented bodies work towards the development of communities, empowerment of people, shaping youths, improving the quality of life, raising awareness in different realms, promotion of games and sports, preservation of culture and extending solidarity, etc. Considering the importance of local clubs, the present study investigates the role of local clubs in fighting the pandemic. The descriptive survey method was adopted to conduct the research. Data collection was done through telephonic and personal interviews. The findings revealed pivotal roles played by the local clubs ranging from the distribution of essential commodities to spreading awareness or helping the government isolate the individuals with travel history. The study suggests that working hand in hand with the community is the need of the hour. The government can control the spread of the COVID-19 transmissions with the nearby club's help.

Keywords: Community participation, global crisis, local club, pandemic, social well-being

Introduction

The COVID-19 pandemic presents an unrivalled global crisis and affected every aspect of livelihood. On 11 March 2020, the World Health Organization pronounced it as a pandemic (WHO, 2020). The pandemic affected almost every nation and region around the globe and has caused a worldwide interruption. COVID-19 spread quickly and has lower casualties than MERS and SARS (Petersen, et al., 2020). The whole world is facing its consequences today. The first COVID-19 case in India was reported on 30 January 2020 in Kerala, the patient with a travel history to Wuhan, China (Vaman, et al., 2020). As per the most recent report of the Ministry of Health and Family Welfare, Government of India, the COVID-19 active cases in the country are 1,43,625 on 9 February 2021, the total number of recuperated cases is 1,05,48,521, and the total death is 1,55,158.

The central and state governments took several measures in fighting the pandemic. The nation was forced to lockdown completely beginning from 25 March 2020 to control the transmission (India coronavirus lockdown, 2020). The Ministry of Health and Family Welfare of India took necessary actions to control the spread of COVID-19 (Kumar, et al., 2020). Efforts were made to decrease contact, including shutting schools and organisations, forcing travel limitations and curfews, and restricting the size of gatherings (Favas, et al., 2020). WHO and other organisations

issued several guidelines and protocols to be followed from time to time to fight the pandemic.

Community Participation

The pandemic threatens to affect the poor and widens the existing disparities in access to instruction, human services, and social administrations (OCHA, 2020; Vegas, 2020). India, the second largest population globally, will require a huge workforce and resources to control this disease's transmission. The transmission of COVID-19 could be decreased by the deliberate accomplishments of the government and the community. The community's involvement is the key factor and is extremely indispensable to support the exercises of reconstructing the shattered community life (Bhagat, 2016). Community cooperation spurs individuals to cooperate where people feel a sense of belongingness and perceive the advantages of their inclusion (Hossain, 2013). Communities are the best adjudicators of their weakness and are equipped for settling on the best choices for their prosperity. The engagement of the community could be a vital aspect of pandemic control as learned from the experience with Ebola and SARS (Lau, et al., 2020). Community engagement in fighting the COVID-19 is very significant as it can reduce the spread and curb the frequency of cases, giving time to the health workers to prepare to respond systematically and effectively (Blake and Ngo, 2020).

Local Clubs in Manipur

The importance of community participation is always valued and recognized. However, the efforts and approaches of effective community participation in the COVID-19 crisis may vary in different societies and regions. In the context of Manipur, different clubs in almost every locality play an indispensable role in the social prosperity of the community. Social Development Club, the New Young Sporting Club, Youth Sporting Club and Juvenile Educational and Sporting Association, etc., are some of the clubs in Manipur. The local clubs are a social body that comprises the local people working for the welfare of the people. Forming a club with proper infrastructure that has an office, library, ground and a hall has become a norm (Ningthoujam, 2011). These voluntary and service-oriented bodies work towards the development of communities, empowerment of people, shaping youths, improving the quality of life, raising awareness in different realms, promotion of games and sports, preservation of culture and extending solidarity, etc. The club's governing body consists of youths as members and the senior members of the community as advisors. The administrations and services are provided voluntarily by the local individuals with no compensation. Contributions and donations from the inhabitants/community members are made to raise funds for carrying out different tasks. The clubs also support the government in association with *Sarva Siksha Abhiyan*, (Total Literacy Campaign) of the National Literacy Mission, National Health Mission, Total Sanitation Campaign, and *Bharat Nirman* started by the Government of India to accomplish the Millennium Development Goals. Considering the importance of local clubs, the present paper highlights the research finding of the role of community participation through clubs in fighting the COVID-19 pandemic.

Focus of the Study

In Manipur, the local club acts as a medium for fostering a sustainable community. These social capital institutions are registered bodies under the Cooperative Societies Act, rendering social and selfless service during any calamities. The study has been taken up to explore the extent of local club's participation in controlling and combating the COVID-19 pandemic.

Method and Procedure

Manipur is one of the Indian states located in the north-eastern part of the country. Total active cases of 85 with 28672 recoveries from the disease were reported on 9 February 2021 in the state as per the Ministry of Health and Family Welfare, Government of India. For the present study, the descriptive survey method was adopted. A self-constructed interview schedule was employed to collect data. Telephonic interviews were conducted. Secondary data were collected from journals, newspaper articles, blogs, and YouTube.

The purposive sampling technique was used to collect data from five clubs in the Wangoi constituency, Imphal west district of Manipur. All the local clubs in Manipur constituted the study population, and five clubs were selected as samples according to the purpose of the study.

Results and Findings

The findings revealed pivotal roles played by the local clubs ranging from the distribution of essential commodities to announcing a speculated case or helping the government isolate the individuals with travel history. The study found remarkable roles played by the clubs in battling the pandemic.

Segregation: The clubs played a vital role in isolating the travellers to limit the outbreak's size and its impact on the well-being of the public. Records of the individuals with travel history were maintained and strictly monitored for any symptoms of the disease. Furthermore, travellers under home quarantine and community quarantine were supervised, and thermal checkups were done from time to time.

Distribution of *Arsenicum Album* 30: A prophylactic medicine called *Arsenicum Album* 30 was distributed to the locality of approximately three thousand people to boost immunity against COVID-19 after the recommendation of Ministry of AYUSH to use it as it enhances the defense mechanism of the body. However, the efficacy of this homeopathic drug is not tested nor has been developed specifically for the current pandemic (Sheikh, 2020).

Distribution of relief materials: Sanitizers and food items including rice, pulses, salt packets, sugar, and seasonal vegetables were distributed to the public as relief materials from the club fund and contributions from MLAs and other social workers of the community. The public was urged to contribute to the local club fund and Prime Minister's National Relief Fund or Chief Minister Relief Fund. Physical and social distancing was maintained while distributing the relief materials.

Volunteering at quarantine centres: In addition to segregating travellers to quarantine centres, the club members volunteered in the community quarantine centres. They helped in the supply and distribution of food along with maintaining decorum at such centres. Reports of

Some pictures taken with permission from the Social Development Club, Samurou' Manipur

Seggregating travellers and monitoring home quarantine

Club members disinfecting public places

Packing relief materials for distribution in the club office

Assisting health workers in mass testing

extending self-less service in institutional as well as community quarantine centres without any financial assistance were expressed by the clubs.

Ban on *marup*, microfinance, and money lender's interest: The pandemic has an adverse impact on the economy. Almost every aspect of society is disturbed. In this crisis, the club members played a vital role in restricting the payment of interest to the money lenders and micro-finance groups. There was a ban on *marup*, which is a type of micro-saving credit system.

Disinfection of public places: Spraying sodium hypochlorite to disinfect the locality was reported from time to time. Sodium hypochlorite is a very common disinfectant that is used for water purification, cleaning purposes, as well as removing odour. People were also made aware of the importance of personal and environmental hygiene in protecting against the disease.

Spreading awareness and solidarity: The club members, along with the local youth volunteers, spread awareness to the public by religiously reminding the dos and don'ts. The basic steps to protect from COVID-19 by following social distancing, wearing a mask, covering mouth while coughing and sneezing and frequent washing of hands were continuously reminded to people in general. Proper information and awareness about extending solidarity and not stigmatizing the infected individual, family, and frontline workers were imparted at the community level.

Airing important news and updates: The clubs reported airing important announcements and updating the locals concerning the COVID-19 pandemic. The daily news was also aired for the public by installing speakers in the club offices.

Strict monitoring on price rise and opening of shops: The clubs ensured that shops sell essential commodities at a fair price. Hoarding huge amounts of goods by the shopkeepers were also monitored to avoid inflation, which might otherwise cause difficulty to the whole community.

Checking substance abuse: Cases of substance abuse ascended in the wake of forcing lockdown in the state. The youths fall prey to such practices in the light of numerous reasons. The local clubs reported drug seizures and a ban on the sale of alcohol in their localities.

Restrictions on public gathering: Public gatherings in the locality related to political, educational, social, cultural, and religious purposes were strictly restricted in the locality. People were made to understand the huge risk such gatherings have in virus transmission.

The imposition of Standard Operating Procedure: The guidelines and standard operating procedures (SOPs) given by the experts and government were imposed on the club's locality. The volunteers ensured that people in the locality followed the SOPs issued in public places. In addition to this, they assisted the frontline workers in maintaining the lockdown in their respective jurisdictions.

Tracing contacts and follow-up: The club members helped in tracing the contacts of the patients for isolation and testing. After identification of the contacts, they were informed to the concerned authorities for further process.

Discussions

The findings reveal that the efforts of the local clubs are commendable in fighting the spread of COVID-19. Steps taken by the clubs in segregating the travellers and monitoring them in-home or community quarantine are exceptionally fundamental in controlling the infection transmission. Hellewell, et al. (2020) in their study reported that effective tracing of contacts and isolation could reduce the magnitude of the outbreak. Isolation of travellers and segregating them for 14 to 28 days until the quarantine period at the quarantine centres were also advocated. Although, the Government of

India under *Pradhan Mantri Garib Kalyan Yojana* (PMGKY) declared Rs 1.7 lakh crore relief packages during the COVID-19 pandemic, the clubs extended monetary assistance for the distribution of relief materials from their fund as well as urged the public to raise money to help the weaker sections of the community. The club took initiative in disinfecting the public places to control the widespread of the disease that helped in reducing the rate of transmission and secured the vulnerable population. He, et al. (2020) reported disinfecting public places as one of the most important steps to manage COVID-19. Further, the clubs' participation in the distribution of relief materials while maintaining the issued guidelines and SOPs guarantees the target population gets the maximum benefit. The findings of the study reveals the potential role a club offers in containing the spread of the COVID-19 pandemic thus highlighting the importance of community participation. Bedford, et al. (2020) found the importance of community participation in controlling the COVID-19 pandemic, which is in tune with the findings of the current study.

Conclusion

The current investigation sheds light on the significant roles played by the local clubs in battling the pandemic. Different tasks were carried out selflessly by the clubs for the welfare of the community at the grass-root level before and during the pandemic. The service extended by the club members should be recognized and appreciated. Furthermore, the clubs should be empowered as they are often the ones on the ground level working relentlessly before, during, and long after a crisis is over. Community participation should be supported and encouraged for implementation of government programmes and policies. Working hand in hand with the community is the need of the hour. The government should consider the importance of community participation and involve the local people, youths, or local club in not only combating the pandemic but also in the future endeavours.

References

Bedford, J., Enria, D., Giesecke, J., Heymann, D. L., Ihekweazu, C., Kobinger, G., Lane, H. C., Memish, Z., Oh, M. D., Sall, A. A., Schuchat, A., Ungchusak, K., Wieler, L. H., and WHO Strategic and Technical Advisory Group for Infectious Hazards. 2020. COVID-19: towards controlling of a pandemic. *The Lancet* (London, England), Vol. 395 No.10229, pp.1015–1018. https://doi.org/10.1016/S0140-6736(20)30673-5

Bhagat, S. 2016. Community-based disaster management strategy in India: An experience sharing. *Journal of Energy and Management*, Vol. 1, pp. 11–17.

Blake, S., and Ngo, T. D. 2020. A rapid review of community engagement and so cial mobilization strategies for a Covid-19 response- study description.

Coronavirus confirmed as a pandemic by World Health Organization. March 11 2020. BBC News. https://www.bbc.com/news/world-51839944

Favas, C., Abdelmagid, N., Checchi, F., Garry, S., and Jarrett, P. 2020. Guidance for the prevention of COVID-19 infections among high-risk individuals in camps and camp-like settings. London School of Hygiene and Tropical Medicine.

He, F., Deng, Y., and Li, W. 2020. Coronavirus disease 2019: What we know? *Journal of Medical Virology*, Vol. 92 No. 7, pp. 719–725. doi:10.1002/jmv.25766

Hellewell, J., Abbott, S., Gimma, S., Bosse, N.I., Jarvis, C.I., Russell, T.W., Munday, J.D., Kucharski, A.D., Edmunds, W.J., Funk, S., and Eggo, R.M. 2020. Feasibility of controlling COVID-19 outbreaks by isolation of cases and contacts. *Lancet Glob Health*, Vol. 8, No.4. DOI:10.1016/S2214-109X(20)30074-7

Hossain, A. 2013. Community participation in disaster management: Role of social work to enhance participation. *Antrocom Online Journal of Anthropology*, Vol. 9, pp. 159–171.

India coronavirus lockdown | Day 1 updates (2020, March 25). *The Hindu*. https://www.thehindu.com/news/national/india-coronavirus-lockdown-day-1-updates-march-25-2020/article31159466.ece

Kumar, S. U., Kumar, D. T., Christopher, B. P., and Doss, C. G. P. 2020. The Rise and Impact of COVID-19 in India. *Frontiers in Medicine*, Vol. 7, 250. https://doi.org/10.3389/fmed.2020.00250

Lau, L. S., Samari, G., Moresky, R. T., Casey, S. E., Kachur, S. P., Roberts, L. F., and Zard, M. 2020. COVID-19 in humanitarian settings and lessons learned from past epidemics. *Nature medicine*, Vol. 26. No. 5, pp. 647–648. https://doi.org/10.1038/s41591-020-0851-2

Ministry of Health and Family Welfare of India. Government of India. https://www.mohfw.gov.in

Ningthoujam, I. 2011. 'Leikai-club' in the contemporary Meitei society. e-pao. net. http://http://www.e-pao.net/epSubPageExtractor.asp?src=manipur.Ethnic_Races_Manipur.Leikai_club_in_contemporary_Meitei_society

OCHA. 2020. *Global Humanitarian Overview* 2020. United Nations. https://www.unocha.org/sites/unocha/files/GHO-2020_v9.1.pdf

Petersen, E., Koopmans, M., Go, U., Hamer, D. H., Petrosillo, N., Castelli, F., Storgaard, M., Al Khalili, S., and Simonsen, L. 2020. Comparing SARS-CoV-2 with SARS-CoV and influenza pandemics. *The Lancet. Infectious Diseases*, Vol. 20. No. 9, e238–e244. https://doi.org/10.1016/S1473-3099(20)30484-9

Sheikh, S. 2020. Homeopathic drugs such as arsenicum Album 30, promoted by AYUSH, do not boost immunity against COVID. https://www.altnews.in/homeopathic-drugs-such-as-arsenicum-album-30-promoted-by-ayush-do-not-boost-immunity-against-covid/

Vaman, R. S., Valamparampil, M. J., Ramdas, A. V., Manoj, A. T., Varghese, B., and Joseph, F. 2020. A confirmed case of COVID-19 among the first three from Kerala, India. *The Indian Journal of Medical Research*, Vol. 151. No.5, pp. 493–494. https://doi.org/10.4103/ijmr.IJMR_2205_20

Vegas, E. 2020. School closures, government responses, and learning inequality around the world during COVID-19. https://www.brookings.edu/research/school-closuresgovernment-responses-and-learning-inequality-around-the-world-during-covid-19/. Brookings Institution.

WHO characterizes COVID-19 as a pandemic. World Health Organization. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/events-as-they-happen

TEACHING-LEARNING OF SCIENCE IN ONLINE MODE DURING COVID-19 LOCKDOWN IN RURAL SCHOOLS : PERSPECTIVES OF STAKEHOLDERS OF BOLGARH BLOCK OF ODISHA

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Over these years the world has explored many exciting opportunities with new technologies which have changed the trends and have brought people more closely with each other. Innovation has changed the manner in which individuals communicate and cooperate, it has set an open social platform that permits the occupants of this planet earth to interface with one another with ease bringing the whole world under one umbrella. COVID-19 has changed the approach of each sector and forced to change their preferences and needs. Education is one of the important sectors of the country. Looking at the difficulties and challenges faced in teaching-learning process during this period, Government of India as well as state governments are taking many initiatives. One of those initiatives is Odisha Siksha Sanjog launched by Government of Odisha. Based on qualitative design the present study collected data from parents, students and teachers and explores the perspectives of the stakeholders in rural areas on online teaching and learning, its benefits, challenges and possibilities.

Keywords: Online learning, online learning platforms, teaching science.

Introduction

Online learning or e-learning is a broad term used to allude to a type of learning in which the mentor and mentee are isolated by space or time but the two are connected using web advancements (Reshma, et al., 2017). India's education sector is being revolutionised by rapid increases in internet penetration. But in rural areas same traditional method is still in practice even in the e-learning era (Mukherjee, 2009). Many initiatives have been taken up by Government of India as well as state governments towards digital India (access, equity, and quality) and digital literacy in India, to facilitate the online mode of teaching and learning. Some of the initiatives are mentioned here.

- **National Digital Library of India (NDLI)**: It was propelled as a pilot venture in 2016, and is offering more than 2 million eBooks and others in excess of 100 dialects.
- **Swayam:** Free online education: It assembles courses educated in state funded schools from ninth class through to the post graduate level. The online courses incorporate four segments: videos, online readings and assets, self-appraisal tests, and open online forum.
- **Swayam Prabha:** It is a free educational channel providing educational contents 24x7 across the country. It covers the contents starting from Class I to higher

education classes including graduate, postgraduate, vocational and teacher training courses as well. It deals in science, arts, commerce, social sciences and humanities, engineering, technology, etc.

- **Diksha application**: Diksha makes it possible for the education ecosystem (Experts, Educationists, Organisations, Institutions-Government or Non-Government Organisations) to participate, contribute and leverage a common platform to achieve learning goals at a scale for the country.
- **Madhu app**: The app named after Utkal Gourab Madhusudan Das, has been developed in accordance with the 5T initiative of the state government of Odisha for school students on 3 December 2019. It is an e-learning smart phone application which will help the students of schools in the state to learn their lessons through tutorials and high-quality video lectures available in Odia language.

As the world is going through a very tough and unfavourable situation due to COVID-19 pandemic, and almost all the countries are under lockdown situation, each and every sector is affected including the education sector in India. To address these issues many initiatives are being taken care of by the Government of India as well as Government of Odisha to promote education through online platform amidst the lockdown. In the light of this, Government of Odisha launched Siksha Sanjog initiative on a pilot basis in Khordha district on 19 April 2020 and later it was extended in government-run schools across the state from 4 May 2020.

Need of the Study

E-learning arrived late in India obviously, yet it is by and large quickly acknowledged in a major way. India might have viewed the achievement of the west in embracing e-learning and is making a decent attempt to execute it (Imran, 2012). India has, of late, observed a flood in the selection of ICT based items and arrangements. Innovative works in this field have additionally observed upward trends. But the status of rural India in accordance to internet facilities and its benefits to rural India is still a question and needs to be answered.

Following are some reviews which state the use of online learning and its status in rural India.

Study directed by Abbasi, et al., (2020) found that students preferred classroom learning over e-learning. Dhawan (2020) in her examination concentrated on the web-based learning and the qualities, shortcomings, openings, and difficulties of e-learning modes in the hour of emergency. This article likewise throw some light on the development of EdTech Start-ups during the hour of pandemic and incorporates proposals for scholastic organisations on how to manage difficulties related to web-based learning. A study conducted by Baloran (2020) found that the respondents were happy with the administration's activity to moderate issues. However, reluctance with online-mixed learning approach was observed. Jadhav, et al. (2020) directed an examination on the students' role to look at problems in education system during lockdown issues in Maharashtra. The effect of lockdown on training has been referenced. Their points

of view on the online training during the lockdown and the outcomes were recorded. Jena (2020) studied the effect of COVID-19 on advanced education in India and has recorded some post COVID-19 patterns which may permit envisioning another method of showing learning of advanced education in India. Manazir, et al. (2020) led an investigation to see how to make e-learning more fruitful under the current circumstance and if an ever-comparable circumstance comes up in future. They found inclination for 'WhatsApp' and 'Zoom' platforms for video conferencing. Reshma et al. (2017) in their investigation expressed that there are a few innovations accessible to empower different audience today. Two such developing innovations which have extraordinary potential for e-learning in rural India are the Next Generation Internet and Natural Language Interfaces. Both these advancements are still at a beginning phase both in India and abroad. Be that as it may, our industry and policymakers can exploit these innovations and use them to serve the country. As per the investigation conducted by Yadav and Tiwari (2016) improvement of any general public relies on its access to data and the same is relevant to India as well. E-learning can do some incredible things toward this path and help the socially minimised network to achieve their qualifications. Patel, et al. (2014) in their investigation found that utilizing e-Learning Tools one can enormously improve learning process and procure learning in simple issue-free condition. Another significant advantage of the e-learning is that one can make adapting consistently on. Aggrawal (2009) pointed out the social ramifications of web-based learning. A summary of the studies discussed is provided below:

1. E-learning tools can be utilised enormously to improve learning process.
2. E-learning can do something amazing and help the socially unprivileged community to accomplish their privileges.
3. The main constraints to access e-learning facility among rural people are network problems, discomfort ability, lack of technical knowledge, etc.

Because of the lockdown, online teaching and learning is a matter of concern. There is a need to study the status of online mode of teaching-learning in rural Odisha. From the above discussion, it can be concluded that a lot of work has happened in the area of online learning. However, a lot is yet to be explored and researched upon. In this analysis, the researcher aimed to illustrate the perspectives of different stakeholders on online method of teaching and learning.

Operational Definitions

Online mode of teaching-learning: In general, online mode of teaching and learning is an acquisition of knowledge through different online modes. But for the present study the online mode is defined as using WhatsApp as an online medium of teaching.

Stakeholders: Stakeholders in educational process may include administrators, principals, teachers, counsellors, parents, students, etc. For the present study, stakeholders include teachers, parents and students.

Research Questions

1. What are the online resources and programmes available from school education department for teaching-learning of science in rural Odisha?
2. What are the perspectives of the stakeholders related to implementation and challenges in using online resources during this lockdown?

Delimitations of the study: The study was conducted in one of the blocks of Odisha, i.e. Bolgarh block of Khordha district. Ten teachers, ten parents and ten students each from primary and secondary schools have been taken into account to generalise the findings.

Methods and Procedure

Research design: For the present study descriptive research approach was followed to collect data by using a self-constructed interview schedule.

Population: The targeted populations for the study were the government school teachers teaching science in primary and secondary schools of Bolgarh block, the parents of the students who are studying in those schools and the students of Bolgarh block studying in primary and secondary schools. In Khordha district there are six blocks. One of the blocks is Bolgarh which includes 16 clusters. Total numbers of schools coming under the Bolgarh block is 205 including primary, elementary and secondary schools.

Samples and sampling procedure: Convenience sampling method was used which is a type of non-probability sampling. For the present study 20 teachers (ten from each: teachers of primary and secondary schools), 20 parents (ten from each: parents of primary and secondary school students), 20 students (ten from each: primary school and secondary school students) were selected as participants (Table 1).

Data collection procedure: The period for data collection lasted for almost fifteen days. Face-to-face as well as telephonic mode of interview between the researcher and the participants were employed to collect detailed information about their experiences of online mode of teaching and learning using WhatsApp. The whole process of interview was recorded by using an audio recorder for precise transcription and the researcher noted the valuable and important points provided by the participants. During the face-to-face interview, all the Covid-19 guidelines were followed.

Findings of the Study

The information gathered by both recorded and composed structures were translated and classified based on the reactions of the

Table 1: Participants for the present study

Teachers (20)		Parents (20)		Students (20)	
Upper Primary	Secondary	Upper Primary	Secondary	Upper Primary	Secondary
10	10	10	10	10	10

members to each questions. The reactions were then classified into topics and sub subjects.

1. Online Resources Used for Teaching and Learning during Lockdown

About Odisha Siksha Sanjog

A programme of Government of Odisha to impart teaching and learning during the lockdown period due to Covid-19, Odisha Siksha Sanjog emphasises on online learning through WhatsApp. This was continued for six weeks till 13 June 2020. WhatsApp groups have been formed at different levels starting from DEO to students for sharing the following materials:

- PDF of parts of reading material accessible in OSEPA site.
- Question bank (containing inquiries of various qualities, i.e., 3-mark, 2-mark, 1 imprint and so forth) model answers/ answer keys.
- Teaching material for every exercise/ period comprising exercise content worksheet and answer key.
- Written clarification arranged by educators, video chronicles or sounds cuts arranged by instructors, video exercises/movement recordings accessible in Madhu App, Diksha Portal or other comparative locales/ computerised stage might be utilised as exercise content.
- Worksheets of Ujjwal and Utthan for rudimentary classes can be utilized.

Teachers' Perspectives: All the participants were of the same view that under the Odisha Shiksha Sanjog programme, they have been teaching through WhatsApp. When the teachers were asked about the other platforms or applications they are using for the teaching and learning, teacher participants 7, 9 and 17 stated about the Madhu app. But they are not using it. Teacher participants 12, 15, 18 and 19 stated about the Diksha app and ePathshala. They referred to the contents at times.

Parents' Perspectives: All the participants stated that, they heard about the online teaching from the class teachers when they called and asked about their WhatsApp number.

Parent participant 3 stated "Sir called me and told to give the WhatsApp number. I don't even know about WhatsApp. I asked the teacher what it was and then he made me understand. When I told him that I don't have a WhatsApp number and mobile also, then he told to ask my elder daughter (sir knew her as an old student). Then I asked her and gave her number".

Parent participants 11 and 14 stated "Sir called and asked for the WhatsApp number. We had mobile phones but don't have WhatsApp. Sir told how to install it. Then we installed and gave the number".

Students' Perspectives: When asked them, they told their teachers used to send questions in WhatsApp and they used to send answers back to them.

2. Use of WhatsApp as a Platform or Medium of Interaction

Teachers' Perspectives: During the interaction all the teachers stated that they get questions from the Cluster Resource Centre Coordinator (CRCC). They stated that

"we have a WhatsApp group, questions are made by the subject-wise resource person at the district level, and they send the subject and class-wise questions and materials to Block Resource Centre Coordinator (BRCC). BRCC sends the materials to CRCC. We get the materials in the previous day evening; and we send those materials during the fixed time tables (8 am-11 am for primary classes and 8 am-12 am for Classes IX and X) and students were asked to send answers back to us. In the same day evening, we send the answer sheet, so that students can self-evaluate".

When they were asked whether the materials sent by the resource persons are sufficient or not, all the teachers were of the same view that the materials provided by them are not enough.

Teacher participant 5 stated "sometimes I used to make some questions and send to students", and all others stated. "Although we have instructions that we can make if we wish to but looking at the students' problems we don't generally give, but if any students asks anything then we answer them".

Teacher participants 13 and 16 told we don't have any other option than sending the materials.

Parents' Perspectives: Parent participants 3, 5, 14, 17, and 18 stated that, we don't know much. But when sometimes we ask them, they told sir and madam are sending questions in WhatsApp and we answer them.

Students' Perspectives: Our teachers used to send the questions and we answer them. In the evening, when teachers send the answers we match the answers with our answers.

3. Attendance of Students

Teachers' Perspectives: When asked about 'whether all the students attend the class' all the teachers replied maximum numbers of students were not attending. Only 30-40 per cent of students of the class have WhatsApp number of their parents. Some of them have also given their neighbour's number, uncle's number, etc., and the number of students decreased in the lower classes. However, two teacher participants 2 and 6 also told that "we also didn't have WhatsApp, now we also installed it".

Teacher participants 13 and 14 belonging to the same secondary school stated that some of their old alumni students who are in higher positions donated seven mobile phones to the needy and talented students.

Parents' Perspectives: Out of the 20 parent participants, 13 have phones (parent participant no.1, 2, 4, 6, 8, 9, 10, 11, 13, 14, 16, 17, 20) out of which seven parent participants have smart phones (parent participant no.2, 4, 6, 9, 11, 16, 17), while four of them were not using WhatsApp (parent participants 4, 9, 11, 14). Other seven parent participants 3, 5, 7, 12, 15, 18, 19 have arranged for smart phones from their elder son or daughter or from their neighbours.

Students' Perspectives: Out of the twenty student participants, three student participants 4, 13, 18 of Class IX do not have any access to mobile phones and others have somehow arranged and are attending the classes.

4. Response from the students in online learning

Teachers' Perspectives: Out of 30-40 per cent students who have WhatsApp number of their parents, almost 50 per cent used to send back the responses. Teacher participant 3 stated "we also don't know whether they are sending or someone else like elder brothers

or sisters are answering so that they don't have to sacrifice their phone for their younger brothers or sisters' study purpose. But we are trying our best to monitor." Other teacher participants like 12 and 19 stated the same thing.

Parents' Perspectives: Some parent participants who are having their own mobile phones told "our children must be sending as they are using the mobile phones for study purposes". Two parent participants 2 and 6 told, "Yes they are sending and we are monitoring". Parent participants 3, 15, 18, 19 stated "sir, getting others' phone every day is very difficult as they have their own works". Parent participant 1 told "sir, I have a small child, giving her mobile is a very difficult job as she may break it." So I am not giving, when I am free, I used to sit with her and give her mobile."

Students' Perspectives: Except student participants 4 and 13, who are siblings, others told "yes we used to response to our teachers' questions". And student participants 4 and 13 replied "Sir, we don't have mobile phone, we sometimes go to my friend's house, asked him/her what question sir has given, I answered them from his mobile in my name. But every day it is not possible."

5. Implications of online learning

Teachers' Perspectives: According to the teachers, it is useful for the students as they are engaged in certain academic activities. "Something is better than nothing," teacher participant 5 stated. At least some students take it as a burden that some work has been assigned and we have to complete.

All teachers also told that "it is also helpful for us as it is making us more conversant with technology, before we were not using".

Parents' Perspectives: "It's better to read something," they stated, "otherwise they are not even looking at their books."

Students' Perspective: Five secondary school student participants 8, 10, 12, 13, 16 told, "Although it is difficult to connect, but at least we could ask doubts to our teachers. At least we get some guidance from the teachers."

6. Challenges of Teaching-learning of Science through WhatsApp in Rural Areas

Teachers' Perspectives: All the teachers agreed and stated the following points. Each and every parent can't afford to have a mobile phone and they are hesitant to ask for mobiles to their neighbours regularly. Secondary science teacher participants 9 and 20 stated "teaching science through WhatsApp is not at all sufficient. There are many complex concepts in Class VIII and Class IX; it is very difficult to teach these concepts through WhatsApp. We don't even know that students are getting anything or not." All other teachers agreed to this point. Secondary school teacher participants 5, 9, 10, 11, 17 also stated that, "Parents don't want to give mobiles to the children as they were misusing it, and if they are also not given for longer times, it is difficult if sometimes we want to call and make them understand the complex concepts". Secondary school teacher participant 9 specifically stated that "our HM called one student and scolded him for uploading status in WhatsApp during the class."

Teacher participant 1 stated "as face to face mode of teaching is not there, so students are casual as they know that teachers will not say anything, if they don't do the assigned tasks." Other teachers also agreed upon the same issue.

Teacher participants 1, 2, 7, 10, 13, 16, 17, 19 stated "Interaction and communication with students is difficult, as calling each student is next to impossible work as they don't have their own mobile phones but we are trying." Primary teacher participant 2 stated "it's difficult to teach through WhatsApp to junior classes like Classes II and III, as they cannot even read clearly. So their parents have to help them in reading out the questions for them, some parents who have time are doing it, but some other parents are illiterate."

Teacher participants 3 and 5 stated "Network problems and money are the constraints for them. Every parent cannot avail the internet facilities as it is costly. Sometimes if they want to recharge also, due to lockdown it's a difficult task." All teachers agreed upon "Attendance of students is the major issue. Students who don't attend the classes, they miss and it's difficult to go at the pace in the next class and they don't understand the science concepts." Teacher participants 1, 11 and 15 stated "In some schools there are Classes up to V, VII or VIII. The pass out students from these schools could not get admission to the next class and for which they were debarred from the online mode of teaching." Teacher participants 3, 7, 9, 12, 13, 16 stated "Books were also not been provided for the next class to which students were promoted, and as they are having the issues related to mobile phones and networks, etc. it is not possible for them to access the internet facilities and download the e-Books and video tutorials."

Parents' Perspectives: Unavailability of smart phone with each and every parent is the major issue. Parent participants 5 and 7, 12 and 18 stated "we don't like to ask for mobile phones to our neighbours daily." Parent participants 1, 4, 6, 10, 17 and 20 stated "Children use the mobile phones for other works rather than study, they used to play games, watch videos, etc."

Students' Perspectives: Student participants 4, 7, 11, 13, 14 and 18 told "I don't have a mobile phone, many of our friends also don't have mobile phones. Learning through WhatsApp is not at all sufficient; we don't get everything teachers want us to understand. The complex and critical concepts are hard to understand. Generally, our teachers write the things on some papers and send us. We sometimes get, otherwise we ask. Sometimes our teachers make us understand over phone if we have doubt. But as all of us don't have any mobile phones and every time it is difficult for us to clear our doubts."

7. Possibilities

Teachers' Perspectives: All the teachers stated about follow up, monitoring as well as awareness to parents. It is much more important as parents only can guide their children. In this problematic situation, parents' role is more important. Initiatives from government and NGOs towards these needy students can also be helpful. Help from the old students also can be helpful.

Parents' Perspectives: Parent participants 2 and 6 stated that "role and responsibilities of parents are more. We have to monitor and guide our children. Then it can be more successful." Other parents also agreed on that point that they have to monitor their own wards.

Students' Perspectives: Student participants 6, 9, 10 stated, "If government gives one mobile phone to each student as they are

giving bicycles, it will be helpful. Because we don't have mobile phones, so we cannot use them for studying." Student participant 19 and 20 told "some of the old students have contributed some mobiles for us. We are thankful to them."

Online platform in rural areas of Odisha in Teaching and Learning Science.

The interaction and discussion with the teachers, parents as well as students helped to project the ground reality about the status of online mode of teaching and learning and its need for people residing in the rural areas. From the above discussion the following points can be agreed upon:

(a) Mostly the e-learning initiatives deployed so far are at basic level and is more traditional in nature.

(b) The way education has been dealt since ages — the same practice is going on even in the e-learning era.

(c) Merely a change in medium has taken place without considering any change in pedagogy or delivery objective.

(d) Rural people were not aware about the online platform of reading. Many people thought of only the negative impacts as they had been listening from different sources.

(e) Teachers of the rural areas are not conversant with the use of ICT and its use in teaching-learning processes, so they need to be trained to update their knowledge about online teaching-learning, use of ICT in their practices. And they can also further make parents aware as well.

(f) There were numerous penniless students in rustic zones that are being deprived of the online instruction.

Discussion of Results

The present study projects the perspectives of different stakeholders on online mode of teaching and learning in rural schools of Bolgarh block of Odisha. Based on the findings, it was realised that people of rural areas were not conversant with the online mode of teaching and learning and e-learning in the rural areas is still in the basic level. Mukherjee (2009) in his study also agreed and stated that in rural areas same traditional method is still in practice even in the e-learning era. However, it was realized that in the lockdown situation, where movement is strictly prohibited, e-learning has come in to practice. Patel, et al. (2014) in their study stated that e-learning is something which can make learning ON anytime. And the present study also agreed to the point stated as online education has become one of the alternatives to continue the teaching-learning. Manazir, et al. (2020) in their study also tried to understand the success of online platforms during this period and has suggested different platforms like WhatsApp and Zoom for online study. So, online mode can be used for teaching and learning as it will help in the development of the country and will be a step forward in the digital India initiative. The present study is about using WhatsApp (as part of *Siksha Sanjog* initiative) as a platform for teaching and learning. In addition to Zoom and Google meet, WhatsApp also can be used

as a medium for online interaction. Yadav and Tiwari (2016) in their examination expressed about the importance of digitalisation and utilisation of data and correspondence advances for the improvement of the nation. It has been understood that there are several issues for the moderate digitalization in rustic zones. Similar problems and negative factors which were influencing the progress of the country were cited by Reshma, et al. (2017). The present study found that the unavailability of resources, poor financial conditions of people and very minimum awareness about the online mode of teaching and learning slows the online teaching and learning process as well as the digitalisation process. Dhawan (2020) in her investigation concentrated on the web-based learning and the qualities, shortcomings, openings, and difficulties of e-learning modes in the hour of emergency has likewise recorded numerous advantages, difficulties and opportunities of online stages. Online mode of learning has been an alternative in this critical and unprecedented situation. The present study also discussed about the benefits, challenges and possibilities of online mode of teaching and learning, and mainly discussed the use of WhatsApp as a learning platform. Jena (2020) has additionally recorded some post COVID-19 patterns which may permit envisioning another method of showing learning of advanced education in India. From this study, we learned that teachers and students feel face-to-face method of interaction to be better than the online mode despite the fact that they acknowledged the online method of learning. The present study discussed about some possibilities like prioritizing the awareness, training and monitoring about the use of different platforms. Abbasi, et al. (2020) in their investigation likewise found that students do not have inclination for e-learning and prefer face-to-face learning. The present study also agreed about the fact that they face less challenges in face to face mode of teaching and learning as compared to online learning when their understanding about the complex concepts is taken into account. Also, the unavailability of smart phones with many students also affects their learning.

Conclusion

The present study focused on the perspectives of different stakeholders on online mode of teaching and learning in rural areas. After going through all the discussions, it can be concluded that rural area is developing but in a very slow pace. Teaching-learning of science through online mode during COVID-19 is very much tough in higher classes as there are many complex concepts. Government needs to see and focus on the ground reality during formulating any guidelines or taking any initiatives. Still it can be concluded from the above findings that Odisha Shiksha Sanjog, although could not cater the needs of all the students, but it is a welcoming step towards educating students in the unfavourable situations. The government should make strategies to address the challenges and take certain steps for the benefit of the people and the society as a whole. Monitoring at district, block and cluster level will be more helpful for online learning.

References

Abbasi, S., Ayoob, T., Malik, A., and Memon, S. I. 2020. Perceptions of students regarding E-learning during Covid-19 at a private medical college. *Pakistan Journal of Medical Sciences*, Vol. 36(COVID19-S4), S57–S61. https://doi.org/10.12669/pjms.36.COVID19-S4.2766

Aggarwal, D. 2009. Role of e-Learning in a Developing Country Like India. Proceedings of the 3rd National Conference; INDIACom-2009.

Baloran, E. T. 2020. Knowledge, attitudes, anxiety, and coping strategies of students during COVID-19 pandemic. *Journal of Loss and Trauma*, Vol. 25, No. 8, pp. 635–642. doi:10.1080/15325024.2020.1769300

Dhawan, S. 2020. Online learning: A panacea in the time of COVID-19 crisis. *Journal of Educational Technology Systems*, Vol. 49, No. 1, pp. 5–22. doi:10.1177/0047239520934018

Imran, S. M. 2012. Trends and Issues of e-learning in Lis-Education in India: A pragmatic perspective. *Brazilian Journal of Information Science*, Vol. 6, No. 2. doi:10.36311/1981-1640.2012.v6n2.03.p26

Jadhav, V. R., Bagul, T. D., and Aswale, S. R. 2020. COVID-19 era: Students' role to look at problems in education system during lockdown issues in Maharashtra, India. *International Journal of Research and Review*, Vol. 7, No. 5, pp. 328–331.

Jena, P. 2020. Impact of Covid-19 on Higher Education in India. *International Journal of Advanced Education and Research*, Vol. 5, No. 3, pp. 77–81.

Manazir, S. H., Rubina, and Govind, M. 2020. E- Learning pedagogy in institute of higher education in India post lockdown due to COVID-19 pandemic. Digital Inclusion Research Forum (DIRF), New Delhi.

Mukherjee, D. 2009. E-learning a potential learning solution for rural India – A critical analysis. *Researchgate*. Retrieved from https://www.researchgate.net/publication/304892967

Patel, H., Patel, P., and Shah, P. 2014. Impact of e-learning in the development of student life, Impact. *International Journal of Research in Engineering and Technology*, Vol. 2, No. 4, pp. 233–238.

Reshma, S., Soumya, E., and Sr. Juli, A. 2017. Awareness of e-learning among rural people of Kerala. *International Journal of Education and Applied Sciences Research*, Vol. 4, No. 01, pp. 01–08.

Yadav, S., and Tiwari, A. 2020. E-learning in rural India. *International Journal of Science and Environment and Technology*. August 9, 2020

IMPACT OF COVID-19 PANDEMIC ON SCIENCE LEARNING AT SECONDARY LEVEL

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Science is suffering from potential loss, and this is going to be very costly. Science learning is being compromised due to strict stay-at-home orders and school closures for Indian students. In this article, the researcher tried to investigate the effect of COVID-19 on the teaching and learning of science (particularly at the secondary level) in India's schools and educational institutions. The thought of online teaching and learning may sound exciting to many, but to science lovers, it is not! Students seem to dislike science with online classes because the essential elements of science classes are absent in online classes. Moreover, this may affect the future scientists of the nation. Additionally, access to technology, strict time tables, and teachers' inability to adapt to this online culture can be considered the main hurdles in teaching science in online mode. Further, the researcher has also elaborated on the point of online lectures and virtual labs. Somehow, this pandemic may end up helping us to address the improper science assessment policies too.

Keywords: Science learning, lockdown, school, students, COVID-19.

Introduction

Human life is approaching a new normal. The COVID-19 pandemic is staying longer than expected. The coronavirus pandemic is perhaps the most significant challenge faced by humans since Second World War. This virus is not looking for boundaries of the nations and states. When writing this article, the world's total coronavirus cases have crossed 14,78,84,279 cases, including 1,76,36,307 cases in India (Human Rights Watch; ISRC, 2020). All the countries of the world are racing to slow down the curve of infected patients. It includes testing and treating patients, contact tracing, restricting people's travel, and quarantining suspected patients. Since it is a communicable disease with no known effective drug treatment available, the best way is to close down everything and practice social distancing.

The COVID-19 pandemic has affected all the spheres of life, including education. This pandemic has resulted in the almost total closure of schools, colleges, and universities. All governments have temporarily closed all the schools and other educational institutes to contain this novel coronavirus, so has the Indian government. All the governments are increasing the vaccination drives in their respective nations. India has also given emergency approval to Oxford-AstraZeneca's COVISHIELD and Bharatbiotech's COVAXIN and has administered over twelve crore doses.

The COVID-19 is a communicable disease. World Health Organization (WHO) confirmed

its human-to-human transmission through nose, mouth, and eyes long ago; this disease is caused by SARS-CoV-2, which first appeared in Wuhan, China. It has resulted in a pandemic and was declared a health emergency. The first case of coronavirus in India was reported in Kerala, and then the cases started rising quickly. The Indian government imposed a lockdown on 24 March, 2020, for curbing the spread through human transmission. The lockdown measures and the stay-at-home orders led to the closure of all educational institutes and academies. Moreover, the learning of students from K-12 to higher education stopped.

Schools have to close down to adhere to public health measures. Today educators across the nation are worried about catering to the diverse needs of all the learners. The unequal access to technological tools and technology are significant hindrances. In order to sustain the interest of all learners in learning science, numerous efforts were made to run all the educational institutions online.

Experimentation and laboratory works are integral parts of science learning. According to NCF (2005),"scientific inquiry involves observation and experimentation to validate predictions made by theory (hypotheses), which instruments and controls may aid." However, experiments are not possible because of the shutdown. Science teaching and learning are critical because it is tough to continue this scientific learning (using scientific ways) through online mode in India.

This inspired the researcher to investigate the effect of COVID-19 on the teaching and learning of school science, particularly at the secondary level in India.

Methods and Procedures

The opinions from various teachers and students were taken online, mainly through emails and Google forms. Telephonic interviews were also conducted to know the different perspectives of all the stakeholders. The qualitative data collected were analysed and synthesised. Different policy documents were analysed to find their perspective about teaching and learning science. The inclusion of a lower economic section of society in the study was problematic because of lockdown and curfews; they did not have appropriate access to technology, which may be regarded as a limitation. However, various efforts were made to proportionate the share of students from all sections of the society. In addition to this, many research articles were analysed to observe the pandemic's global impact on school education and higher education in India.

Further, new concepts of virtual labs and virtual learning environments were also reviewed through open access literature available on the internet. In this article, the researcher explores the challenges regarding science learning through perception and opinion from various stakeholders. After gathering opinions from the field, the researcher reflected on all the aspects and put his thoughts together.

Results and Discussion

From the data collected through various means, students reported that they find science class annoying. Science has become a more robust and stricter subject. A child says, "I just cannot do science anymore." However, high scores said that they love

online lectures because they are in a good flow and good quality.

Teachers say that learning is being affected due to the closure of science labs. "We are not able to conduct experiments in laboratories due to this shutdown." A teacher from the rural area adds, "we have a tiny science lab in school with limited tools available; now the only means is also closed." Further, another teacher said, "I find these online classes as a burden because I am not aware of the appropriate use of technology; we have been given little to no training." He also said, "my complete focus in an online class is on the appropriate use of different technological tools rather on scientific concepts, and our students are not able to access these online classes due to various reasons."

Students and parents say that they do not have the appropriate tools. "We lack the internet and appropriate device for attending class online; many times, we cannot open documents in our phone due to different formats of the documents. We do not like learning science this way." "I have started hating science," a child added. Educational administrators add that "the budget for purchasing the latest technological tools is not available, but we are still focusing on teaching and learning online because it is the only way possible." The discussion on the data collected is discussed in the rest of the article.

Science Learning is Suffering in Shutdown

It just means that science is suffering from potential loss. This is going to be very costly for everyone. Science, which is considered one of the complex subjects, is already suffering from the stigma of 'meant for the intelligent', and the closing of all the essential places of scientific interest leads toward a new and drastic condition of 'hatred for science.' The students who are marginalized and were interested in science are losing their valuable time for sure. After this academic session is over, no one is looking for the deficiency in their understanding of scientific concepts (It is a general trend in India that we do not look at the concepts of previous sessions). This will deepen the gap in understanding, and we could lose the pure intentions of our potential scientists. This process is being explained in the different sections of this article.

Poor Quality of Science Learning During Pandemic

Many researchers repeatedly say that most Indian teachers are not prepared to teach online, and teachers have admitted it. The thought of online teaching and learning may sound exciting to many, but to science lovers, it is not! Merely replicating the regular science curriculum to learners through online platforms is harmful and unnecessary (Anderson, et al., 2020). They may end up disliking science. Teachers in India are not trained to teach science in online mode. They are ignoring the principles of science teaching because their working memory is already filled with the thoughts of technological tools. Further, all the universities and colleges are pretending to deliver the content online. It would be funny to imagine that all our students are studying online because the majority of the students belong to the lower middle class and poor class families and hence accessibility to technology is an issue

here (Government report as cited in *Hindustan Times*).

Following a demanding school day, timetable/schedules can hamper the learning. The unique materials that are commonly used in teaching and learning science are not available at home. Teachers have to take care of all these things while delivering instructions. The asynchronous mode is better than the synchronous mode because students will have more choice in attending classes.

Impact between Haves and Have-nots on Science Learning during Pandemic

The National Curriculum Framework (2005) says science "curriculum should engage the learner in acquiring the methods and processes that lead to the generation and validation of scientific knowledge." The closure of schools automatically meant the closure of all science experiments and the closure of all the science learning labs for most students. The lower income group of the society, having much potential for science learning, is out of the school's science class. They are not able to attend online classes or instructions. Additionally, merely attending online classes of science is not adequate until and unless some sorts of experiments supplement classroom learning. All these things are fictional now, which is why we may lose the charm. It is time for teachers to show their skills in making learners 'self-helped.' Teachers have to create some activities and must train students to prepare replicas of equipment through improvisation. Educators have to make sure that science lovers' learning is not limited by their access to technology. Science learning can be made with family members' help, e.g., how does your mother cook? (finding and locating science.) Creating the local pool for teaching and learning of science can be a good idea.

Senior students may be asked to prepare some models/tools/accessories of scientific interest as part of their science learning project, and these may be used by teachers or by senior students to popularize science interest among young ones. This crisis may be considered a good start in understanding the true nature of science, which is about life and not just book and curriculum. The books and curriculum are tools to learn science; they are not science in themselves. The syllabus is the complex mix-up of daily life phenomena. "To observe the physical and biological environment, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world" (NCF, 2005); these wordings of the National Curriculum Framework-2005 may be realized now. Some ways may help in growing science learning in this pandemic situation. Some of these are explained in the discussion below.

Necessary Virtual Environment

The highly contagious novel coronavirus is responsible for the closure of all educational institutions. The norms and guidelines for this health emergency are responsible for the disturbance in a regular face-to-face classroom. These norms are inevitable to prevent the spread of this disease among other members of society. Like many other professional activities in the economy, the campus-based teaching and learning process has come to a halt. All the standard face-

to-face teaching strategies of education and science, in particular, are suspended indefinitely. This has suspended the dominant understanding of various main concepts in the minds of students. The concepts that require a demonstration of the skill/experiment are no longer accessible. All the laboratories and other experimental spaces of all the educational institutions are closed. This may lead to a more impoverished understanding of some essential concepts of science, and in a broader context, it may destroy the interest of students in the learning of science.

Nevertheless, the ICT or Information and Communication Technology advancements allow teachers and educators to connect with their students over the internet from their homes. Educational administrators are also trying to ensure that the learning should continue and should not come to a halt, no matter what the situation is. Many institutions and reputed schools have already been shifted to the virtual mode of transmission. They are creating an educational mission through a virtual environment. The remote learning strategies or distance learning strategies and television broadcasts are the most excellent examples of teaching and learning science in different ways. Teachers can teach, and students can study while staying at home and following the strict social distancing orders and stay-at-home.

"Online learning and virtual teaching are the recent development for popularizing science education; also, it has improved the spread of educational resources" (Hunter, 2015; Waldrop, 2013a, 2013b). According to Srivastava, et al. (2013), poor nations have a limited number of skilled teachers in science, and the number of students opting for science is much more than the resources available. Hence the use of distance and online learning is essential for these nations. Highly equipped educational schools and campuses are the need of the hour, but they are not accessible to all the interested students. It is the main reason why many students have to opt for non-science streams (despite having much interest in science). The Massive-Open-Online-Courses (MOOCs) is very popular in many countries across the world. However, the rates of completion of the courses are meagre.

Video lectures by experts and high-quality learning resources are, no doubt, beneficial for all students. Additionally, it may support the regular classroom learning of students in schools, colleges, and universities. The online streaming of the lectures is better because it may benefit most students, and students could ask their queries in the live classes. The use of platforms like Skype and Zoom for group discussion is better for enhancing the learning experience. The academic curriculum through a virtual environment is being followed even during this health emergency of COVID-19.

Popularising Virtual Labs

Digital learning is perhaps one of the biggest things for learning during this COVID-19 shutdown. One of the disadvantages of online classrooms and lectures is that they cannot provide adequate laboratory experiments, skills and expertise. The virtual lab—most popular thing for science learning in today's era can add this dimension. The virtual labs are a replica of real-life-laboratory in the virtual world. They are safer for students and newly appointed teachers. These provide some of the practical skills to students in

a virtual setting (Huang, 2004; Ray, et al., 2012, 2016; Ray and Srivastava, 2020). The main advantage of these labs is that it is helping learners in "obtaining the knowledge regarding real-life experiments in a risk-free environment devoid of any direct physical contact with any toxic chemical or pathogenic substances" (Jones, 2018) and significantly more helpful for underdeveloped countries having a low educational budget. Notably, different studies have shown that no significant difference exists in the students' learning outcomes of real laboratory and virtual laboratory (De Jong, et al., 2013; Ray, et al., 2016; Ray and Srivastava, 2020). Virtual labs provide learning spaces for students to enter the real laboratory with adequate skills because mistakes in the real laboratory are costly. The debate on completely replacing the real labs with virtual counterparts is on. However, the combination is always better than either of the choices.

The virtual labs facilitate the learning and teaching of science amid COVID-19. Virtual labs are better options for learning laboratory science experiments. The interested students are working in these virtual labs to gain some fruitful knowledge. This simulated experimental setup is, no doubt, a better option. The virtual labs are indeed a better option for learning some of the science experiments during this pandemic.

Experimental and Assignment Based Examinations

Returning to school campus again is still tricky for Indian students and teachers. The outbreak has not ended; in India, even the rate at which the virus is spreading is very high. It may result in a significant challenge in conducting the semester-end examinations for all schools and universities. They have to opt for another assessment strategy that can work in this COVID-19 pandemic, resulting in better assessment strategy development by educational administrators. It is more likely that the developed new assessment policy will undoubtedly be better than the term/semester end examinations because the term-end examinations cannot judge the understanding of the science skills and processes. Process validity is an essential criterion since it helps the student in learning to learn science (NCF, 2005). This pandemic is going to teach us better ways of assessing the outcomes of science learning. The virtual modes of assessment will also be strengthened and improved.

Conclusion

All Indian schools and colleges were closed to contain the spread of the novel coronavirus, which resulted in the total closure of face-to-face classes. To fill the deficit of knowledge, many schools started online classes with limited technological tools. This online culture leads to the discontinuation of hands-on experimentation and laboratory work, which is considered an integral part of science in schools. We investigated the effect of this pandemic on the teaching and learning of science at the secondary level in India.

In the online survey, we found that students with a high achievement level were comparatively more satisfied with online classes than their low scorer counterparts. In our talks with teachers, we found that Indian teachers are worried about science learning

by their students in the online mode because all hands-on experiments and laboratory works are entirely at a halt. Further, the teachers accepted their inability to use technological tools in teaching online. It is resulting in poor teaching quality of teaching and learning. Additionally, lack of access to technology and its tool to students is also a hurdle in attending classes online. In short, science learning is suffering in lockdown. This situation may increase the hatred for science among our learners.

Further, the researcher has elaborated on improving the quality of science teaching and learning during the lockdown. Online lectures by experts are one of the main recommendations. It will make learning lucid and exciting. It is time to shift to virtual labs and online laboratory for making science learning more effective. We have also suggested how new assignment and project-based examinations may increase love for science among all learners (even during shutdown).

References

Anderson, R. M., Heesterbeek, H., Klinkenberg, D., and Hollingsworth, T. D. 2020. How will country-based mitigation measures influence the course of the COVID-19 epidemic? *Lancet* (London, England), Vol. 395, No. 10228, pp. 931–934. https://doi.org/10.1016/S0140-6736(20)30567-5

De Jong, T., Linn, M. C., and Zacharia, Z. C. 2013. Physical and virtual laboratories in science and engineering education. *Science*, Vol. 340, No. 6130, pp. 305–308. doi:10.1126/science.1230579

Government Report. (n.d.). 2021 29 million students don't have access to devices: Govt report. Latest News India - *Hindustan Times*. Retrieved October 07, 2021.

Huang C. 2004. Virtual labs: E-learning for tomorrow. *PLoS biology*, Vol. 2, No. 6, e157. https://doi.org/10.1371/journal.pbio.0020157

Human Rights Watch | Defending Human Rights Worldwide. https://www.hrw.org/

Hunter P. 2015. The virtual university: digital tools for e-learning and remote learning are becoming an increasingly important tool for teaching at universities. *EMBO Reports*, Vol. 16, No. 2, pp. 146–148. https://doi.org/10.15252/embr.201440016

ISRC (Indian Scientists' Response to COVID-19) | Science based resources and guidelines. https://indscicov.in/

Jones N. 2018. Simulated labs are booming. *Nature*, Vol. 562, No. 7725, pp. S5–S7. https://doi.org/10.1038/d41586-018-06831-1

National Curriculum Framework. 2005. p. 43. National Council of Educational Research and Training, New Delhi.

Ray, S., and Srivastava, S. 2020. Virtualization of science education: a lesson from the COVID-19 pandemic. *Journal of Proteins and Proteomics*, Vol. 11, No. 2, pp. 77–80. https://doi.org/10.1007/s42485-020-00038-7

Ray, S., Koshy, N. R., Diwakar, S., Nair, B., and Srivastava, S. 2012. Sakshat Labs: India's virtual proteomics initiative. *PLoS Biology*, Vol. 10 No. 7, e1001353. https://doi.org/10.1371/journal.pbio.1001353

Ray, S., Srivastava, S., Diwakar, S., Nair, B., Özdemir, V. 2016. Delivering on the Promise of Bioeconomy in the Developing World: Link It with Social Innovation and Education. In: Srivastava, S. (eds) *Biomarker Discovery in the Developing World: Dissecting the Pipeline for Meeting the Challenges*. Springer, New Delhi. https://doi.org/10.1007/978-81-322-2837-0_6

Srivastava, S., Özdemir, V., Ray, S., Panga, J. R., Noronha, S., Nair, B., and Diwakar, S. 2013. Online education: E-learning booster in developing world. *Nature*, Vol. 501, No. 7467, pp. 316. https://doi.org/10.1038/501316c

Waldrop M. M. 2013. Education online: the virtual lab. *Nature*, Vol. 499, No. 7458, pp. 268–270. https://doi.org/10.1038/499268a

____ 2013. Online learning: Campus 2.0. *Nature*, Vol. 495, No. 7440, pp. 160–163. https://doi.org/10.1038/495160a

ONLINE TEACHING: WHAT DO TEACHERS THINK?

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The teaching-learning process has been through a paradigm shift from face-to-face to online teaching using varied digital platforms in the current pandemic milieu. This transformation process was sudden and unscheduled and so has drawn attention towards the adaptation of the teaching community at large. The researchers aimed to explore the experiences of 100 school teachers towards online teaching. A self-constructed questionnaire was used to ascertain the experiences and perceptions of teachers towards online teaching. Teachers' responses brought to light that they are confident about online teaching and have adapted well to the situation. They highlighted the flexibility and reach to many learners as advantages of online teaching and challenges like connectivity issues and infrastructure.

Keywords: Online teaching, teachers' perception.

Introduction

The term online teaching and learning also finds itself clubbed under the umbrella term digital literacy, one of the most important 21-century skills for teachers and learners. As per Wikipedia, digital literacy is defined as: "...the ability to find, evaluate, and communicate information by utilizing digital media platforms." Digital literacy is considered one of the most important skills for teachers and learners because of today's scenario prevailing in the world. Most education institutions are integrating digital literacy training for their teachers and learners because they acknowledge how the world is already developing and understand the significance of online literacy and the role that collaboration and online engagement play in learning process and their future work environment.

Online teaching is not a new concept; in fact, its origin dates back to 1960 at the University of Illinois when it created an intranet for its students. It was a system of linked computer terminals where students could access course materials and listen to the recorded lectures. From then to now, online teaching has evolved so much that in a situation of complete lockdown across the world, learners from kindergarten to the ones studying in the university are receiving online classes. Teachers are using various online channels (like Zoom, Microsoft teams, Skype, etc., different tools, and pedagogical strategies to connect with their learners and ensuring that the curriculum is delivered within the given time. Teachers play a key role in the

successful implementation of any learning approach. However, in such a pandemic situation, online teaching is now considered one of a teacher's biggest virtues. The need of the hour is that we start integrating technology into the teaching-learning process so that delivering education is not limited to face-to-face classrooms.

Online teaching, in general, offers flexible timings, location flexibility, access to plenty of resources, variation in interaction patterns and information sharing, diverse and enriching experience, equal opportunities of learning for all, digital information literacy, and aids in proper administration. There are some restrictions, limitations, or considerations also with the usage of online teaching. Some of these are access to technical know-how, accessibility concerning the internet, lack of trained teachers, isolation, and information overload.

Review of Related Literature

Extensive online teaching adoption in such pandemic times is a newer feature, and so not many studies were available in this regard, especially to do with teachers' experience or perception. The researchers have compiled the limited work in the area in the following paragraphs.

Vonderwell and Turner (2005) examined pre-service teachers' experiences in an online course. The findings showed that the online teaching/learning environment requires a change in student-teacher roles, relationships, and practices. The study showed how factors like preparing students for active engagement in learning, understanding student expectations, and motivation support active learning. Peer support was also considered an important factor for improved communication leading to active learning.

Ellis, Steed and Applebee 2006 explored teacher conceptions of blended learning and blended teaching. Twenty-two teachers from two campus-based Australian universities were interviewed, and the responses from them were categorized into qualitatively varied categories of conceptions and approaches. The results showed that teachers perceived blended learning as the best choice to achieve learning outcomes. Students also benefitsed themselves through the blended learning approach that resulted in new ideas, thoughts, and better understanding.

Agustina and Cahyono (2017) and Dja'far, et al. (2016) have highlighted that teachers should analyse what is currently presented and what is the better way to present a subject to completely understand course by examining faculty perceptions, training, mentoring and best practices.

Teachers at several points have opined that through faculty development programme one can become an effective online instructor, and he/she can develop the best career journey as mentorship (Billings, 2008), and Conrad and Donaldson (2004) highlighted the importance of building a sense of community in online teaching from teachers' perspective. Much research supports the point of 'Training and Development' for effectively conducting an online class (DiPietro, et al., 2008).

Redmond (2011) shared the experiences of two instructors who moved from teaching in a face-to-face environment to blended learning and then to online teaching. This study also explored the instructors' issues, perspectives, and practices and the resulting effect on

their pedagogical practices' online student engagement. The study showed a change in the instructors' beliefs and practices in online teaching to a dialogical approach to online learning providing impetus to student learning.

Sahin, et al. (2016) studied teachers' first-year experience with Chromebook laptops and their attitude towards technology integration. The researchers adopted a mixed-method approach. Quantitative and qualitative analysis was done to give a voice to teachers' concerns. They found that teachers' comfort of teaching is not significantly correlated with their years of experience. There was a statistically significant relationship between the number of technological tools they had and their comfort in teaching with technology.

Beach (2017) investigated elementary teachers' self-directed learning in an online environment. The methodology included think-aloud protocols with screen recording technology to capture cognitive processes from 15 teachers as they used a professional development website. Three-stage coding was used to explain how teachers use and learn from a professional development website. Findings offered deeper insights into how and why teachers used professional development websites. According to Ballew (2017), 74 per cent of the online instructors of K-12 opined that the promotion development programme must be added to the school programme to enhance the instructor's teaching ability.

The discussed studies highlight different aspects of online teaching-learning, focusing more on the technology part, while others on the experience part. Since the area is comparatively newer, especially in India – there are not many studies. It will not be wrong to say that the onset of pandemic and physical closure of schools ushered in adopting the online teaching-learning model in Indian school classrooms. So, the Indian teachers would present an altogether different perspective to this aspect, which was the focus of this research.

Objectives of the Study

This research study aimed to capture teachers' present experiences concerning online teaching as it has become the norm of the day amid the present pandemic crisis. The researchers intend to study the readiness, confidence, attitude/perception of teachers towards online teaching. They will also highlight the specific challenges faced by teachers and suggest pragmatic recommendations/implications leading to effective use of technology in the teaching-learning process. This paper aims to:

1. survey the preparedness of teachers for online teaching amid COVID-19 situation,
2. gauge the extent to which teachers feel confident in online teaching,
3. explore their perception of online teaching,
4. analyze their views about the future of online teaching, and
5. study the benefits and challenges teachers faced in online teaching.

Methodology

This was a descriptive study as the survey was undertaken to know teachers' experiences while conducting online teaching. Details

of the methodology are being shared in this section.

Sample

A total of 100 teachers teaching different subjects in private schools were identified through snowball sampling from Faridabad and Delhi. The snowball sampling technique was adopted because the schools were physically closed, and there was no other way to approach the teachers formally. The snowball technique helped the researchers to reach a wider audience in a short period.

The teachers were asked questions on the different factors like confidence, preparedness, attitude, and skills required for online teaching.

Instrumentation

As the study focused on collecting data from teachers conducting online teaching, the researchers decided to use a comprehensive questionnaire with close and open-ended questions. Questions were put in a google form, and the survey took not more than 10 minutes to be completed by the respective teachers. Questions pertained to collecting the teachers' demographic information, experience-related information, and few questions had a five-point scale to gauge the teachers' confidence and questions on their attitude or perception towards online teachers. Researchers incorporated questions specific to the benefits and challenges of online teachers and how teachers foresee the status of online teaching compared to face-to-face teaching.

The questionnaire was submitted to three independent experts in the area of teaching and technology. These experts performed semantic and content validation. The items were considered valid in relation to the objectives and purpose of the research study. We also shared our tool with an analytical consultant who determined the factorial reliability as a precursor to using the tool with the target audience.

Data Collection

The study could not have adopted a linear approach because of the pandemic situation created due to COVID-19. Researchers had initially thought of conducting a comparative study between face-to-face and online teaching. But unfortunately, due to the lockdown announced post 22 March 2020, it became difficult to observe the face-to-face teaching and see the effect of certain skills being transferred to the online teaching component as well. So, it was decided to send in the e-questionnaire post 22 April 2020 specifically for the primary reason on account of the new session. By that time, teachers might have got an idea about online teaching, skills needed, and how to conduct the same. The link to the google form was shared with a few acquainted teachers, who then forwarded it to their colleagues. The access to the google link was closed once 100 teachers had filled in the form.

Data Analysis

The questionnaires consisted of several types of questions—there were close-ended questions, rating scale, and open-ended questions. A frequency count was done to analyze the responses to the close-ended questions. In the rating scale, there were ten items—Range and Mean were calculated on each item. The mean gave a good idea about the confidence of the respondents on different

aspects of online teaching. For open-ended questions, similar qualitative responses were clubbed together, and frequency was counted against them.

Findings and Discussion

Data collected from 100 teachers was analyzed, and findings have been encapsulated in the following paragraphs for better comprehensibility of the readers.

1. Demographic details: The sample comprised 76 females and 24 males. The sample's age ranged from 22 years to 48 years, with an average of 31.49 years. Out of 100 teachers, 44 of them exclusively taught primary classes, while 48 were handling secondary classes, and the rest 8 of them were dealing with both primary and secondary. When it comes to online teaching usage, 77 teachers used it for school teaching, while the rest used for both school and private tuitions or coaching centre. Majority (32) of the teachers who formed a part of the sample of the research and responded to the questionnaire were into language teaching, 27 were mathematics teachers, 34 were teaching commerce and economics, 30 were science teachers, 32 taught social science, and 7 were teaching some form of creative arts. There were multiple responses on this item because there are teachers who are handling more than one subject. There were 57 teachers with more than five years experience and 43 with less than five years experience in teaching.

2. Interface with online teaching: There were only 31 teachers who had done some form of online teaching before the COVID-19 pandemic. That means this was a new form of teaching for 69 teachers. Teachers were using different kinds of platforms/learning management systems for online teaching—Zoom was the most predominantly used platform as 65 teachers were using it. The Google Classroom was used by 11 teachers, followed by others like Microsoft Teams and Canvas. However, several (23) reported that they are planning to shift from Zoom because of security concerns. Teachers reported that they were given time to prepare for shifting to online teaching ranging from 2 days to 10 days. Some of the teachers felt that they should have been given more time to prepare for that. The teachers' responses to how their institution influenced their transition from face-to-face subjects/classes to an online platform were collected. The responses received are provided in Fig. 1.

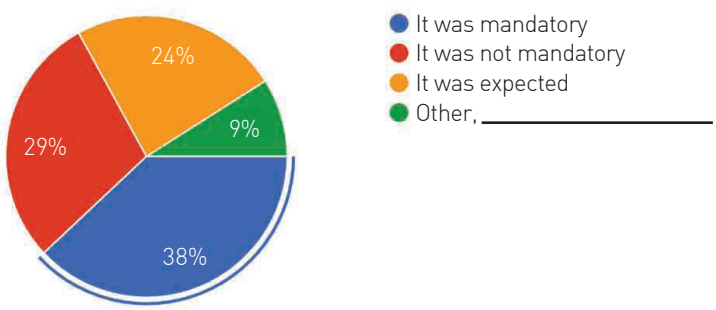

Fig. 1. Influence of institution in the transition from face-to-face mode to an online platform

The pie chart gives a clear idea that the schools had instructed the teachers to transit to online teaching. The school and teachers had well realized that education could not be hampered, and it needs to continue, so they have to resort to other ways than face-to-face teaching to continue the teaching-learning process. Many schools did not even wait for instructions from the government and started looking for alternatives. One of the teachers reported that their school started with online teaching from 20th March for their board classes. This was the usual time when their classes would have started if they would have been going to school. This, in a way, shows the concern on the part of the teaching fraternity for students' well-being and further the teaching-learning process.

A large majority (76) of teachers responded that they were given training to take up online classes, while 24 said that they learnt on their own. The school had supported them only through training, except for one. Only one teacher said their school gave hardware support from the school. This teacher said that their school provided them with infrastructural support like installing whiteboards in their homes and providing laptops to teachers who did not have them.

3. Confidence in online teaching: There were ten items to be marked on a Likert scale of 1 (strongly disagree) to 5 (strongly agree). The findings are provided in table 1.

The range in which their responses lie and the mean on aspects clearly shows that teachers are very confident about online teaching. The overall confidence (on all the ten aspects) is 4.17 (very confident), which is an optimistic sign of this mode of delivery in the education system. There was only one aspect on which the respondents felt not so confident, which was to do with online student assessment. This could probably be because teachers have not yet dwelled on formal assessment.

Table 1 – Teachers' confidence in online teaching

S.No.	Aspect	Range	Mean
1	Able to explain important course topics	2-5	4.89
2	Able to provide clear instructions to students on how to participate in online learning	2-5	4.38
3	Able to keep course participants engaged and participate in online learning	2-5	4.27
4	Able to focus discussion on relevant issues	2-5	4.37
5	Able to provide feedback to students	1-5	4.34
6	Able to implement the curriculum in an online environment	1-5	4.14
7	Able to implement different methods of teaching online	1-5	4.0
8	Able to encourage online interactivity among students	2-5	4.12
9	Able to use online student assessment to modify instruction	1-5	3.92
10	Able to meet overall demands of online teaching	1-5	4.03

4. Perception about online teaching: When asked about the ease of doing online teaching, 49 teachers found it easy, while 24 found it difficult, and 27 found it mixed depending on resources one has. Teachers, responses on the need for some special skills to teach students through online mode have been captured in Fig. 2.

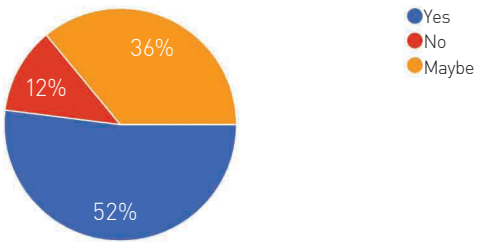

Fig. 2. Teachers' responses on the need for special skills in online teaching

Thus, more than half of them held that teachers dwelling into online teaching require some special skills, while another 36 of them were not noticeably clear on this aspect. Teachers had quite a different perspective on the interesting aspects of online teaching. Some of the aspects highlighted were – flexibility in timings, sharing of different kinds of resources, exposure of students to educative use of technology, focus on one topic, the possibility of involvement of parents, online record keeping, engaging fun resources, the novelty of method, professional updating of teachers, staying connected to our students, better classroom management. Some of them also pointed out certain non-academic reasons that make online teaching interesting for them; these were avoidance of traffic, more confidence in teaching, and opportunities for parents to see teachers' hard work, among others. One mathematics teacher did not find online teaching interesting because he could not directly and continuously see what his students were doing.

When asked about the transference of skills in face-to-face teaching to online teaching, 38 responded in affirmative, while 40 of them responded otherwise, and 22 said maybe. Teachers listed several benefits of online eaching: saving energy and time, comfort and ocus, better time management, option for students to revisit the lectures and resources, and opportunities for parent involvement, among others. One of the teachers captured it very well by responding, "Anytime, anywhere and anyone means no demographic obstacles." Also, few other takes like online teaching are more eco-friendly as it saves fuel and paper also. Though teachers listed many benefits of online teaching, yet they differed on the ability and prospect of online teaching replacing face-to-face teaching; their responses have been captured in Fig. 3.

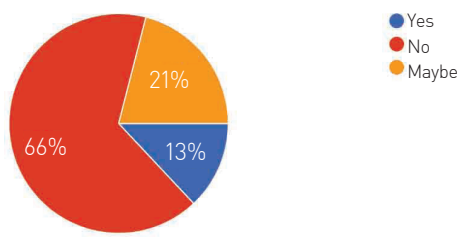

Fig. 3. Teachers' views on replacement of face-to-face teaching with online teaching

Thus, the majority believed in face-to-face teaching efficacy and held that it could not be replaced by online teaching. They ascertained points of differences in the two modes of online and face-to-face teaching

like interaction pattern between teachers and students, and among students; individual attention; personal relation with students—eye contact with students and personal touch; two-way communication and body language; assessment; dependence on technology; and preparation for teaching among others. One of the interesting replies by a teacher summates how they feel about online teaching, "I am a person who enjoys face-to-face teaching and conversations, so I think online portal does not give much space to that, though there is teaching through videos but still..." This would summarise how many teachers feel. Then there was another one who pointed out that the "affective domain does not work properly in online mode and also value education is not possible in online education."

The teachers also highlighted their challenges with online teaching, predominant among them are— connectivity and network issues, unavailability of teaching materials, environmental disturbances, non-availability of technology with students, no emotional connect with students, classroom management, interference of parents, balancing home and work simultaneously, cybersecurity and technical challenges, among others. Teachers pointed out that online teaching may not be the best medium for many learners, especially kinaesthetic learners. Some of them also pointed out that their working hours have increased, and it is taking a physical and mental toll on them as one of them said that "…. increased screen time leading to frequent headaches, sore eyes and stiff neck…." Some held that they faced challenges initially, but with time, they have got used to it.

Teachers were divided on the future of online teaching. Sixty-four teachers believe that online teaching is here to stay even after this pandemic period because it has shown a way that a much larger audience can be reached using technology. They hold that with proper training of teachers, this can be a good prospect and a game-changer in the field of education— "it can become a supplement to physical classrooms." On the other hand, 36 teachers pointed out this mode is not sustainable—higher costing involved, lack of infrastructure and can be used only for emergency purposes, while few pointed out that it is useful only for higher classes. One of them affirmed, "It is good that we have at least an option for teaching students during this lockdown period, but we cannot ignore the advantages of face-to-face teaching; online teaching can assist a teacher, but it can NEVER replace a teacher."

Discussion

Our study tried to explore varied aspects of online teaching—both physical and psychological. It was interesting to find how teachers very admirably adapted to this alternative form of teaching, i.e., e-learning, against face-to-face teaching. Most of the teachers agreed that though time was less for them to learn the nuances involved in online teaching, the present complex situation motivated them to come out of their comfort zone and work for their students' best interest through online support, engagement, and continuous assessment. Initially, it was challenging for teachers to face teething problems related to online teaching, like difficulty paying individual attention to all students, engaging students, and handling technical issues. With time and practice, teachers overcame their inner inertia and felt noticeable confidence in teaching

through online mode. Teachers believed that online teaching has both pros and cons, but considering the present pandemic situation, online teaching had a positive effect on student's learning. They could transfer certain face-to-face skills to online teaching but considered planning and assessment as the two major areas of further exploration. Teachers want to continue with online teaching post-pandemic but expressed their concern to sustain this aspect of teaching in the future and not as a replacement to face-to-face teaching.

Concerning the studies highlighted under review, if we look at the Indian context, teachers have been happy in routing through the alternative mode of teaching to achieve the desired learning outcomes. There is a need to prepare both pre-and in-service teachers to face a situation like the present, leading to a community of teachers to discuss and share their success stories and specific challenges. A blended learning approach can also be thought of as against only online teaching to cater to the diverse needs of the students and encourage an inclusive environment in the classroom.

Conclusion

"Technology alone is not going to improve student achievement. The best combination is great teachers working with technology to engage students in the pursuit of the learning they need," (Duncan 2010).

Technology or online teaching may be a solution in the present crisis but cannot be a permanent solution. For real and effective teaching, we need a blended approach, open-mindedness, quality training programmes, optimism, support from the administration, support from parents, and last but not the least, teacher's well-being and critical reflection to prepare learners for the 21st century. Based on responses from the respondents and consequent data analysis,the researchers would like to put forward some practical suggestions:

- More skills-based training needs to be delivered to the teachers concerning online teaching like access to various online tools, how to handle technical issues, how to manage the audience through online mode, how to ensure cybersecurity, and most importantly, how to engage students effectively along with innovative ideas to do an online assessment.
- It is important to make the teachers aware of online resources' availability to make their teaching engaging, interesting and effective. In addition to this, the relevance of these materials should be one of the considering factors for the appropriate integration of technology into the teaching-learning process. They should be able to pay attention to the diverse needs of the students to encourage inclusive practice.
- Engaging students is one of the major challenges faced by teachers while teaching. Teachers should include tools and multiple types of learning approaches such as podcasts, videos (teaching channel, own videos, live classes), discussions, various forms of text through stories, activities, articles, and blogs and use different assessment methods (tests, quizzes, assignments, and projects), learning

activities and collaboration for better learning outcomes.

- Sometimes teachers are not given enough time for the preparation of content for their students. Moreover, some students avoid communication with teachers during online learning. Researchers suggest that teachers should conduct discussions for specific content among the students to effectively problem-solve and learn. Also, conducting a discussion on open-ended questions through pair/group work by the students can encourage collaboration, peer learning, and critical thinking among students.
- One of the challenges observed is the assessment which is the most important aspect of online learning for students and teachers. Therefore, whenever there are assignments or projects, teachers might face many questions from the students. As there is less communication between students and teachers, expectation from the students' performances also differs. Teachers should try to anticipate the type of questions students might ask and prepare FAQs. Teachers should give proper assignments and conduct formative assessments at regular intervals like performance-based tests, quiz and open-ended tasks like creating a poster, writing a story, making a comic strip, etc.
- Every student needs feedback for their performance for improvement. Teachers find it difficult to give feedback to all students individually. Teachers need to understand how important it is to give feedback to the students for their growth and improvement. Teachers should make sure that they provide personalized guidance to all the students as per their learning abilities. This could be done by providing constructive feedback focusing on the strengths and areas of development.
- It is also observed that during such a pandemic situation, the teachers' mental health should be a top concern, and any additional work should not take a toll on the same. The future holds uncertainty, so motivation, encouragement, and support from the parents and the school organisations can work wonders for our teachers to do much better with utmost joy and happiness.

The researchers are not trying to generalize the results because the sample was small and because it was from Delhi-NCR; however, we largely feel that the teachers are going through the same changing times since the onset of online teaching in schools during the pandemic.

Acknowledgments

The researchers would like to thank all the teaching community members who helped us by filling the tool by taking out precious time from their busy schedules.

References

Agustina, E., and Cahyono, B. Y. 2017. Perceptions of Indonesian teachers and students on the use of quipper school as an online platform for extended EFL learning. *Journal of Language Teaching and Research*, Vol. 8, No. 4, pp. 794. doi:10.17507/jltr.0804.20

Beach, P. 2017. Self-directed online learning: A theoretical model for understanding elementary teachers' online learning experiences. *Teaching and Teacher Education*, Vol. 61, pp. 60–72. doi:10.1016/j.tate.2016.10.007.

Ballew, T.D. 2017. Teacher Perceptions of a Technology-Based Google Classroom, Carson-Newman University.

Billings D. M. 2008. Developing your career as a nurse educator: the professional portfolio. *Journal of Continuing Education in Nursing*, Vol. 39, No. 12, pp. 532–533. https://doi.org/10.3928/00220124-20081201-09

Conrad, R., and Donaldson, J. 2004. Engaging the Online Learner. Wiley and Sons. San Francisco.

DiPietro, M., Ferdig, R. E., Black, E. W., & Preston, M. 2008. Best practices in teaching K-12 online: Lessons learned from Michigan virtual school teachers. *Journal of Interactive Online Learning*, Vol. 7, No.1, pp. 10–35.

Dja'far, V. H., Cahyono, B. Y., and Bashtomi, Y. 2016. EFL teachers' perception of university students' motivation and ESP learning achievement. *Journal of Education and Practice*, Vol. 7, No. 14, pp. 28–37. http://ezproxy.lib.utexas.edu/login?url5http://search. ebscohost.com/login.aspx?direct5true&db5eric&AN5EJ1102990&site5ehost-live

Duncan, A. 2010. The digital transformation in education. United States Department of Education. https://www.ed.gov/news/speeches/digital-transformation-education-us-secretary-education-arne-duncans-remarks-state-edu

Ellis, R. A., Steed, A. F., and Applebee, A. C. 2006. Teacher conceptions of blended learning, blended teaching and associations with approaches to design. *Australasian Journal of Educational Technology*; Vol.22, No.3, pp. 312-335 . https://search.informit.org/doi/10.3316/aeipt.154272

Redmond, P. 2011. From face-to-face teaching to online teaching: Pedagogical transitions. ASCILITE 2011 – The Australasian society for Computers in Learning in Tertiary Education. https://www.researchgate.net/publication

Sahin, A., Top, N., and Delen, E. 2016. Teachers' First-Year Experience with Chromebook Laptops and Their Attitudes Towards Technology Integration. *Technology, Knowledge and Learning*, Vol. 21, No. 3, pp. 361–378. doi:10.1007/s10758-016-9277-9

Vonderwell, S. and Turner S. 2005. Active learning and preservice teachers experiences in an online course: a case study. *Journal of Technology and Teacher Education*, Vol. 13, No. 1, pp. 65-84. https://www.learntechlib.org/primary/p/18892/

INTEGRATING SCIENCE AND SCIENTIFIC INFORMATION IN MESSAGES FOR EFFECTIVE COMMUNICATION DURING PANDEMIC AND BEYOND—SPECIAL REFERENCE TO COVID-19 PANDEMIC

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An enormous volume of information is being circulated since the beginning of the COVID-19 pandemic by all and sundry using all possible mediums, mostly electronic media, thanks to internet facilities which are now available at everybody's disposal. Barring those official publications of the governments or organisations such as WHO, much of the information were not checked, verified, or authenticated by experts. As a result, misinformation and disinformation spread faster than the virus itself leading to pandemic-induced attitudes such as undue fear, over-complacency, utter carelessness, unnecessary bravado, vaccine-hesitancy, etc., among the public. The information circulated are often haphazard without considering the what, when, where, how, for whom, and who components. Most importantly, much of the information circulated even by authentic sources were mostly 'instructions' to make the public aware about the DOs and DON'Ts but lacked information on the science behind such instructions. Understanding the basic science behind it could help avoid some, if not all, pandemic-induced attitudes. Hence, there is a need for effective communication to fight pandemic which can be achieved only when the research community and professionals in different disciplines such as epidemiology, social sciences, research and development, diplomacy, logistics, and crisis management come together. Such efforts need to be made even beyond the COVID-19 pandemic.

Keywords: COVID-19 pandemic, SARS-CoV-2, COVID-19 appropriate behaviour, vaccine, herd immunity, effective communication, misinformation, disinformation.

Introduction

"...But we're not just fighting an epidemic; we're fighting an infodemic..." said World Health Organization (WHO) Director-General, Dr. Tedros Adhanom Ghebreyesus, during his address at the Munich Security Conference on 15 February 2020. He went on to say "... Fake news spreads faster and more easily than this virus, and is just as dangerous..." (WHO-1). This clearly tells us the magnitude of information that is being generated and circulated through all possible mediums as we fight this war against SARS-CoV-2 and the nasty disease it wreaks called the Coronavirus disease 2019 (COVID-19) which led to this pandemic. Given this situation, it is left to the sense and sensibilities of the users to decide which information to consume and share. Such decisions are, more often than not, biased and scientifically incorrect, and dangerous.

There are broadly three stages during which information and communication can be provided related to a pandemic:

1. Before/ Preventive preparedness (Pre-pandemic)
2. During/ Emergency response (During pandemic)
3. After/ Continuing after the threat (Post-pandemic)

In this article, the focus will be on communication as an emergency response during the pandemic in the context of India. Here, emphasis will be on effective communication in a public setting and not in formal setting (pedagogy or in classroom setting) though the information will still be useful for formal settings as well.

Brief Review of Literature

The need for scientifically sound effective communication is paramount to address any issue which requires participation and contribution of every individual and hence, it is not limited to infectious diseases but to many other areas as well such as communicating about climate change (AAAS, 2007, Spitzer, 2014, Corner, et al., 2015, Jordan, et al., 2018). With the increase in the emergence of infectious diseases, the need for effective communication is increasingly felt. Numerous studies have been undertaken and articles written in this area, for example, understanding risk communications theories and suggestions thereof (Holmes, 2008), crisis, and emergency risk communication–be first, be right, be credible (Centers for Disease Control and Prevention, 2014), how poor communication, especially risk communication will not only undermine its effectiveness but exacerbate the threat and lead to greater disease effects as well as loss of trust in the government's ability to protect the nation (Sell, 2017), the need for rapid dissemination of trustworthy information during uncertainty in terms of transparent identification of cases, data sharing, unhampered communication, and peer-reviewed research (Editorial-Lancet, 2020), the role of media in the spread of anxiety about the COVID-19 outbreak in Iraqi Kurdistan (Ahmad and Murad, 2020), the need to develop communication strategy with toolkits to address COVID-19 pandemic (Depoux, et al., 2020), the need for clear, specific, unambiguous, and consistent lay language and elements that determine how to communicate health information to the public effectively, how information is received by different audiences (Finset, et al., 2020), the various aspects that need to be considered for effective communication during COVID-19 pandemic highlighting some examples specific to India (Reddy and Gupta, 2020), factors influencing public panic during the COVID-19 pandemic in Henan Province, China (Nie, et al., 2021), etc.

Some Unpleasant Episodes during the Pandemic

It is not to our surprise that the virus is evolving, and so is our knowledge, and understanding about the implications, complications and ramifications this can cause in our attempt to neutralize the virus through drugs, vaccines, hygiene, appropriate diet, etc. Yet during the course of this pandemic, the content and the manner in which information has been circulated should make us realise how haphazardly they have

been disseminated and how dangerous many of which are turning out to be. We are aware of the stigma healthcare workers and their families have to face from the same people for whom they risk their lives. We also saw the increasing homophobia as if everybody was loaded with the virus that is ready to explode. There was a lot of myths regarding the carriers of the virus as if people from a particular race was to be blamed, or the myth that one could get the virus from a non-vegetarian diet thus leading not only to giving up a non-vegetarian diet, especially birds such as chicken, but also phobia and stigmatization of people who consumed a non-vegetarian diet. This eventually led a set of lawmakers from a state in India to widely circulate a picture of them eating chicken in an attempt to remove the myth from the minds of the people. This was hilariously necessary. Then there was, and is, a lot of misconceptions and fear about the effects of vaccines and hence, the hesitation to get the shots. Sometimes it is misinformation that is doing the damage but there is also disinformation circulated on purpose. We are aware that a huge chunk of Americans and many others, including many in India are anti-vaccine. There are people who still believe that the pandemic is a hoax and the virus nothing more than those that cause flu. The list could be endless but we get the point.

Communicating during Pandemic

It is true that during a pandemic the focus is to address a crisis that requires immediate action with little time for dialogue or to obtain feedback. Therefore, during such a situation, we see only "one-way transmission of information to the public by 'experts,' often via the mass media, and focuses on getting across 'the facts' so that the public: (a) won't panic and (b) will do what the experts advise."(Holmes, 2008). But such one-way transmission of information could also instead lead to confusion, panic, or distrust because of ineffective communication which could be giving out mixed messages, not convincing explanation, risk not clearly communicated, obscure presentation of data, etc. It is quite possible that a good chunk of the stigma, myths, phobia, misconceptions, etc., associated with this pandemic as discussed above could have been avoided if we had paid directed and focussed attention to the various aspects related to effective communication—the what, when, where, how, for whom and who.

While there are social, economic, environmental, or political components that can form part of the communication, the focus here will be in such areas where, the contribution and intervention of the scientific community are crucial, i.e., those related to the science aspects which is the core in this whole pandemic crisis.

Messages (What)

The science of various aspects of the COVID-19 pandemic needs to be communicated which constitutes the "what" component. These are broadly discussed under the following heads:

(i) COVID-19 appropriate behaviour

We are all aware that since the COVID-19 pandemic was declared by WHO on 11 March 2020, several 'instructions' have been produced and disseminated to the general public about COVID-19 appropriate behaviour such as hand hygiene, masking, and physical distancing. These were intended to make the public aware of the DOs and

DON'Ts. However, the science behind such recommended behaviours has not been communicated adequately and effectively. For example, many might wonder, including the educated lot, why should one wash hands with soap or hand wash for twenty seconds. The science behind the role of soap or hand wash was never considered a matter to be clarified. A person with an understanding is more likely to use soap or a hand wash while washing hands. Similarly, there has been much confusion regarding the use of masks, much to do with the lack of understanding of what a mask does and how different types of masks serve different purposes. The confusion was no less with physical distancing as well. Since the scientific findings of how the 6-feet or 1-metre distance was arrived at were not known, it was assumed to be sacrosanct.

(ii) Testing

The types of testing available for SARS-CoV-2 have also caused confusion. There was a lack of clarity on the difference between Rapid Antigen Test (RAT), Rapid Antibody Test (RAT), and Reverse Transcription Polymerase Chain Reaction (RT-PCR), and how there could be seemingly contradictory results. In addition, there was also a lack of clarity on when a person was supposed to take which test. Educated and people who have personal interest look for resources or sources and try to find the answers for themselves but others are lost in doubt and confusion and live with it.

To make matters worse, with the detection of new strains, there have been increasing test results showing false-negative. Adequate attempts have not been made to effectively communicate regarding this.

(iii) Quarantine and isolation

The basic difference between quarantine and isolation and what is the science behind 14 days for quarantine and 10 days for isolation from the time one tested positive are questions that many are still asking. Understanding the rationale behind those recommendations is more likely to motivate or influence people to follow the norms.

(iv) About SARS-CoV-2

While adequate information about SARS-CoV-2 virus itself has been circulated, not much authentic information on the origin, spatial spread (in terms of geographical locations or its spread from animals to humans, etc.), mode of transmission (through droplets and air), super spreaders, new strains, etc., is available for the public to understand. For example, during the first few months of the pandemic, there was fear psychosis for SARS-CoV-2 as if it was running after us. The awareness material on how to protect oneself from infection did not seem to convince the public. Similarly, there is so much fear every time we hear about mutation and detection of new strain as if a mutation or new strains are being observed only in this virus. On the other extreme, there are those who believe they are superhumans and would not be infected or affected by the virus. If we had understood the science behind how the virus is transmitted or how it is common for the virus to mutate, then we could have avoided, or we would have been able to reduce, if not avoid, some of the pandemic-induced attitudes such as undue fear, or over-complacency, utter-carelessness, unnecessary bravado, etc., exhibited by people in different settings and sectors of our population.

(v) Opening and closing of institutions

Every now and then we saw the debate surrounding the safety or danger of opening up or closing down of schools, universities, businesses, offices, etc. However, what science and scientific understandings say about such opening and closing have never been explained.

(vi) Vaccines and plasma therapy

More than any other aspect, information related to vaccines has been the most poorly communicated. Questions related to the types of vaccines, the efficacy, possible side effects, associated myths, why the same vaccine has to be taken in both the doses, why Covaxin should be taken after a gap of 4-6 weeks (extendable to about 8 weeks) between the two doses while it is 6 to 8 weeks (extendable to about 12 weeks) for Covishield, why should there be dose interval of 4 to 12 weeks for Covishield, in case of infection after the first dose just before eligibility for the second dose, why should one get the second dose only after 10 days for asymptomatic persons after detection and 4-8 weeks after complete disappearance of symptoms for persons who have a symptomatic infection, the severity of re-infections after fully getting vaccinated, etc., have not been part of information disseminated for public awareness. Asking the public to get vaccinated or telling them that it is safe may not work for many. There are numerous misinformation and disinformation that are advocating against vaccination and people do come across such information and are often convinced by it too. Therefore, for a successful vaccination campaign, it is necessary to explain scientifically, the importance of vaccination and how it will help. Having an understanding of the science behind all these will also avoid people from getting panic even if they do not get their shot on the appointed day. At the same time debunking myths, misinformation and disinformation need to be done simultaneously and convincingly. Often complete information is not shared with the public to avoid fear but such an attempt could backfire leading to mistrust. For example, we may not want to tell the public openly that people do die (very rarely, though) even after vaccination fearing that this may result in apprehension and hesitation for vaccination. But when the public figures out this fact from other sources then, it could lead to a lack of trust in the system and stir up doubt at the same time. Therefore, transparency in sharing scientific information could be the key to effective communication. Instead of keeping specific information from the public we need to tell them the pros and cons and how the pros overweigh the cons. For example, it will be a good idea to inform the public about why and how not getting a vaccination can kill more people. Also related to vaccination is the lack of clear communication on herd immunity (Fincet et al., 2020) which could be crucial to bring the pandemic under control. In the recently published news item in *New York Times*, hesitancy for vaccination is considered to be one of the reasons herd immunity may not be achieved in the United States (Aschwanden, 2021). This conforms to the earlier findings that a high vaccination rate is necessary to reach the herd-immunity threshold (Ministry of Health and Family Welfare).

Another aspect of vaccines that needs to be clarified is related to who should get

vaccinated and why. In India, we started off the vaccination programme with the healthcare workers, those above 60 and those with co-morbidities, followed by 45 and above, and subsequently, the drive began for those who are 18 and above. WHO says that vaccine, for now (while the article is being written), is only for those 18 and above, because the trials for children below 18 have not been done. However, it is now learned that US Food and Drug Administration is poised to authorize Pfizer/BioNTech's vaccine for those aged between 12 to 15 after clinical trials involving 2260 of those 12 to 15 year-olds showed 100 per cent efficacy and is well-tolerated by adolescents. The fact that vaccine administration to different age groups is not only done based on a priority basis but more so because of successful clinical trials for those age groups, people need to be made aware of such information related to scientific studies.

Plasma therapy has also become a commonly used term ever since the COVID-19 pandemic hit us. However, the science behind this has never been explained in a term to be understood by the public. Just like blood donation, understanding the science of plasma therapy might encourage more eligible people to donate their plasma and save lives.

(vii) Pandemic-appropriate lifestyle

We have often heard experts and doctors suggest that the best way to build our immune system during a pandemic is to maintain pandemic-appropriate lifestyles—eating healthy, getting sufficient sleep, physical exercise, keeping in touch with friends and family for mental and emotional health, etc. It will help the public if we could explain how this works scientifically.

(viii) Post-recovery

This aspect seems to be the most neglected one. However, we are aware of the issues people who came out of COVID-19 have to go through. It is, therefore, important to understand the science behind complications that can be experienced post-recovery. This will help people who have recovered and their families deal better with post-recovery issues.

The mental and emotional health of patients (during and after treatment) and their families, medical staff, etc., are altogether a huge challenge that is beyond the purview of this article.

Having discussed the various aspects where messages need to be disseminated, it may be emphasized here that several Awareness materials (audio, video, text, infographics, posters, etc.) have been prepared by the Ministry of Health and Family Welfare, Government of India such as on COVID-19 appropriate behaviour, quarantine, myth busters, stigma, and discrimination, vaccine, etc. More than 50 posters (both in English and Hindi) were prepared on Stigma and Discrimination alone many relating to healthcare workers (Ministry of Health and Family Welfare). Although, such a huge collection of information are available online, not many people will be able to access those. Rightly so, such information have been prepared for circulation by the concerned department or people and everyone was not expected to be accessing such resources. In addition to information overload, while preparing such huge resources for public consumption, if not carefully examined and reviewed, some resources could turn out to be misleading. For example, one of the posters had this message:

"Let's not reject, harass, abuse, hurt, or harm anyone

Not all who cough or sneeze have COVID-19"

It almost seems to suggest that it is okay to reject, harass, abuse, hurt, or harm anyone if they have COVID-19! It is therefore important to produce specific resources for a specific message with clear and correct information to be circulated widely.

The WHO also prepared such advice for the public on mythbusters, how to report misinformation, masks, transmission, vaccines, etc. (WHO-2). Again, such resources are informative but they will be useful only to those who will intentionally go to the website and are interested to learn more, but not so useful for the general public.

Therefore, the attempt should be to prepare resources that are authentic and reviewed by experts, specific, and useful for the intended target groups that should be circulated so widely that there is a lesser chance for the public to stumble upon misinformation or disinformation. Such resources should also be updated as and when there are new findings of the way the virus behaves and mutates or those related to treatment. When it comes to uploading such resources on the website, it is also important to indicate when the information was last updated. This will remove a lot of confusion that might arise due to change in the data frequently as the virus evolves and so also our understanding associated with it.

Method (How)

However important the message may be, it has to be communicated systematically so that the intended audience will be able to grasp the message. Therefore, how the message is communicated becomes crucial. The 'how' can be broadly divided into two:

(i) How to present the message such as data

For example, whether it will make more sense to provide absolute numbers or provide percentages. How to present the message will also be determined by what you want to emphasize in the data obtained. People, including experts/ scientists/ researchers, interpret the same data differently. They have their own biases. So, nobody is wrong or evil but just that their biases are different from others. What we value is often reflected in our interpretations. For example, let's say 15 crore doses of 270 crores have been vaccinated in 20 days. In this case, if one wants to show to the public that a lot of people have been vaccinated, he/she will give the absolute numbers only i.e., 15 crores without showing the total number to be vaccinated which is a lot for a layperson. However, if one is not biased, he/she will present the data in terms of percentage as well which is just about 5.5 per cent. It is also important to focus on which part of the fact of the message we want to emphasise. For example, there has been a lot of information circulating about the loss of lives due to blood clot after getting vaccinated. However, there has not been adequate information circulating about the number of people who die due to such clots and what percentage of the vaccinated population they constitute. It will turn out that it is insignificantly low. We have also failed to highlight that not taking the vaccine was costing more lives. It is definitely easy to empathize with those who died from clots but in doing so many fail to focus on the usefulness of vaccination and how many lives it has saved or could save.

During a pandemic, due to the enormous number of deaths, the number of lives lost

becomes just a statistic. However, for a family who lost a loved one, it is unbearable. A more humane and ethical way of presenting such numbers may be considered while presenting data.

While transparency in sharing information to the public could be a good idea, it is important to note that unnecessary information should not be given out, such as those information where there is no clarity yet, such as, when herd immunity will be achieved. We do not want to give out confusing or mixed messages to the public. If in a school or college setting, we can talk about all the different views, dissect them, debate them, etc., but we cannot afford to do that for general public messaging.

(ii) How to present the message using different media

Different media can be used to present the message–TV, radio, WhatsApp, Facebook, ringtones, texts, posters, infographics, fliers, pamphlets, websites, etc. However, all media do not serve the same purpose. It has to be decided based on the kind of message (general or specific, short of long, etc.), the period, the location and the audience for whom it is to be presented. This will be discussed in more detail when discussing about the 'when', 'where' and 'to whom.'

Periods (When)

The messages that are to be communicated during a pandemic are different for different periods/phases of the pandemic. Provided below are four phases of the COVID-19 pandemic beginning with the declaration of the COVID-19 pandemic by WHO in March 2020 along with the messages that could require more emphasis during the corresponding phase. However, as we can see below, some of the messages may be equally relevant in most or all phases.

1. **First quadrimester (March to June 2020)—**COVID-19 appropriate behaviour, testing, quarantine, removal of myths, stigma, and fear in patients, public and healthcare staff, etc.
2. **Second quadrimester (July to October 2020)—**About SARS-CoV-2 origin, spatial spread, mode of transmission, super spreaders, COVID appropriate lifestyle, etc.
3. **Third quadrimester (November 2020 to February 2021)—**Safety/ danger of opening up/closing down, herd immunity, rigorously advocating for COVID appropriate behaviour using role models, detection of new strains, etc.
4. **Fourth quadrimester (March 2021 onward)**—Vaccines, testing flaws such as false negativity with the detection of new strains, etc.

Location (Where)

Communication is also different for different settings. For example, the message, in terms of content as well as medium, is meant for public transportations (trains, bus, airplanes, etc.), residential areas (slums, colonies, etc.), schools, colleges, institutions, offices, hospitals, etc., have to be different.

Audience (For Whom)

Much of the information circulating seem to target the English-educated, techno-savvy population. For example, useful information shared on Instagram will not be accessed by a huge chunk of the population and the same information is not necessarily available on other platforms or media. Therefore, for whom (audience) the message is targetted is crucial for effective communication. We know

that people's opinions are formed based on the context, their upbringing, their privileges, their opportunities, their society, education, exposure to technology, occupation, etc. Nobody is stupid, ignorant, foolish, dumb, etc. It is just that we learn differently. Therefore, it is important to take into consideration such aspects. Without understanding the intended audience, the message may never reach them. For example, how could you reach out to a migrant worker during a pandemic? Without an appropriate message in terms of content and medium, most probably they will miss the message. Or how should we provide scientific information to people who are more at risk? What would be the ramifications of labelling them at risk more than others?

Communicator/Messenger (Who)

Finset, et al., (2020) pointed out that for effective communication the number of spokespersons should be limited and consistent. Contrary to this, in this age of the internet, information is being shared by all and sundry, trained or untrained, based on their understanding using social media such as Facebook, Instagram, Twitter, WhatsApp, TikTok, etc. We also see in every possible news channel several new faces sharing information on different topics related to the pandemic every day. The authenticity of such information is not checked or verified. The attempt should therefore be to have as few communicators or messengers as possible who are highly acclaimed in the field and therefore can be trusted with the message they give out. However, when it comes to motivating the public into a certain behaviour, communicators could also be popular personalities but their role should be limited to motivation and not replace the role of experts in the field.

Conclusion

One might ask why would public need all such information discussed in this article. Well, all human beings are curious by nature, not just kids. However, in this 'fast' world we want information short and fast. We also seem to have a short attention span. More importantly, we do not want to be told always and we want to know the 'why' so as to be convinced. We search from the enormous volume of information available on the internet and tend to believe based on what we want to believe resulting in pandemic-induced attitudes. Therefore, there is a need to provide authentic, appropriate science-based information to different audiences depending upon their ability to spend time, socio-economic background, education, profession, etc. However, this is easier said than done. It cannot be done by scientists or epidemiologists or virologists alone. It would also require interdisciplinary and transdisciplinary response from the research community and professionals in different disciplines such as social sciences, research and development, diplomacy, logistics, and crisis management (Bedford, et at., 2019). Professionals in the fields of communication, education, and health behaviour change need to take responsibility for carefully evaluating what is known and insights currently emerging (Finset, 2020). It is also of utmost importance that mixed messages should not be sent out to the public at any cost. A consensus on the messages needs to be arrived at before it is put out for the public. Providing science-based and scientific information effectively that is suitable for different audiences could help us fight this pandemic, and any pandemic for that matter, better.

References

AAAS. 2007. Communicating and Learning about Global Climate Change: An Abbreviated Guide for Teaching Climate Change, from Project 2061 at AAAS.http://www.project2061.org/publications/guides/climate.pdf

Ahmad, A. R., and Murad, H. R. 2020. The Impact of Social Media on Panic During the COVID-19 Pandemic in Iraqi Kurdistan: Online Questionnaire Study. *Journal of Medical Internet Research*, Vol. 22, No. 5, :e19556.http://www.jmir.org/2020/5/e19556/

Aschwanden, C. 2021. Why herd immunity for Covid is probably impossible. *Nature*, Vol. 591, No. 7851. pp. 520-522.

Bedford, J., Farrar, J., Chikwelhekweazu, Kang, G., Koopmans, M., and Nkengasong, J. 2019. A new twenty-first century science for effective epidemic response. *Nature*, 575. pp. 130-136 https://doi.org/10.1038/s41586-019-1717-y

Centers for Disease Control and Prevention. 2014. Crisis and Emergency Risk Communication. 2014—Be first. Be right. Be credible, U.S. Department of Health and Human Services. https://emergency.cdc.gov/cerc/resources/pdf/cerc_2014edition.pdf accessed on April 30, 2021)

Corner, A., Roberts, O., Chiari, S., Völler, S., Mayrhuber, E. S., Mandl, S., and Monson, K. 2015. How do young people engage with climate change? The role of knowledge, values, message framing, and trusted communicators. *WIREs Climate Change*, Vol. 6, No. 5. https://doi.org/10.1002/wcc.353.

Depoux, A., Martin, S., Karafillakis, E., Preet, R., Wilder-Smith, A., and Larson, H. 2020. The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, Vol. 27, No. 3. doi: 10.1093/jtm/taaa031

Editorial-Lancet. 2020. COVID-19: Fighting panic with information. *The Lancet*, Vol. 395, No. 10224. pp 537.

Finset, A., Bosworth, H., Butow, P., Gulbrandsen, P., Hulsman, R. L., Pieterse, A. H., Street, R., Tschoetschel, R., and Weert, J. V. 2020. Effective health communication – a key factor in fighting the COVID-19 pandemic. *Patient Education and Counseling*, Vol. 103, No. 5, pp 873–876. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7180027/

Holmes, B. J. 2008. Communicating about emerging infectious disease: The importance of research. *Health, Risk and Society*, Vol. 10, No. 4, pp. 349–360.http://www.informaworld.com/smpp/ title~content=t713424479

Jordan, R., Sorensen, A. E., Shwom, R., Meta-Robinson, J., Isenhour, C., Gray, S., Nucci, M., and Ebert-May, D. 2018. Using authentic science in climate change education.

Applied Environmental Education and Communication, Vol. 18, No. 5, pp. 1-32. https://www.researchgate.net/deref/https%3A%2F%2Fdoi.org%2F10.1080%2F153301 5X.2018.1431162

Ministry of Health and Family Welfare, Government of India https://www.mohfw.gov.in

Nie, X., Feng, K., Wang, S., and Li, Y. 2021. Factors Influencing Public Panic During the COVID-19 Pandemic. *Frontiess in Psychology.* 12:576301. doi: 10.3389/fpsyg.2021.576301

Reddy, B. V., and Gupta, A. 2020. Importance of effective communication during COVID-19 infodemic. *Journal of Family Medicine and Primary Care* Vol. 9, No. 8, pp. 3793-3796 https://www.jfmpc.com/text. asp?2020/9/8/3793/293075)

Sell, T. K. 2017. When the Next Disease Strikes: How To Communicate (and How Not To). *Health Security*, Vol. 15, No.1, Mary Ann Liebert, Inc. doi: 10.1089/hs.2016.0100

Spitzer, W. 2014. Shaping the Public Dialogue on Climate Change in *Future Earth— Advancing Civic Understanding of the Anthropocene*, Geophysical Monograph 203, First Edition. Edited by Diana Dalbotten, Gillian Roehrig, and Patrick Hamilton, American Geophysical Union, John Wiley & Sons, Inc. doi: 10.1002/9781118854280.ch9.

World Health Organization-1 (WHO-1) https://www.who.int/director-general/speeches/detail/munich-security-conference accessed on April 30, 2021.

World Health Organization-2 (WHO-2) https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public

SCIENCE NEWS

Raw Milk May do More Harm Than Good

Not properly stored, it's a source of antibiotic-resistant microbes

Raw or unpasteurized cows' milk from US retail stores can hold a huge amount of antimicrobial-resistant genes if left at room temperature, according to a new study from researchers at the University of California, Davis. The study also found bacteria that harbored antimicrobial-resistant genes can transfer them to other bacteria, potentially spreading resistance if consumed. The study was published in the journal *Microbiome*.

"We don't want to scare people, we want to educate them. If you want to keep drinking raw milk, keep it in your refrigerator to minimize the risk of it developing bacteria with antibiotic-resistant genes," said lead author Jinxin Liu, a postdoctoral researcher in the Department of Food Science and Technology at UC Davis.

Lacking in Probiotics

An estimated 3 per cent of the US population consumes unpasteurized, or raw, milk, which has not been heated to kill pathogens and extend shelf life. Raw milk is often touted to consumers as having an abundant supply of probiotics, or healthy bacteria, compared with pasteurized milk. UC Davis researchers did not find that to be the case.

"Two things surprised us," said Liu. "We didn't find large quantities of beneficial bacteria in the raw milk samples, and if you leave raw milk at room temperature, it creates dramatically more antimicrobial-resistant genes than pasteurized milk."

Bacteria with antimicrobial-resistant genes, if passed to a pathogen, have the potential to become 'superbugs,' so that pharmaceuticals to treat infection or disease no longer work. Each year, almost 3 million people get an antibiotic-resistant infection, and more than 35,000 people die, according to the Centers for Disease Control.

The Longer it Sits, the Worse it Gets

UC Davis researchers analyzed more than 2,000 retail milk samples from five states, including raw milk and milk pasteurized in different ways. The study found raw milk had the highest prevalence of antibiotic-resistant microbes when left at room temperature.

"Our study shows that with any temperature abuse in raw milk, whether intentional or not, it can grow these bacteria with antimicrobial resistance genes," said co-author Michele Jay-Russell, research microbiologist and manager with the UC Davis Western Center for Food Safety. "It's not just going to spoil. It's really high risk if not handled correctly."

Some consumers are intentionally letting raw milk sit outside of the refrigerator at room temperature to ferment, in order to make what's known as clabber. Co-author and Peter J. Shields Chair of Dairy Food Science David Mills said if consumers eat raw milk clabber, they are likely adding a high number of antimicrobial-resistant genes to their gut.

"You could just be flooding your gastrointestinal tract with these genes," said Mills. "We don't live in an antibiotic-free world anymore. These genes are everywhere, and we need to do everything we can to stop that flow into our bodies."

While more work is needed to fully understand whether antibiotic-resistant genes in raw milk translate into health risks for humans, Mills suggests that consumers instead use a starter culture if they want to ferment raw milk, which carries specific strains of bacteria to inoculate the milk.

Other authors include Yuanting Zhu of UC Davis and Danielle Lemay of USDA ARS Western Human Nutrition Research Center.

This study was funded with support from the National Institutes of Health and the Peter J. Shields Endowed Chair in Dairy Food Science.

Source: University of California - Davis

Lifting Weights Makes your Nervous System Stronger, too

The first few weeks of weightlifting strengthen the reticulospinal tract, not muscles

Gym-goers may get frustrated when they don't see results from weightlifting right away, but their efforts are not in vain: the first few weeks of training strengthen the nervous system, not muscles. New research published in *JNeurosci* reveals how.

The brain orchestrates movement via two major neural highways descending to the spinal cord: the corticospinal tract (CST) and reticulospinal tract (RST). The CST is thought to be the dominant pathway, with the RST controlling posture. However, the CST does not change during strength training, so increased strength must stem from the more primitive RST.

Glover and Baker trained monkeys to pull a weighted handle using one arm, with the weight gradually increasing over twelve weeks. Each day, the scientists stimulated the motor cortex and the two motor tracts, measuring the resulting electrical activity in the arm muscles. Over the course of the training regimen, the electrical response from stimulating the cortex and RST increased—a sign of strengthened signaling. After three more months of strength training, stimulating the RST elicited a greater response in the side of the spinal cord connected to the trained

arm. Outputs from the reticulospinal tract become more powerful during weight training and could be the driving force behind increases in strength.

Source: Society for Neuroscience

School Absenteeism has Surprising Consequences for Adults

Even missing school from kindergarten to eighth grade matters

Kids who miss a lot of school from kindergarten to eighth grade may suffer unexpected costs as young adults, a new study finds.

Researchers found that those who were more regularly absent in these early years of school were less likely to vote, reported having greater economic difficulties and had poorer educational outcomes when they were 22 to 23 years old.

The results suggest early school absenteeism should be taken more seriously, said Arya Ansari, lead author of the study and assistant professor of human sciences at The Ohio State University.

"There's this misconception, especially among parents, that it doesn't matter as much if kids miss school early on—that it only becomes important when they get to middle or high school," said Ansari, who is also a researcher at Ohio State's Crane Center for Early Childhood Research and Policy.

"This study shows that those early absences do matter, and in ways that many people don't consider."

The study was published online recently in the *Journal of Youth and Adolescence.*

Ansari and his colleagues used data from the Study of Early Child Care and Youth Development, which is run by the National Institute of Child Health and Human Development.

This study included data on 648 students from 10 cities across the United States who were followed from birth through young adulthood. Researchers had information on the number of days the children were absent from school between kindergarten and eighth grade.

In 2013 and 2014, when the participants were 22 or 23 years old, they reported on a variety of outcomes, from criminal or deviant behaviour to parenthood, political participation and economic hardship.

Results showed that school absenteeism didn't have any relation with criminal, risky or deviant behaviour, Ansari said. But it was linked to political engagement and educational and economic success.

Students who were more frequently absent from school were 4.7 percentage points less likely to have voted in the 2012 election.

They also reported experiencing greater economic hardship (such as difficulty paying bills), were more likely to say they used government assistance such as food stamps, were less likely to have a job and reported poorer educational outcomes, such as a lower high school GPA and a lower likelihood of going to college.

"Absenteeism in those early years of school has pretty far-reaching consequences," Ansari said. "It goes beyond just affecting your education and how well you do in high school."

Ansari said showing up less to school in those early years may set dangerous precedents.

"If you start out being disengaged with school, you may end up being less engaged with society more broadly. You're less likely to vote, less likely to go to college, less likely to be employed," he said.

"We believe disengagement may be one of the key mechanisms linking early school absences to poorer outcomes in early adulthood."

Ansari said the participants in this study were mostly from middle-class families, so results may be different for those from a more disadvantaged background.

"If we're seeing these negative outcomes of absenteeism in this largely middle-class sample, the associations may be even more pronounced among disadvantaged families," he said.

In 2020, parents may be wondering how widespread school closings during the pandemic may be affecting their children. Ansari said this situation is different from what they studied here.

"These really are unprecedented times. All kids are absent. With that said, the differential access to supports and resources will likely result in even greater variability in outcomes when students return to school after the pandemic."

Ansari said he hopes this study will make parents more aware of the importance of school attendance, even for young children.

"What this work suggests is that we should take absenteeism and its consequences more seriously."

Source: Ohio State University

Role Models have Major Influence on Female University Choices

Women exposed to successful and charismatic role models are more likely to follow them in choosing a university major.

An experiment with undergraduates studying introductory economics classes at Southern Methodist University (SMU) in the USA, published in the American economic journal: *Applied Economics*, revealed that female students were hugely more likely to study the subject further having encountered successful female graduates of the same course.

Researchers from Texas A&M University and Lancaster University engaged two role models—chosen with the help of two current female economics majors—to speak with classes of undergraduates studying principles of economics classes about how their choice of major contributed to their success. They measured the uptake of future economics classes among that group when compared with those studying the same course who had no such interaction with the successful women.

Female students' enrolment in further economics classes almost doubled following the role models, encounter, going against general patterns in recent years showing little progress in attracting women to the field.

"Our results show that role model intervention had a significant impact on all outcomes for female students," said report co-author Associate Professor Danila Serra, of Texas A&M University. "Being in a class

that received the role model visits increased the likelihood that a female student would major in economics by almost 100 per cent. The probability of them taking intermediate or any other economics classes also increased by large margins.

"There is strong evidence of the impact of female role models on female students moving into fields of study in which men are traditionally over-represented, and that the encounters served as an inspiration."

Principles of economics classes at SMU are typically gender-balanced, with between 44 and 47 per cent of students female. In contrast, for the next step up, only 26 per cent of students are women, and the gender imbalance worsens by graduation, with less than a quarter of economics degrees awarded to women.

"Due to historical gender imbalances in some subjects, such as economics, it is difficult for young women to come into direct contact with successful women who have majored in these fields and who can inspire them to do the same," said report co-author Dr Catherine Porter of Lancaster University Management School. "Our study suggests that role model intervention could have a significant impact on the treated women's lifetime income streams.

"Our research shows that the long-term goal of moving towards gender parity in the economics profession at all levels could be achieved simply and at a relatively low cost by exposing students enrolled in principles classes to successful and inspiring alumnae."

The researchers' data shows the majority of those women impacted were previously planning to major in lower-earning humanities fields, and the effect did not decrease the number of them majoring in male-dominated, higher-paying fields such as STEM and finance. Those women who swayed towards economics also performed as well, if not better, in exams as the control students, showing the attraction towards the change affected seemingly qualified women who were not previously pursuing economics. Thus, there could be a positive impact on their potential future earnings.

While the effect on female students in the role model classes was marked, there was no effect on the male students in the same groups.

Source: Lancaster University

New Method Measures Temperature within 3D Objects

University of Wisconsin-Madison engineers have made it possible to remotely determine the temperature beneath the surface of certain materials using a new technique they call depth thermography. The method may be useful in applications where traditional temperature probes won't work, like monitoring semiconductor performance or next-generation nuclear reactors.

Many temperature sensors measure thermal radiation, most of which is in the infrared spectrum, coming off the surface of an object. The hotter the object, the more radiation it emits, which is the basis for gadgets like thermal imaging cameras.

Depth thermography, however, goes beyond the surface and works with a certain class of materials that are partially transparent to infrared radiation.

"We can measure the spectrum of thermal radiation emitted from the object and

use a sophisticated algorithm to infer the temperature not just on the surface, but also underneath the surface, tens to hundreds of microns in," says Mikhail Kats, a UW-Madison professor of electrical and computer engineering. "We're able to do that precisely and accurately, at least in some instances."

Kats, his research associate Yuzhe Xiao and colleagues described the technique this spring in the journal *ACS Photonics*.

For the project, the team heated a piece of fused silica, a type of glass, and analyzed it using a spectrometer. They then measured temperature readings from various depths of the sample using computational tools previously developed by Xiao in which he calculated the thermal radiation given off from objects composed of multiple materials. Working backwards, they used the algorithm to determine the temperature gradient that best fit the experimental results.

Kats says this particular effort was a proof of concept. In future work, he hopes to apply the technique to more complicated multilayer materials and hopes to apply machine learning techniques to improve the process. Eventually, Kats wants to use depth thermography to measure semiconductor devices to gain insights into their temperature distributions as they operate.

That's not the only potential application of the technique. This type of 3D temperature profiling could also be used to measure and map clouds of high temperature gases and liquids.

"For example, we anticipate relevance to molten-salt nuclear reactors, where you want to know what's going on in terms of temperature of the salt throughout the volume," says Kats. "You want to do it without sticking in temperature probes that may not survive at 700 degrees Celsius for very long."

He also says the technique could aid in measuring the thermal conductivity and optical properties of materials without the need to attach temperature probes.

"This is a completely remote, non-contact way of measuring the thermal properties of materials in a way that you couldn't do before," Kats says.

Yuzhe Xiao, Chenghao Wan, Alireza Shahsafi and Jad Salman of UW-Madison also contributed to the paper.

Source: University of Wisconsin-Madison

Understanding the Circadian Clocks of Individual Cells

Two new studies suggest cellular rhythms are guided both by heritable and nonheritable components.

The studies led by UT Southwestern scientists outline how individual cells maintain their internal clocks, driven both through heritable and random means. These findings, published online May 1 in PNAS and May 27, 2020 in *eLife*, help explain how organisms' circadian clocks maintain flexibility and could offer insights into aging and cancer.

Scientists have long known that organisms across the spectrum of life have internal clocks—with cycles about as long as a day—that govern behaviours including sleeping, eating, and immune response. However, individual cells also have their own clocks when removed from the organism, with periods that can vary substantially, stretching up to several hours longer or shorter.

How cells maintain these different lengths of internal rhythms has been unknown given that these cells should be the same at the genetic level, explains Joseph S. Takahashi, Ph.D., chair of the department of neuroscience at UT Southwestern Medical Center, a member of UT Southwestern's Peter O'Donnell Jr. Brain Institute, and an investigator with the Howard Hughes Medical Institute.

To investigate this question, Takahashi and his colleagues worked with mouse cells that were genetically altered so that they glowed whenever a prominent circadian clock gene called Per2 turned on. Using this tool, they could see how long the cell's natural oscillations were—ranging from a shorter period of 21.5 hours up to a longer period of nearly 28 hours.

When they isolated cells at the extremes of this range and grew them as clones in petri dishes, the researchers found that these cells maintained their periods. The short and long period cells stayed at their extreme cycle lengths even after many cell divisions over months, suggesting that period length has a heritable component.

When the researchers compared gene expression between the two groups of cells, they found thousands of genes that were either more or less active. Many of these genes appeared to work together in large-scale networks and were associated with stress response signaling pathways and metabolic pathways, underlining the importance of these processes in the circadian cycle. Most of these genes have never been linked with circadian rhythms, says UT Southwestern's Yan Li, Ph.D., the lead author of the studies, suggesting a new pool of candidate genes that might be important in maintaining cellular periodicity.

Looking closer at what caused this differing gene expression between the short- and long-period cells, Takahashi and his colleagues traced it to epigenetic—or "above the genome"—control. Rather than differences in the DNA sequence of genes themselves that caused them to be more or less active, the researchers found that their activity hinged on chemical modifications to the DNA of the genes known as DNA methylation. When they shut down genes that placed or maintained these chemical tags, the cells' circadian cycle length changed.

Although this heritable mechanism accounts for some of the variation between cell period length, it's not responsible for all of it, Takahashi explains. Searching for other sources for cell periodicity, the researchers examined the exact length of circadian cycles in the short- and long-period groups. They found that those with longer periods had the most variability in their cycle lengths. Further tests suggest that this variance is caused by random fluctuations in gene activity. The more of this nonheritable fluctuation that cells exhibited, the longer their cycles were on average. When the researchers dosed cells with a drug that increased this fluctuation in gene activity, it increased their circadian cycles by about 1.5 hours on average.

Together, Takahashi says, these results suggest that the circadian rhythms of cells are controlled both by heritable and nonheritable components. Gaining a better understanding of these mechanisms could provide some insight on natural processes and health problems that are associated

with a decline in circadian clock function, such as aging and cancer. It could also help researchers better understand how organisms maintain flexibility in situations that strain the circadian clock, such as jet lag.

"If every cell in our bodies oscillated in the same way, our bodies would act like one giant clock, inflexible and unable to adapt to a changing environment," Takahashi explains. "Having variability in the cell population makes it more flexible and increases the resilience of an organism."

Source: UT Southwestern Medical Center

New insights into Van Der Waals Materials Found

Layered Van der Waals materials are of high interest for electronic and photonic applications, according to researchers at Penn State and SLAC National Accelerator Laboratory, in California, who provide new insights into the interactions of layered materials with laser and electron beams.

Two-dimensional Van der Waals materials are composed of strongly bonded layers of molecules with weak bonding between the layers.

The researchers used a combination of ultrafast pulses of laser light that excite the atoms in a material lattice of gallium telluride, followed by exposing the lattice to an ultrafast pulse of an electron beam. This shows the lattice vibrations in real time using electron diffraction and could lead to a better understanding of these materials.

"This is a quite unique technique," said Shengxi Huang, *Assistant Professor* of electrical engineering and corresponding author of a paper in *ACS Nano* that describes their work. "The purpose is to understand fully the lattice vibrations, including in-plane and out-of-plane."

One of the interesting observations in their work is the breaking of a law that applies to all material systems. Friedel's Law posits that in the diffraction pattern, the pairs of centrosymmetric Bragg peaks should be symmetric, directly resulting from Fourier transformation. In this case, however, the pairs of Bragg peaks show opposite oscillating patterns. They call this phenomenon the dynamic breaking of Friedel's Law. It is a very rare if not unprecedented observation in the interactions between the beams and these materials.

"Why do we see the breaking of Friedel's Law?" she said. "It is because of the lattice structure of this material. In layered 2D materials, the atoms in each layer typically align very well in the vertical direction. In gallium telluride, the atomic alignment is a little bit off."

When the laser beam shines onto the material, the heating generates the lowest-order longitudinal acoustic phonon mode, which creates a wobbling effect for the lattice. This can affect the way electrons diffract in the lattice, leading to the unique dynamic breaking of Friedel's law.

This technique is also useful for studying phase change materials, which absorb or radiate heat during phase change. Such materials can generate the electrocaloric effect in solid-state refrigerators. This technique will also be interesting to people who study oddly structured crystals and the general 2D materials community.

Source: Penn State University

How does Earth Sustain its Magnetic Field?

How did the chemical makeup of our planet's core shape its geologic history and habitability?

Life as we know it could not exist without earth's magnetic field and its ability to deflect dangerous ionizing particles from the solar wind and more far-flung cosmic rays. It is continuously generated by the motion of liquid iron in earth's outer core, a phenomenon called the geodynamo.

Despite its fundamental importance, many questions remain unanswered about the geodynamo's origin and the energy sources that have sustained it over the millennia.

New work from an international team of researchers, including current and former Carnegie scientists Alexander Goncharov, Nicholas Holtgrewe, Sergey Lobanov, and Irina Chuvashova examines how the presence of lighter elements in the predominately iron core could affect the geodynamo's genesis and sustainability. Their findings are published by Nature Communications.

Our planet accreted from the disk of dust and gas that surrounded our sun in its youth. Eventually, the densest material sank inward in the forming planet, creating the layers that exist today—core, mantle, and crust. Although, the core is predominately iron, seismic data indicates that some lighter elements like oxygen, silicon, sulfur, carbon, and hydrogen, were dissolved into it during the differentiation process.

Over time, the inner core crystallized and has been continuously cooling since then. On its own, could heat flowing out of the core and into the mantle drive the geodynamo? Or does this thermal convection need an extra boost from the buoyancy of light elements, not just heat, moving out of a condensing inner core?

Understanding the specifics of the core's chemical composition can help answer this question.

Silicates are predominant in the mantle, and after oxygen and iron, silicon is the third-most-abundant element in the Earth, so it is a likely option for one of the main lighter elements that could be alloyed with iron in the core. Led by Wen-Pin Hsieh of Academia Sinica and National Taiwan University, the researchers used lab-based mimicry of deep Earth conditions to simulate how the presence of silicon would affect the transmission of heat from the planet's iron core out into the mantle.

"The less thermally conductive the core material is, the lower the threshold needed to generate the geodynamo," Goncharov explained. "With a low enough threshold, the heat flux out of the core could be driven entirely by the thermal convection, with no need for the additional movement of material to make it work."

The team found that a concentration of about 8 weight per cent silicon in their simulated inner core, the geodynamo could have functioned on heat transmission alone for the planet's entire history.

Looking forward, they want to expand their efforts to understand how the presence of oxygen, sulfur, and carbon in the core would influence this convection process.

The authors were supported by the Academia Sinica, the Ministry of Science and Technology of Taiwan, the National Natural Science

Foundation of China, the Foundation for the Advancement of Outstanding Scholarship, the Chinese Academy of Science, the U.S. National Science Foundation, the Army Research Office, the Deep Carbon Observatory, and the Helmholtz Young Investigators Group.

Source: Carnegie Institution for Science

Neurobiology: How Much Oxygen does the Brain Need?

The brain has a high energy demand and reacts very sensitively to oxygen deficiency. Ludwig-Maximilians-Universitaet (LMU) in Munich neurobiologists have now succeeded for the first time in directly correlating oxygen consumption with the activity of certain nerve cells.

The brain requires a disproportionate amount of energy compared to its body mass. This energy is mainly generated by aerobic metabolic processes that consume considerable amounts of oxygen. Therefore, the oxygen concentrations in the brain are an important parameter that influences the function of nerve cells and glial cells. However, how much oxygen is consumed in the brain and how this is related to neuronal activity was so far largely unknown. LMU neurobiologists Hans Straka, Suzan Özugur and Lars Kunz have now succeeded for the first time in directly measuring this in the intact brain and correlating it with nerve cell activity. The scientists report on their results in the journal *BMC Biology*.

In an already established animal model—tadpoles of the clawed frog Xenopus laevis—the scientists used electrochemical sensors to determine the concentration of oxygen in the brain and in one of the brain ventricles. They were able to specifically control the amount of oxygen available to the brain as well as inhibit nerve cell activity with the help of pharmacological substances. Using the example of nerve cells that control eye movements, the scientists succeeded in directly recording the relationship between oxygen consumption and nerve cell activity. "We have found that the brain is anoxic in a normal air-saturated environment, which means that no oxygen can be measured," says Straka. The complete oxygen was therefore immediately used by the cells to synthesize energy-rich substances. If more than twice the atmospheric oxygen concentration was available, the energy metabolism was saturated and oxygen was abundantly present in the brain. "We were also able to show that during normal operation only about 50 per cent of the oxygen is used for nerve cell activity," says Straka. "So the other 50 per cent are required for glial cells and for maintaining the basic metabolic rate of nerve cells. However, nerve cells with increased activity consume more oxygen."

In order to better understand how information is processed in the brain, knowledge of the relationship between oxygen availability and brain activity is essential. The scientists' results provide initial insight into this and are an important basis for further investigations of the brain's energy balance in future experiments and for measuring oxygen consumption for various nerve cell functions. This could also be relevant from a medical point of view, for example to better understand the consequences of oxygen deficiency in the brain or to better interpret the information on brain activity obtained with imaging techniques.

Source: Ludwig-Maximilians-Universität München

What Happens when Food First Touches your Tongue

A new study might explain why humans register some tastes more quickly than others, potentially due to each flavor's molecular size.

The research, published last month in the journal *PLOS Computational Biology*, also provided explanation as to why humans register taste more quickly when food or drink moves over their tongues quickly, as compared to when they are held in their mouth steadily.

The findings indicate that both the speed with which food and drink move in our mouth and the size of the molecules in the food that we consume affect our ability to taste.

"Our tongue has papillae on it that act like a sea of kelp in an ocean," said Kai Zhao, lead author of the paper and an associate professor of otolaryngology at the Ohio State University College of Medicine. "Those papillae—the small bumps that contain taste buds on the human tongue—move and sway as food or drink flow past them."

The human tongue has four kinds of papillae; three of those contain taste buds. (The fourth kind is the most numerous on the tongue, and functions primarily as a way to increase friction.)

For this study, the researchers modelled the way flavors move around the papillae in the tongue, using a range of salty and sweet stimuli. The researchers also built a computer model that simulated previous studies around taste perception.

The model considered the human tongue as a porous surface, with the spaces between the papillae acting like the holes of a sponge. Then the researchers simulated what would happen if they passed a range of salty and sweet flavors over that surface, first quickly, in one intense rush, then slowly.

They found that passing flavors over the tongue quickly caused the flavors to penetrate into the papillae gaps quicker, and that would register flavor more quickly.

And their findings could explain why taste buds were quicker to register a sweet compound with small molecular size as compared with those with large molecular size, such as salty flavors.

"Smaller molecules may diffuse quicker, and we think this could be the reason they move through the papillae gaps more quickly," Zhao said.

This study focused on the early stages of taste—what happens before taste buds have even registered a flavor. Compared with the other senses—sight and sound, for example—taste operates on a sort of time-delay. We hear a sound almost as soon as it is emitted; it takes our taste buds a little longer to register flavor.

"That early response is changed depending on how the molecules of what we are consuming interact with the tongue's surface," Zhao said. "It is a complex process."

Prior to this study, scientists knew that if they dropped a flavored solution onto a person's tongue, the intensity of that solution's taste would increase over time. But they did not know why that happened.

Zhao said scientists assumed the increase in flavor had something to do with papillae, so

for this study, his lab focused on studying the mechanics of how papillae work.

"Our taste buds are important," he said. "They help us figure out what food to eat, how much food to eat, and how to balance the body's nutritional needs with its energy needs."

Taste buds also help humans avoid poisonous substances, can help identify edible and nutritious foods, and contribute to the cravings humans feel for things like ice cream and potato chips.

Zhao said his lab decided to focus on the early stages of taste because it is connected to so many other public health issues, including nutrition and obesity.

Source: Ohio State University

Study Sheds Light on how Cancer Spreads in Blood

Analysis of particles shed by tumors points to new, less invasive way to diagnose malignancies

A new study sheds light on proteins in particles called extracellular vesicles, which are released by tumor cells into the bloodstream and promote the spread of cancer. The findings suggest how a blood test involving these vesicles might be used to diagnose cancer in the future, avoiding the need for invasive surgical biopsies.

The research is a large-scale analysis of what are known as palmitoylated proteins inside extracellular vesicles, according to Dolores Di Vizio, MD, PhD, professor of Surgery, Biomedical Sciences and Pathology and Laboratory Medicine at Cedars-Sinai. Di Vizio is co-corresponding author of the study, published online June 10, 2020 in the *Journal of Extracellular Vesicles*.

Extracellular vesicles have gained significant attention in the last decade because they contain proteins and other biologically important molecules whose information can be transferred from cell to cell. They are known to help cancer metastasize to distant sites in the body, but exactly how this happens is not clear.

To learn more about this process, the research team looked into a process called palmitoylation, in which enzymes transfer lipid molecules onto proteins. Palmitoylation can affect where proteins are located within cells, their activities and their contribution to cancer progression.

The investigators examined two types of extracellular vesicles, small and large, in samples of human prostate cancer cells. Using centrifuges, they separated the extracellular vesicles from the other cell materials and analyzed the levels of palmitoylation and the types of proteins present.

The team found extracellular vesicles derived from the cancer cells contained palmitoylated proteins that are associated with the spread of cancer. Further, when the team chemically suppressed the palmitoylation process, the level of some of these proteins went down in the extracellular vesicles.

"Our results suggest that protein palmitoylation may be involved in the selective packaging of proteins to different extracellular vesicle populations in the body," Di Vizio said. "This finding raises the possibility that by examining these proteins in extracellular vesicles in the bloodstream, we may be able

to detect and characterize cancer in a patient in the future without performing a surgical biopsy."

Di Vizio said the next step in the research is to conduct a study in collaboration with her Cedars-Sinai colleagues and industry partners that will use advanced technologies, including mass spectrometry and flow cytometry, with the goal of identifying clinically significant prostate cancer at diagnosis.

In addition to Di Vizio, Wei Yang, PhD, associate professor of Surgery at Cedars-Sinai, and Andries Zijlstra, PhD, are co-corresponding authors for the study. Zijlstra completed the research while working at Vanderbilt University Medical Center in Nashville. Javier Mariscal, PhD, a post-doctoral scientist in Di Vizio's laboratory, is the study's first author.

Source: Cedars-Sinai Medical Center

Form IV *(See Rule 8)*

School Science

1. Place of Publication	National Council of Educational Research and Training (NCERT), Sri Aurobindo Marg, New Delhi 110 016
2. Periodicity of Publication	Quarterly
3. Printer's Name	Manoj Sharma: M/s Chaar Dishayen Printers Pvt. Ltd. G-39 & 40, Sector, Noida (UP) 201301
(Whether citizen of India?)	Yes
(If foreigner, state the country of origin)	Not applicable
Address	
4. Publisher's Name	Anup Kumar Rajput
(Whether citizen of India?)	Yes
(If foreigner, state the country of origin)	Not applicable
Address	Professor and Head, Publication Division, NCERT, Sri Aurobindo Marg, New Delhi 110 016
5. Editor's Name	Sunita Farkya
(Whether citizen of India?)	Yes
(If foreigner, state the country of origin)	Not applicable
Address	Academic Editor, Department of Education in Science and Mathematics, NCERT New Delhi 110 016
6. Names and addresses of the individuals who own the newspaper and partner or shareholders holding more than one per cent of the total capital	National Council of Educational Research and Training, New Delhi *(An autonomous body of the Government of India in the Ministry of Human Resource Development)*

I, Anup Kumar Rajput, hereby declare that the particulars given above are true to the best of my knowledge and belief.

Publisher

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Published by the Head, Publication Division, National Council of Educational Research and Training, Sri Aurobindo Marg, New Delhi 110 016 and printed at Chaar Dishayen Printers (P.) Ltd., G-39-40, Sector-3, Noida- 201 301 (U.P.).

R.N. 7455/63

Subscription Rates for NCERT Journals

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फिरकी बच्चों की (अर्द्ध वार्षिक) (Firkee Bachchon Ki) Half-yearly	₹35.00	70.00

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