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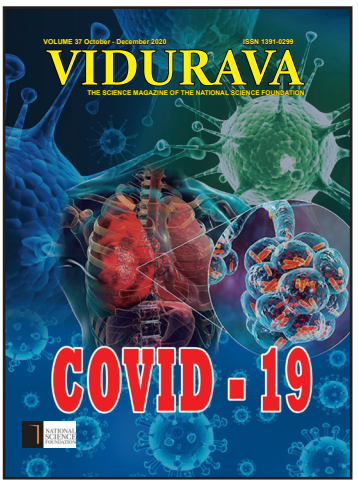

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Editorial

Challenges Of A Global Invasion And Traditions In The Containment Of Viral Diseases

The survival of the human race has been at risk on many occasions throughout the last Millennium through the emergence of inhuman pathogenic invasions. The latest being the appearance of what has been referred to as the Severe Acute Respiratory Syndrome, Corona virus 2 (SARS – CoV – 2).

Since its initial appearance in the Wuhan Province of China in late 2019, it has since then invaded over 200 countries across the globe causing in the wake demonic fright, and taking the lives of several millions of people.

Pathogenic virus invasions have come in various forms. Many surviving elders may recollect the emergence during the initial post World War 2 era, of four well known virulent and contagious pathogenic virus infections, which were popularly recognized by layman as deities illnesses. These were Small-pox, Measles, Chicken-pox and Mumps. Of these, Small-pox was an acute, and often a fatalistic contagious viral disease with symptoms of fever, and inflicting lesions or pustules, that usually left permanent scars on the body.

In the case of Measles, the infection by the virus was often marked by mild fever, which was the first stage of this disease. This was then followed by the outcropping of a skin rash on the third to fifth day of the disease, which was the culminating phase of the infection.

On the other hand Chickenpox, which was less virulent, and very much confined to the younger generation, had symptoms of fever and rash of small blisters. The fourth contagious disease Mumps was an infectious viral disease that caused a swelling of the parotid salivary gland in the face. Two features that were observed in this particular disease were, first the fact that this swelling appeared in the front of the ear and filled the wedge between the angle of the mandible and the mastoid process. The second feature was that, the inflammation of the gland was associated with great oedema and tenderness.

Treatment regimes for most of these viral diseases were not as rigorous as could be expected. Nevertheless, because of the contagious nature of these diseases total isolation and bed rest were the measures that helped the induction of immunity to fight back the virus.

However, in the case of Mumps, one may recollect that it was customary to apply externally around the affected mandible, a paste prepared from Red Sandalwood (*Sinh. Rath-handhun*), which had provided relief and facilitated early recovery.

Tradition also has it that maintaining a veil of secrecy about the outbreak and prevalence of these virulent infectious deities' diseases in the neighborhood, and total bed rest were features in the management of the disease.

Finally, in addition, village folk, in a show of cooperative participation in the redress of these victims of "demonic" diseases, invoke the blessings of the tutelary gods with various offerings, as well as organizing performances of customary rituals (*Charithra-varithra*), while also at the sane time conducting special religious ceremonies such *Pujās* as well as the chanting of *'Seth Pirith'*. Among other traditions are the reciting of specially formulated ritualistic verses (*Yāthikā*), performing secretive spiritual prescriptions (*Kem* and *Manthra*), and reciting incantations (*Yāthikā*) seeking the blessings of tutelary deities (*Kannalavu-yāthikā*) for the protection and early riddance of these virus diseases.

M. Asoka T. De Silva

Novel Corona Pandemic: Virus, Disease and Prevention

Prof. Manuj C. Weerasinghe

Background

Emerging infectious diseases are considered a major threat to health. The world has witnessed several such infectious diseases within the first two decades of this millennium. SARS and MERS are two of those infections which quickly transformed to epidemic proportions. Now we are witnessing Covid 19, the worst epidemic in a hundred years. The World Health Organization elevated it to a pandemic status in March 2020. At the time of writing this article, the reported patients of COVID-19 across the globe has passed 5 million with over three hundred and fifty thousand deaths. It is predicted that this pandemic will last for over a year accounting to millions of infections and an unprecedented number of deaths. Most countries are still experiencing the initial phase.

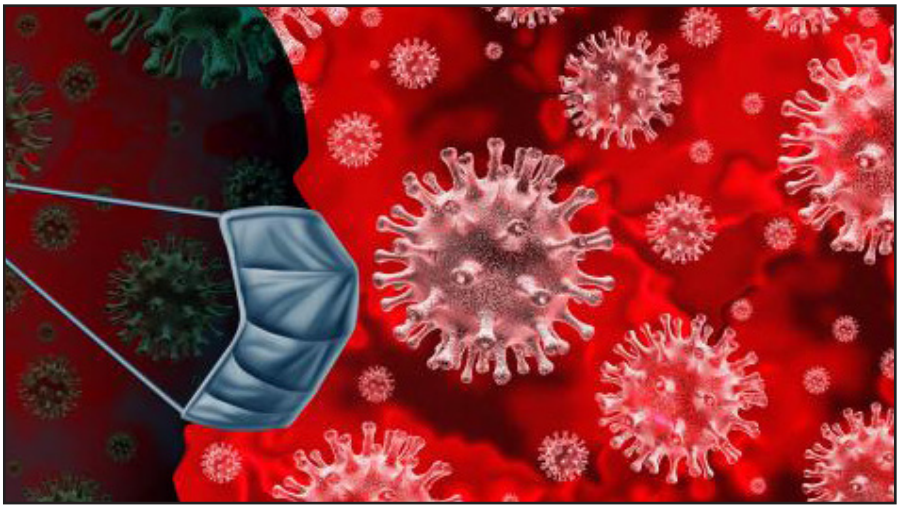
Emerging Infections

According to World Health Organization, Emerging Infectious Diseases (EIDs) are serious public health threats globally. An emerging infection is an infection that has either appeared and affected a population for the first time, or has existed previously, but is rapidly spreading either in terms of the number of people getting infected, or in terms of new geographical areas. Many EIDs are zoonotic in origin, which means that the disease has emerged from an animal and crossed the species barrier to infect human beings. Often human beings may have little or no natural immunity to EIDs, consequently, their impact, on health, society and the economy, are difficult to predict.

When an infection that becomes widespread and affects a whole region, a continent, or the world due to a susceptible population, it is called a pandemic. By definition, a true pandemic causes a high degree of mortality (deaths). The word "pandemic" comes from the Greek word; "pan", which means "all", and "demos" mean "people or population". Therefore, "pandemos" means "all the people". Pandemic in this sense affects all the people.

Novel Corona Virus

Novel corona virus is a RNA virus. It belongs to the family of viruses that include the virus causing common cold, and viruses such as severe acute respiratory syndrome (SARS) and Middle East



Respiratory Syndrome (MERS). Novel corona virus is scientifically named as SARS CoV 2 according to the international nomenclature. This virus was first isolated from patients reported with an unusual respiratory condition from Wuhan Province of China in late December 2019. The condition was marked by several symptoms including fever, dry cough, and tiredness. Less commonly aches and pains, sore throat, diarrhoea, headache and loss of taste or smell has been reported. More serious symptoms are difficulty of breathing or shortness of breath and chest pain.

COVID-19 is thought to spread from person to person, mainly through respiratory droplets produced when an infected person coughs or sneezes. These droplets can land in the mouths or noses of people who are nearby or possibly be inhaled into the lungs. Spread is more likely when people are in close contact with one another. Symptoms may appear 2-14 days after exposure to the virus (incubation period of the infection).

It is observed that most patients show a mild disease. Only around 20 % show moderate to severe symptoms. From the current evidence, only 5% to 6% of patients will need advance life support and admission to intensive care units. New evidence is now emerging that certain patients may not present any symptoms. Although any age group is at risk of getting infected by this virus, it is seen that elderly persons (those over 60 years of age), as well as those already having non communicable diseases, and those who smoke are at a greater risk of developing sever disease symptoms and complications. Death rates among older people are much higher than the relatively younger patients. Based on available evidence, children do not appear to be at higher risk for COVID-19 compared to adults. While some children and infants are reported to be infected, adults make up most of the known cases to date. Also, it has been observed that males have a higher chance of getting infected. However, it is too early to conclude on the disease patterns in different age groups or gender. This is a newly identified virus and much research is needed to understand its true behaviour.

Diagnosing COVID-19

Diagnosis of any disease is based on symptoms of the patient, clinical examination and/or diagnostic tests. Generally, when a person with symptoms is detected, he or she is directed for laboratory diagnosis to confirm the infection.

Routine confirmation of cases of COVID-19 is based on the detection of unique sequences of virus RNA by nucleic acid amplification tests (NAAT) such as real-time reverse-transcription polymerase chain reaction (rRT-PCR). This is the only test recommended by the World Health Organization to detect an infected person.

Reverse transcription polymerase chain reaction (RT-PCR) is a laboratory technique combining reverse transcription of RNA into DNA, and amplification of specific DNA targets using polymerase chain reaction (PCR). It is primarily used to measure the amount of a specific RNA. This is achieved by monitoring the amplification reaction using fluorescence. PCR technique has been used for medical investigations and scientific research for over two decades.

Prevention and Control of COVID-19

Best approach to any diseases is prevention. It is of much relevance to infectious diseases when the infection is an imported one without a local reservoir. As stated, this novel corona virus was first identified from China, which subsequently spread across the globe. Therefore, prompt action from the country of origin and the recipient countries could have reduced the extent of the spread. However, in the present global economic context, where people tend to travel widely across countries and continents, infective agents are transmitted within hours

to far away destinations. Therefore, it was difficult to control the spread across countries and continents.

There are several measures prescribed to prevent spread of infection within the community. These include cancellation and suspension of events with super spreader potential; use of social distancing measures to reduce direct and close contact between people in the community; travel restrictions including reduced flights; suspension of public transport and route restrictions; voluntary home quarantine of contacts; and clear communication on aspects of hygiene from health authorities to ensure verified information to the community.

The Sri Lankan Situation

COVID-19 confirmed cases in Sri Lanka presents a unique picture. All the cases detected up to now can be categorised into four groups: (1) those who returned from overseas, (2) immediate family or close associates of overseas returnees, (3) extended contacts of known cases and (4) service personal infected due to their exposure to patients. Thus, a clear link between newly infected and the known cases can be established among Sri Lankan patients. Therefore, Sri Lankan epidemic can still be considered a cluster epidemic.

Sri Lanka initiated public health response approach even before the first case was detected in late January, by establishing a task force to overseas the mitigation activities. Thus the country was already prepared to face the challenge by the time of detecting the second case in mid-March. Establishing screenings at entry points to the country; guidance on self-quarantine, and mandatory institutional quarantine for travellers from high risk destinations; closure of educational institutions and work from home to enforce physical distancing; closing of sea ports and airports to stop imported cases; and imposing an island-wide curfew to enhance physical distancing, were some of the key measures taken. Basically Sri Lanka instituted a strategy of tracing contacts of known cases, testing them and providing prompt treatment if found positive. These measures were implemented along with an awareness campaign to obtain the support of the general public. The Sri Lankan strategy of facing the COVID-19 challenge is seen as a success compared to many other countries. However, maintaining the epidemic within control, depends on how the public responds and continue to comply with prevention measures.

Future of the Pandemic

Any pandemic has a beginning; a rapid transmission across the globe reaching a peak; and gradually causing a reduction of the number of cases. The natural history of this can be only altered if preventive actions developed and executed by the governments and international collaborations are overlooked. One of the proven preventive methods for infectious diseases is the development of a vaccine. A potent vaccine when injected to a healthy non infected person will generate antibodies inside his body that will protect him from the infection. Many viral and bacterial infections in the past were prevented through immunization. However, development of a vaccine for a new virus takes a considerable time. At present many research groups are trying to develop vaccines against novel corona virus. These studies are still in the preliminary stage. It is estimated that at least another year will be required to produce an effective vaccine. There are also ongoing experiments to discover new medicines to treat the patients. Several drugs are already been used for treatment at experimental level. However, at present none of the drugs have emerged for successful treatment

Hence, the reality is for the public to live with the pandemic for a considerable period of time taking all the precautions as individuals as well as communities to minimize the spread of the infection. We have to learn to Coexist with COVID-19 by adjusting to a new life of keeping physical distance, hand hygiene and wearing a face mask in day to day activities.

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Role of Real-time Reverse Transcription - Polymerase Chain Reaction in the Detection of COVID - 19

Prof. Ranil Dassanayake and Mr Charitha Rajapakse

Coronavirus disease 2019 (COVID - 19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since its first discovery in Wuhan, China in late 2019, it has escalated into a global pandemic within a few months, affecting more than 185 countries. As of 1st of May 2020, it has claimed more than 200,000 lives with more than three million confirmed cases worldwide. Due to the alarmingly rapid rate of the viral spread and the accompanying surge of COVID-19 cases, healthcare systems are challenged with the necessity to control the spread of the virus while treating and monitoring the patients. The presence of a considerable number of mild and asymptomatic cases renders the clinical characteristics alone insufficient for an accurate diagnosis. Furthermore, it has been observed that there is a time window between the viral infection and the manifestation of the clinical symptoms. However, these asymptomatic cases are capable of transmitting the virus. These features present an additional challenge in curbing the spread of the virus. Therefore, an accurate standard method for the detection of the virus is of utmost importance. Nucleic acid amplification tests (NAAT) have emerged as simple and reliable tests for the detection of viral pathogens. Among NAAT, the Polymerase Chain Reaction (PCR) based method is considered to be the gold standard for the detection and quantification of viral RNA.

SARS-CoV-2 belongs to a sub-family of the coronaviridae class of viruses which are capable of infecting mammals and birds. They are commonly found and are responsible for causing a wide array of symptoms ranging from mild to severe. In fact, about one third of the viruses that cause common cold are coronaviruses. They contain an envelope with protein spikes which appears as a crown in electron micrographs, thus inspiring the name 'coronavirus'. These protein spikes play an important role in the entry of the virus into host cells. A schematic representation of the SARS-CoV-2 viral structure is shown in Figure 1. SARS-CoV-2 is an RNA virus consisting of a single stranded positive sense RNA molecule. The term 'positive sense' indicates that the viral genome can be directly used for protein synthesis by translation in host cell ribosomes. This RNA molecule

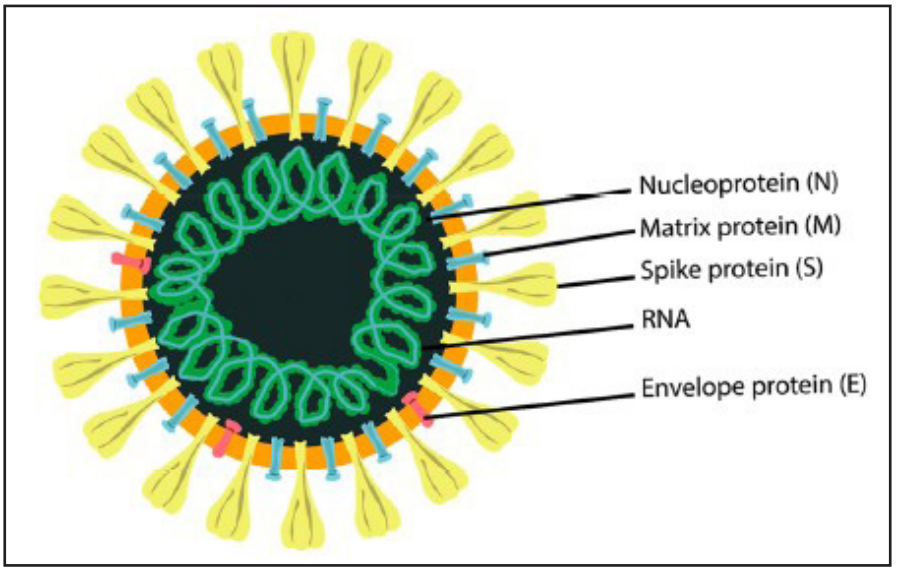

Figure 01 : A representation of the SARS-CoV-19 viral structure

is less than 30,000 bases long and codes for 16 proteins which are necessary for the survival and the propagation of the virus. The RNA genome of the virus contains sequences that are conserved among the virus family as well as sequences unique to the virus. Such sequences unique to the SARS-CoV-2 virus allow for the specific detection of the virus using nucleic acid based detection methods such as RT-PCR.

The detection of SARS-CoV-2 viral particles is based on the specific amplification of the unique regions of the viral genome. The amplification is carried out by a technique referred to as Polymerase Chain Reaction (PCR) in which a desired section of DNA is amplified to a detectable concentration. Since the SARS-CoV-2 genome is made up of RNA, an additional step has to be carried out to synthesize complementary DNA (cDNA). This reaction is called reverse transcription and thus the entire process is referred to as Reverse Transcription - Polymerase Chain Reaction (RT-PCR). This process allows for the real time detection of the amplification as well as the quantification of the viral load. As such it is also referred to as quantitative Real Time Reverse Transcription - Polymerase Chain Reaction (RT-qPCR).

In reverse transcription, an enzyme called reverse transcriptase is utilized. It is capable of synthesizing a complementary DNA (cDNA) molecule using an RNA molecule as the template. In addition to the template RNA and the enzyme, deoxyribonucleotide triphosphates (dNTPs) are used in the reaction as building blocks to synthesize the cDNA strand. Once the reaction mixture is composed, the reaction is facilitated by providing the optimal temperature required for the enzyme to function which is typically 42-48^{o}C.

The composition of a PCR includes the template DNA to be amplified, oligonucleotide primers, a polymerase enzyme to catalyze the reaction, and dNTPs to synthesize new copies of DNA. In addition, magnesium ions which are required for the enzyme function are also added to the medium. A PCR consists of three repeating steps collectively referred to as a PCR cycle. The first step is the denaturation of the double stranded template DNA which is facilitated by the elevation of the temperature to around 94-98^{o}C. In the second step, the temperature is decreased to facilitate the binding of oligonucleotide primers to the denatured template strands. The two primers will bind to the two separated strands of the template DNA flanking the desired region to be amplified. This binding, referred to as annealing, occurs due to the complementary base pairing between the template and the primers. Thus, it determines the specificity of the reaction. The annealing temperature can vary between 48-72^{o}C and is determined by the lengths and the base compositions of the primers. In the third step, the primers are extended by adding nucleotides using the template strand as a guide. Extension is carried out by a polymerase enzyme which is typically active at 68-72^{o}C. At the end of each PCR cycle, the number of copies of the template DNA is doubled. In order to obtain a considerable number of copies, the PCR is usually carried out for about 30-40 cycles. A PCR can be simplex where only one target is amplified, or multiplexed where more than one target is amplified simultaneously. Multiplexing is achieved via the utilization of several pairs of primers.

Both the above reactions are carried out in a buffered aqueous medium to provide the optimal chemical environment for the enzymatic reaction. An RT-PCR can be done either in a single step or in two steps. In a single step RT-PCR, the constituents required for both the reverse transcription and the PCR are added to the same vessel and the temperatures are provided such that the reverse transcription is followed by the PCR. In a two-step process, the two reactions are carried out separately.

In real time PCR, the amplification process is monitored at the end of each cycle. This is achieved by introducing a fluorescence-quencher probe to the reaction composition. The probe used is a single stranded oligonucleotide whose sequence is complementary to a region within the template to be amplified. Thus, it is capable of annealing the denatured template strand. The probe is tagged with a fluorescence reporter molecule at the 5' end and a quencher molecule at the 3' end. When the probe is intact, the quencher molecule captures the fluorescence emitted by the reporter molecule, thus no fluorescence can be detected. During primer extension, the annealed probe is hydrolyzed by the DNA polymerase so that the fluorophore and the quencher are separated. This results in the emission of a detectable fluorescence signal. A schematic representation of this principle

is shown in Figure 2. Since only the probe molecules bound to a template are cleaved, the intensity of the emitted fluorescence is proportional to the number of copies of the template DNA at the beginning of the cycle. Thus, by recording the emitted fluorescence at the end of each cycle, the progress of amplification of cDNA can be visualized in real time.

The quantitative endpoint for real-time PCR is the threshold cycle (Ct). The Ct is defined as the PCR cycle at which the fluorescent signal of the reporter molecule exceeds the chosen threshold above background fluorescence. There is an inverse relationship between the numerical value of Ct and the amount of amplicons in the reaction. That is, lower the Ct higher the amplicons in the reaction mixture. This Ct value contributes in generating a numerical relationship to analyze results. Moreover, both positive and negative controls should be in place in every RT-qPCR assay, as it is important to carry out an accurate interpretation of the end results. Negative control should not exhibit fluorescence signals more than the background to obtain a Ct value. A negative control which obtains a Ct value is considered as a false positive, thus the run should be invalidated and the assay should be repeated with utmost care.

It is essential for the success of the procedure to provide the precise temperatures at each step. This is difficult to achieve manually. Thus, an instrument called the thermocycler, which is capable of precisely providing the appropriate temperatures, is used. The apparatus may also include a mechanism to detect and record the emitted fluorescence.

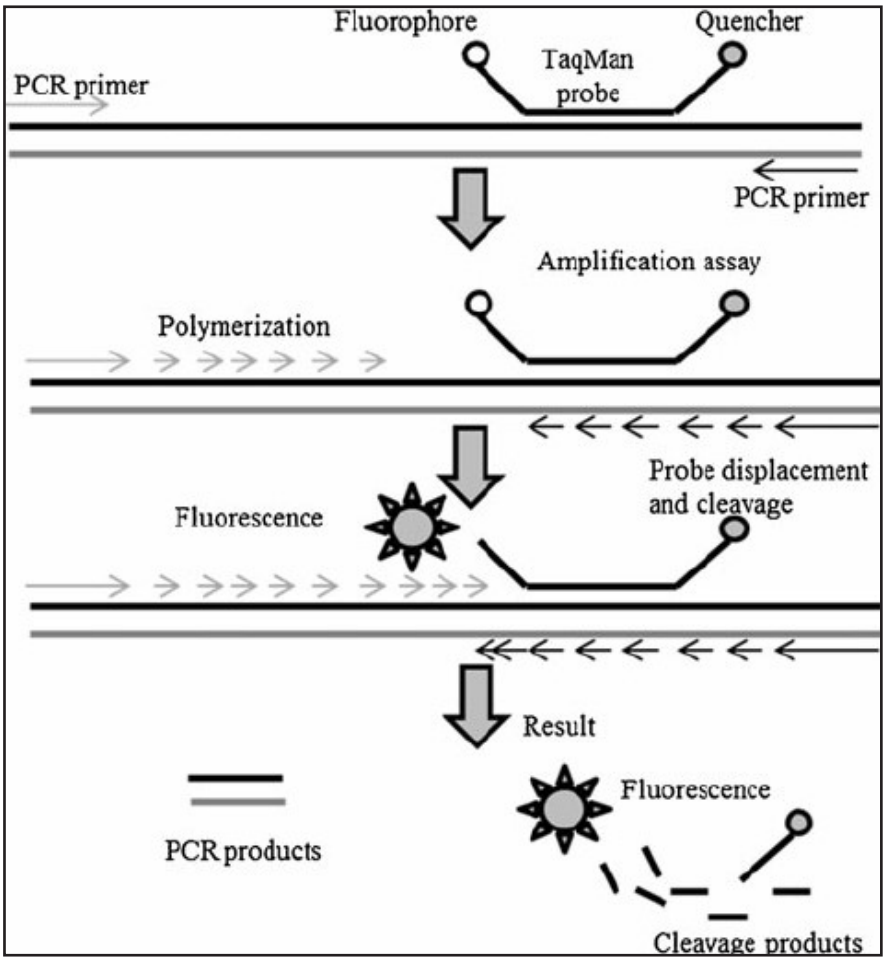

Figure 02 : Emission of fluorescence by the flourophore after the cleavage of the probe by DNA polymerase

The design and establishment of an RT-qPCR assay for the detection of a virus typically involves two steps. The first step involves the design of specific primers and probes. Since the specificity of the test is determined by the primers used, it is important to thoroughly and attentively analyze the genomic sequence of the target virus as well as those of related viruses. The primers should be designed in such a manner that they can selectively recognize the SARS-CoV-2 viral genomic sequences. The second step involves optimization of the reaction conditions and testing the assay.

In order to detect SARS-CoV-2, the viral RNA can be extracted from several types of samples. These include respiratory specimens such as sputum, bronchoalveolar lavage fluid (BALF), tracheal aspirates, as well as nasopharyngeal or oropharyngeal aspirates, washes or swabs. Among these, BALF is recommended for the monitoring of the virus in severe cases. However, its collection might be somewhat difficult as well as cause discomfort to the patients, rendering its use impractical for routine diagnosis. Thus samples which are more rapid, simpler and safer to collect, such as sputum,

nasopharyngeal and oropharyngeal swabs, are typically used in routine diagnosis. Furthermore, the sample used for viral RNA extraction as well as the time of its collection may have a significant impact on the accuracy of the test depending on the viral load they contain. It is also imperative that the collection of samples is done without introducing any contaminants or amplification inhibitors. Furthermore, the collected samples should be transported to the laboratories as soon as possible to test the viral RNA, otherwise RNA may get decomposed due to its inherent instability.

Once the RNA is extracted from a sample collected from a suspected patient, the reaction mixture is prepared by adding the required constituents according to the optimized volume of each component. The reaction vessels are placed inside the thermocycler and the assay is conducted under the optimized parameters. The thermocycler cycles through programmed temperatures triggering the processes described above ultimately resulting in the amplification of the targeted section of cDNA. Continuous amplification of the cDNA is detected via the fluorescence signal emitted due to the cleavage of the fluorophore-quencher probe. It is expected that in a well-designed and optimized RT-qPCR assay to detect SARS-CoV-2, the amplification and the subsequent emission of fluorescence will only occur if the virus is present.
Different organizations and companies have developed several RT-qPCR assays. These include both simplex and multiplex RT-qPCRs. They all employ the approach described above. However, different assays may achieve specificity by selectively amplifying different unique regions of the SARS-CoV-2 viral genome. This is determined by the primers and probes used in each assay. The RT-qPCR assays developed by Centers for Disease Control and Prevention, United States (CDC, US), National Institute of Infectious Diseases, Japan and National Institute of Health, Thailand all target different regions of the N gene which encodes the nucleocapsid protein. Among these, the assay developed by CDC, US is a multiplex assay while the other two are simplex assays. Chinese Center for Disease Control and Prevention (China CDC) has developed a multiplex RT-qPCR assay targeting sequences in the N gene and the ORF1ab gene. Charite - Universitätsmedizin Berlin, Germany has developed a multiplex RT-qPCR assay which targets the RdRP gene (RNA-dependent RNA polymerase gene), the E gene (Envelope protein gene) and the N gene. The multiplex RT-qPCR assay developed by the Hong Kong University targets regions in the ORF1b-nsp14 and the N gene.

The RT-qPCR assay is characterized by its high sensitivity and specificity. Thus, it allows to achieve a highly accurate qualitative assessment about the presence of viral RNA in a sample. It can also be used to generate accurate quantitative data to assess viral load in a sample which might be helpful in monitoring the disease progression. In addition, this method allows early detection of the infected individuals compared to assays based on immunological detection. There are also a few limitations associated with this technique. It can only be performed by trained personnel who are familiar with testing procedures and interpretation of results. In addition, the requirement of sophisticated equipment such as thermocyclers confines the testing procedure only to laboratories with the aforementioned resources. Thus, in addition to the time spent for the procedure itself, additional time will be spent on sample transportation as well. Hence, the overall turn-around-time for the test is typically long. Furthermore, there is a possibility of the occurrence of false negative results due to improper sample collection, handling and transportation.

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COVID-19 and Personal Protective Equipment (PPE)

Prof. K.M.Nalin De Silva

In December 2019, a novel coronavirus infection was detected in Wuhan, Hubei Province, China. The virus responsible for the current outbreak was originally called novel coronavirus, now renamed SARS-CoV-2, due to its relationship with the SARS virus (viral agent responsible for the epidemic in China in 2002-2003). COVID-19 poses a greater threat to the older demographic and those that suffer from other illnesses such as diabetes, cancer, respiratory issues such as asthma and cardiovascular disease.

Due to the high rate of transmission of the disease, the WHO declared the epidemic a Global Health Emergency on January 30, 2020 and released various health alerts.

Initially it was thought that the droplet transmission is the most likely mode, however recommendations were later upgraded to airborne and contact transmission as well, due to the infection rates of disease. It was also noted that the contagiousness is very much higher than SARS virus, and transmission of the virus can occur even before a patient shows symptoms or even a few days after they have made a full recovery. This situation was alarming and therefore, the use of Personal Protective Equipment (PPE) as a measure of mitigating the transmission of the virus in the current pandemic situation was considered to be of utmost importance for all personnel (especially medical/ military/laboratory) who have

Figure 01 : "Trust him, he's a doctor" An engraving of a plague doctor, circa 1656. Image via Wissen Media.

the risk of exposure to the virus. The protection of our frontline health workers is paramount, and PPE, including medical masks, respirators, gloves, gowns, and eye protection, must be prioritized for health care workers and others caring for COVID-19 patients.

Personal Protective Equipment (PPE)

The use of medical PPE extends back to the 17th century. During the bubonic plague, doctors wore a wide-brimmed hat (to defend the head), and a mask with a protruding beak extending from the nose carrying aromatic herbs (for protecting from fatal miasmatic smells) (Figure 1).

In general, PPE includes skin and eye protective equipment (medical/surgical face masks, face shields, gloves, coveralls, isolation gowns, aprons, safety shoes, helmets, and goggles) and respiratory protective equipment (respirators; i.e. N95 or FFP2 or FFP3 standard or equivalent). One of the fundamental principles of occupational health and safety is that PPE should be considered

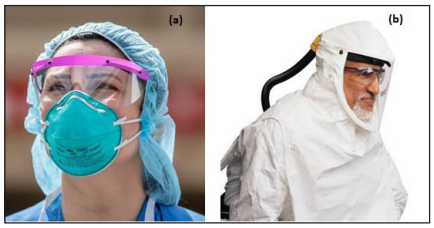

Figure 02 : (a) NIOSH- Approved N95 mask and (b) PAPR for bearded personnel

as the last line of defense, after other measures have been taken. On the other hand, the selection process of proper PPE can be tedious and time-consuming, as the specifications for PPE are technical. The better selection is achieved when the user can understand the technical details about the PPE. As far as designing of a PPE for a particular task is concerned, factors such as the following should be taken into consideration :

- Suitability and appropriateness for the risks involved
- Ensuring of compatibility in situations where the user is required to wear more than one item of PPE
- Effectiveness in mitigating the risks
- Comfort for the wearer
- Compliance with legislative standards of manufacture (EN and CE requirements)

Finally, the readiness of the PPE for the given task is achieved *via* completion of a local hazard analysis and risk assessment, coupled with a thorough review of a facility's capability to respond to significant incidents. A summary of currently available PPE options is described below.

Surgical face masks and respiratory PPE

A primary route of transmission of COVID-19 is likely to be via respiratory droplets and therefore the spread of the disease can be reduced by limiting contacts of infected individuals via physical distancing and other measures. The majority of evidence indicate that transmission of the virus through infected droplets can be reduced by wearing face masks. Therefore, it is the responsibility of every citizen to comply with the requirement to wear protective masks in public places to reduce the transmission of the disease and thereby attenuate the death toll and negate the impact on the economy.

As far as face masks are concerned, the N95 respirators (Figure 2a) (the equivalent in Europe is FFP2 respirators) are recommended for health workers who are conducting aerosol- generating procedures during clinical care of COVID-19 patients, while surgical masks are recommended for non-aerosol generating procedures. The importance of masks for health worker protection was emphasized in the early phases of the global pandemic in hospitals all around the world. Due to these recommendations, the world witnessed an elevated spike in surgical masks usage which resulted in a severe shortage of surgical masks. Various strategies were recommended to address this severe shortage, and one such recommendation was to reduce the use of surgical masks and explore options to re-use respirators after sterilization. According to the Occupational Safety and Health Administration (OSHA) regulations, health care workers (HCW) must be properly fit-tested with either a qualitative or quantitative device to ensure the mask makes a proper seal with the wearer's skin and offers adequate protection. Users must be clean shaven for mask use as well as for the fit test. HCW with beards can use a powered air-purifying respirator (PAPR) with a hood (Figure 2b), since these function without the need for a tight skin seal and therefore do not require fit testing.

It is better to discuss more on the difference between N95 and surgical masks. N95 designation is from National Institute for Occupational Safety and Health (NIOSH), meaning it is actually a dust mist respirator which filters out 95% of small particles, but is not resistant to oil (N= Not; 95= 95% filtration efficiency).

A surgical mask (Figure 3) on the other hand, is a loose-fitting, disposable device that creates a physical barrier between the mouth and nose of the wearer and potential contaminants in the immediate environment. Even though surgical masks can prevent inhalation of large droplets and sprays, their ability to filter submicron-sized airborne particles are limited. As SARS-CoV-2 is also embedded in aerosols <5 μm in diameter, it cannot be determined

Figure 03 : Surgical mask

Figure 04 : (a) disposable patient examination gloves (b) disposable isolation gown (front and back view) (c) coverall (front and back view)

whether they are always effective. This has been experimentally proven in a case-control study comparing the protective effect of surgical masks and N95 respirators against SARS among healthcare workers in five Hong Kong hospitals. Surgical masks are not intended to be used more than once and should be discarded if the mask is damaged or soiled, or if breathing through the mask becomes difficult.

Currently, there is a global shortage of surgical masks and N95 respirators and because of this, it was recommended for healthy people to wear a cloth to cover the face in public. The use of cloth masks is a simple, economic and sustainable alternative to surgical masks. This approach will pave the way to reserve disposable surgical masks and N95 respirators for health care facilities all around the world.

(a) Contact PPE

Surgical gloves

Medical gloves (Contact PPE) (Figure 4a) are used by health care personnel to prevent them from coming into physical contact with the virus. Medical gloves are disposable and include patient examination gloves and surgeon's gloves. It is recommended to change the gloves when they become torn or heavily contaminated. It is also a practice to use double gloves so that the outer glove can be discarded when they become soiled or torn.

(b) Disposable gowns

Under contact PPE, several fluid-resistant and impermeable protective clothing options are available in the marketplace for healthcare personnel (HCP). These include isolation gowns (Figure 4b) and coveralls (Figure 4c). Non Sterile, disposable patient isolation coveralls are used for routine patient care in healthcare settings and they are suitable for use by frontline health workers of COVID-19. Coveralls provide a 360-degree protection because they are designed to cover the whole body, including the back and lower legs, and sometimes the head and feet as well. HCP unfamiliar with the use of coveralls must be trained and have practiced prior to using it. On the other hand, many health care personnel tend to use clothing that have a hood integrated into a zip-up gown or full jumpsuit-type clothing, with a face shield worn along with an N95 (Figure 5a) or with surgical mask (Figure 5b)

Figure 05 : Hood integrated into a full jumpsuit-type clothing, with a face shield worn along with (a) N95 and (b) surgical mask

Figure 06 : Eye wear safety includes (a) eye goggles and (b) face shields

for better protection. Even if it is more difficult to put on respirators with coveralls, it may protect better than a mask worn with a gown. However, this PPE is not that user friendly as this is usually associated with increased difficulty in putting on and removing.

Eye Protection

Eye protection is strongly recommended for workers who may be at risk of acquiring infectious diseases via ocular exposure. Eye protection provides a barrier to infectious materials entering the eye and is often used in conjunction with other personal protective equipment (PPE) such as gloves, gowns, masks or respirators. There is a wide variety in the types of protective eyewear, and appropriate selection should be based on a number of factors including the extent of the hazard. Eye protection must be comfortable and allow for sufficient peripheral vision and must be adjustable to ensure a secure fit. Eye safety wear includes eye goggles (Figure 6a), face shields (Figure 6b), full-face respirators and safety glasses.

In general, goggles are available in various styles to fit adequately over prescription glasses with minimal gaps. However, to be efficacious, goggles must fit properly (from the corners of the eye across the brow). The downside of the goggles are that they do not provide splash or spray protection to other parts of the face. For this purpose, face shields have been introduced which can provide protection to other facial areas. To provide a better face and eye protection from splashes and sprays, a face shield should have crown and chin protection and wrap around the face to the point of the ear. This reduces the likelihood that a splash could go around the edge of the shield and reach the eyes. Eye goggles can also be worn alone or with a face shield. Medical staff members wearing protective clothing that include eye goggles, surgical face mask and coverall are depicted in Figure 7.

Figure 07 : Medical staff members wear protective clothing as they arrive with a patient at the Wuhan Red Cross Hospital in China on Jan. 25.

Even if PPE provides protection against diseases there are so many other issues associated with the use of PPE. Masks could induce contact dermatitis as well as contact urticarial due to adhesives, rubber in straps, metals in clips and the possibility of free formaldehyde released from the non-woven polypropylene. The tighter and more secure N95 masks can cause significant skin damage due to the pressure on anatomic points like the bridge of the nose and across the zygoma. Additionally, due to the accumulation of moisture there can be severe skin damages and irritations. Therefore it is of utmost important to recognize the occupationally induced skin conditions due to the use of PPE, and to take preventive measures to mitigate the long term skin issues and other related complications. In addition the long term use of respirators and surgical masks can affect the oxygen intake which may cause further health issues. Therefore it should be emphasized that prolong use of these PPE can also pose a serious health hazard to healthcare workers and general public.

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Vital Role of ICT for COVID-19 Response

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For thousands of years, pandemics of infectious diseases such as small pox, leprosy and tuberculosis have infected human beings. The deadliest pandemic on record was Black Death which caused deaths of up to 25-200 million people in the late Middle Ages, while diseases such as influenza, tuberculosis, smallpox, and leprosy were also responsible for some of the other most widespread outbreaks.

The current corona virus pandemic continues to spread in all parts of the world, after it was first identified in Wuhan, China in December 2019. The spread of the pandemic in terms of cases and deaths have forced countries to impose strict physical distancing and lockdown measures. All social and economic sectors are currently experiencing the devastating effects of the pandemic. Moreover, the health and livelihood of workers and employers are being threatened every day. Across the world, losses in terms of production and unemployment have forced some countries to recession, while poverty levels in developing countries are also on the rise. In order to keep the vital functions of the society operational, information and communication technology (ICT) is increasingly used. In addition, new technological trends are emerging to build resilient societies, better health services, business solutions, and education of the future.

Remote Work

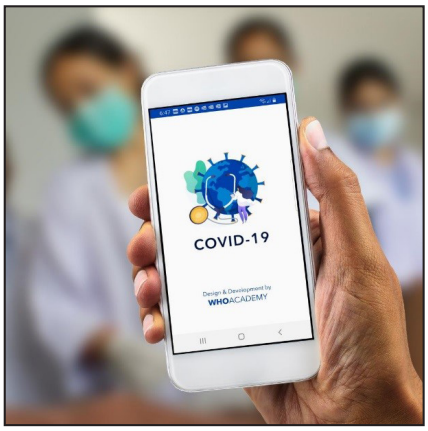

Figure 01 : Mobile phone apps help the fight against the pandemic in many ways

In the past, working from home was rare, and was confined to special cases. On the other hand, recent events have forced many business establishments to permit their staff to work remotely. However, at present most businesses are not technologically geared to support distance work programmes, and therefore, this evolving trend has created new productivity concerns. Further, survey polls have revealed that issues such as poor internet connectivity, lack of good quality devices, as well as cyber security, have negatively affected the ability of employees to work from home. There are also coordination issues, since the modern workforce is increasingly mobile, comprising multi-generations that span across industries, and involving international connectivity. Continuous developments made in the field of communication technology will play a pivotal role to make effective remote working, a true reality in the foreseeable future. To this end, solutions enabled by 5G wireless connectivity, virtual private networks (VPNs), cloud computing and video conferencing tools will allow employees in different locations to actively collaborate and meet deadlines efficiently.

Online Shopping, Digital and Contactless Payments

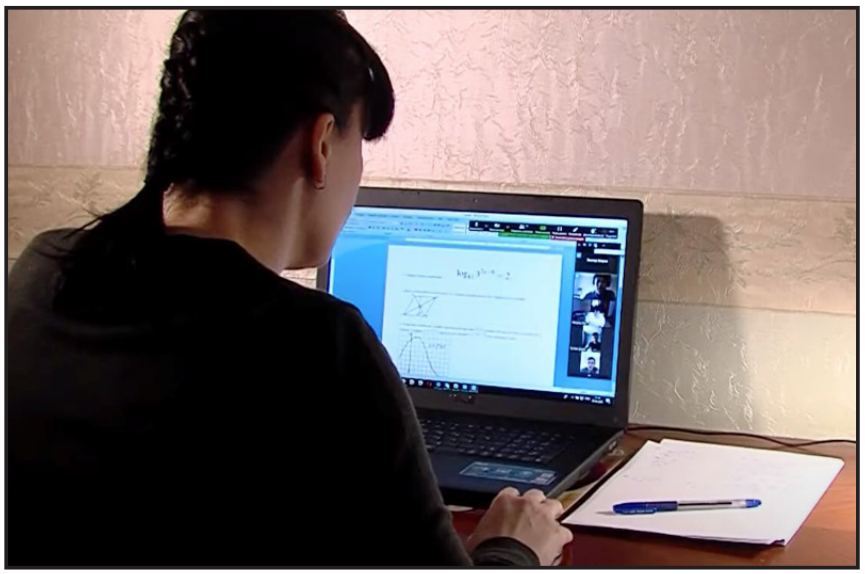

Figure 02 : A mathematics distance lesson during the COVID-19 pandemic in Russia

For some years now, digital payment methods such as credit cards, electronic wallets, smart cards that allow people to pay for goods and services have been popular. The pandemic conditions have caused this trend to accelerate, and for reasons such as fear of touching cash and reducing person-to-person contact, COVID-19 crisis has presented an impetus for the rapid worldwide transition into digital payments. It is important to develop robust identification systems and access to the internet, to enable digital payments. Today, more than three billion people own a smartphone. Smartphone applications allow customers to easily and securely pay and grant access to mobile banking services. Pandemic situation has offered new opportunities to develop contactless systems through innovations in areas such as facial recognition, quick response (QR) codes, block chain technology and near-field communications.

Distant Learning

The COVID-19 crisis has also caused significant disruptions to the provision of education and training. Due to school closures, many children have been forced to learn from home for a prolonged period now. ICT helps to remove barriers in education. Recently, many online learning applications, digital platforms and resources that connect administrators, teachers and students have emerged. Such systems allow documentation, tracking, reporting of student learning activities to create an effective learning environment. There are also Massive Open Online Course (MOOC) platforms that promote distance learning on a wide variety of subjects. Experts have identified Artificial Intelligence (AI) as a tool in education. Coupled with image/ video processing, AI for example, can be used to identify the level of attentiveness of students when learning. Further, AI can be used to deliver personalized education content for individual students by understanding their study habits. Additionally, big data storage technologies and processing techniques are increasingly used to deal with the huge amount of information that online educational systems generate.

Telehealth

Traditionally, telemedicine has concentrated on doctor-patient interactions using audio and video communications. Today, ICT continues to massively transform the extended field of telehealth. ICT-based solutions have allowed hospitals to deliver better healthcare services, training and information dissemination since the beginning of the pandemic. Wireless technologies help doctors, patients, and families of patients to communicate at ease without direct contact. They also allow doctors to extend their consultancy to other under-staffed or heavily loaded hospitals promoting high efficiency. Governments across the world have launched cellular broadcasting services and mobile phone apps to alert the public about infection hotspots, COVID-19 screening centers and broadcast emergency information. Smart phone apps can also perform contact tracing and self-diagnosis of coronavirus symptoms to automate the process of identifying infected people. Internet of Things (IoT) and asset tracking technologies also help to keep a record of location and condition of hospital equipment.

Figure 03 : 3D printed face shield

Visible light communications (VLC) show promise to deliver high speed data rates; operate inside electromagnetic sensitive hospital areas and implement indoor localization systems. For individuals at home, telehealth applications provide a convenient way of accessing comprehensive quality healthcare services. For example, ICT-based solutions will allow patient data to be transferred to hospital servers on a daily basis to run diagnostic tests. Fully automated AI empowered systems will analyze these test results and recommend medication in case of a minor illness or call upon clinicians to analyze the conditions further. Moreover, bio-medical engineering, signal processing and advanced electronics have led to the design and development of implantable sensors that can function inside the human body and transmit data to outside. Real-time health data will facilitate the rapid investigation of situations and attend to emergencies without delays.

Robotics and Drones

The highly infectious nature of the coronavirus has forced robots to be used as contactless alternatives. Robots have been used to decontaminate hospitals and public places with ultraviolet (UV) light. Further, robots work in hospital rooms allow doctors to take measurements from patients remotely. Assistive robots also help to deliver supplies, for example, medicine in hospitals and food to quarantined people in hotels and elder care homes. Research institutions worldwide are continuously developing robots capable of executing complicated tasks with minimal human intervention; remotely taking blood samples, ultrasounds, listening to organ sounds of patients and performing mouth swabs. ICT allows these robots to operate as a swarm to coordinate their activities efficiently. Further, robots can connect with technologies such as cellular or Wi-Fi to transfer data so that medical laboratories can carry out further investigations. Flying robots or popularly known as drones have also been deployed during the pandemic. Drones can deliver test samples to laboratories and monitor crowds to determine whether violations of physical distancing rules occur. Drones can also be fitted with powerful on-board cameras and thermal imaging equipment so that they can zoom in on a person to collect temperature, heart rate information, detect coughing and sneezing etc. They are also useful to sanitize hard to reach surfaces and areas. The limited on-board energy of current drones severely limits their flying times and ability to do advanced processing. However, drones continue to benefit from advances in low-power electronics, and emerging paradigms such as mobile edge computing that enable them to offload computationally heavy tasks to nearby devices and cloud platforms.

Figure 05 : Medical experts holding consultations at a telemedicine center inChina

3D Printing

3D printing is a technology useful to develop new products for the coronavirus pandemic. Students, engineers, and doctors have designed and produced a wide range of 3D printed products such as face shields, ventilator parts, hands-free door openers, wrist attachments etc. Some inventors have uploaded relevant design files into the internet so that anyone in need can freely download and manufacture at a rapid rate. For example, the Prusa face shield (https://www.prusaprinters.org/) takes merely 1 hour and 35 minutes to make and almost 200,000 of them have been donated to medics in the Czech Republic. In countries hit hard by coronavirus infections such as Italy, companies have come forward to print a large number of face masks and other medical components. When it comes to the rapid production of components in need, 3D printing offers new advantages over traditional manufacturing processes. Designers can manufacture, test and customize products in rapid time with 3D printing. Despite the attractive features of 3D printing, there are also complications. Medical equipment should be properly sterilized. However, one of the popular materials used in desktop 3D printing called Polylactic Acid or PLA is unable to withstand the high temperatures used in sterilization. Moreover, as the number of available products

Figure 04 : Ultraviolet disinfection robots

increase, it is important to establish good quality assurance programs that help to build trust among caregivers.

Big Data

Medical big data, advanced analytics combined with AI are imported for fighting the current pandemic. In order to control the transmission of the coronavirus, mass testing should be conducted to identify the positive cases and others who came in close contact with them. Tests produce a wealth of data and big data analytics has the potential to uncover information valuable to the doctors. The Allplex 2019-nCoV Assay, a test developed by the in-vitro diagnostics company, Seegene, Inc. (http://www.seegene.com/) uses a proprietary AI-based big data system. Moreover, contact tracing is an effective tool to rapidly predict the spread of a disease. Once a positive case is discovered, contact tracing technology works backward by using past locations and other information in mobile phones to isolate others who might have been infected, or to forecast the progression of the virus in communities. Tracing becomes accurate when large amounts of data due to multiple sources are merged, and big data analytics is increasingly applied to handle the data processing complexity. On the path to map the virus structure at atomic scale, big data analytics is also a valuable tool for medical researchers across the world. 3D visualization of the virus structure is convenient to understand the function and evolution of the coronavirus as well as to target potential vaccine development.

5G and IoT

5G network deployments continue to grow rapidly across the world since they were switched on in 2019. 5G will connect users and devices at an unprecedented scale and power innovation in the areas such as IoT, AI and virtual reality. 5G will also significantly minimize the end-to-end delays of communication to support new use cases; namely, intelligent transportation, industrial automation, positioning etc. In

Figure 06 : Drone technology is being deployed to monitor crowded places and social distancing

the fight against the pandemic, 5G provides crucial communication support. First, 5G live broadcast services are useful to carry out news delivery related to the pandemic reliably. In China, 5G remote consultation systems have been implemented, so that medical experts can interact with patients without ever entering the isolation wards. 5G communication systems also allow experts to carry out diagnosis of critical patients in rural areas where access to proper medical services are limited. 5G supported unmanned driving technologies can be used for disinfection, cargo transportation and broadcasting pandemic information to the public. Medical robots too can benefit from reliable and low latency 5G links to carryout tasks such as cleaning, delivery of medical equipment, and disinfection.

In conclusion, digital technologies continue to reshape the evolution of every sector in our societies. The outbreak of COVID-19 has given an excellent opportunity to adopt existing and emerging ICT solutions, firstly to fight against the pandemic, and secondly to enable the post COVID socio-economic development. Today, telecommunication operators hold a wealth of customer data in the world. Data science in association with AI will support ICT to develop automated processes that will be efficient and cost-effective when serving the society. There is no doubt that widespread use of ICT comes at the price of key issues such as cyber security, misinformation, and digital divide. All such issues should be addressed through policy development, tailor-made strategies and technological advancements, such that the power of ICT can be harnessed to fight the pandemic, and transform the future society positively.

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Traditional Knowledge and Experiences on Contagious Diseases in Ancient Sri Lanka

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There is substantial indigenous knowledge and experiences in dealing with the spread of contagious diseases in ancient times as evident from archaeological studies. It is also on record that a Chilean woman who had with her a preserved mummy, had died of pneumonia. Historically in a global context, it has been observed that frequent occurrences of the transmission of infectious diseases from person to person had been a matter of worldwide concern. Statistical records show that globally over four hundred thousand people had been killed due to contraction of the dreaded small pox disease. This contagious disease which originated in the 15th Century AD had been seen to re-appear from time to time. The so-called Spanish Fever which appeared for the first time in the 1930's had also been observed to be an epidemic. In Sri Lanka too people had been subjected to epidemics from time to time. In fact the Portuguese conquest of Sri Lanka which resulted in a sense of insecurity, also contributed to this unfortunate situation.

In early 1580, after the arrival of the Portuguese, it is on record that some citizens of Sri Lanka had been infected with small pox. History also records that The King Karaliyadde Bandara and his queen, who was the King of Sri Lanka ruled from Gampola, who had been in the custody of the Portuguese in the Fort of Mannar, had died of small pox.

Subsequently in 1766, by an Agreement with Dutch invaders, the Portuguese were permitted to acquire a considerable extent of the sea front in the Slave Island area, thereby depriving the Sinhala King of the coastal belt.

During this period, combined with the declining economy of the country, the foreign invaders prevented the Kandyan Kingdom of acquiring the salt produced in the country's salterns. In addition, the Dutch invaders brought migrant Indian labour, and settled them along the coastal belt at a time when in several states in South India, the contagious small pox epidemic was prevalent and rapidly spreading. The result of this unfortunate situation was the re-appearance and rapid spread of small pox in Sri Lanka.

By 1796, with the acquisition of some Dutch-owned land areas by the British, large scale transfer and settlement of South Indian labour migrants had taken place. It is also recorded that with the arrival of these migrants, the contagious small pox and cholera diseases had also been introduced to Sri Lanka. Then in 1815, with the fall of the Kingdom of Kandy to the British, the social order of the people also had collapsed with the consequence that both small pox and malaria diseases began to spread rapidly to the rural areas of the country. Unfortunately, these epidemics

which were believed at that time to have been caused by deities or other demon-like evil spirits led to the total isolation of the infected patients. These victims of the dreaded disease, in some instances had been placed in isolated jungle huts as a means of preventing contacts with other people. In current context this is called quarantining and Srilankan people used this method to prevent spreading of infection diseases even in the past.

The Use of Traditional Knowledge in the Occurrence and Prevention of Contagious Diseases

The small pox infection became a problematic issue in 1805. In fact, even King Sri Wickrema Rajasinghe was also known to have been infected with this disease. Nevertheless, the Kings physicians apparently had treated and cured him. During this period a rural indigenous system of medicine was in flourished state, and local physicians with their indigenous knowledge had managed to discover various new herbal medications for the treatment of these so-called "deities illnesses" or infectious diseases. One of these medicines was known as *"Dhivya Rājaguli"*. This medicinal preparation in the form of packs was known to provide protection against infectious diseases when tied to the waist belt of a person. It was also the belief that placing these medicinal packs on top of the door lintel in the house, helps to prevent infection of contagious diseases coming to household. Likewise burying these medicinal packs in the four corners of a hamlet was also believed to prevent the invasion of contagious diseases into the villages.

A local physician by the name Rājaguru Mudiyanse Rālahamy resident in Devinuwara, Matara, had apparently used a knowledge system called "mineral based intelligence" to developed a medicinal preparation called *"Pētha Karosena Guliya"*, and treated persons infected with small pox. These medicinal packs are said to have been intensively experimented, and often included highly toxic ingredients such as mercury, vermillion, arsenic etc., formulated with other appropriate herbal components and finally macerated in bees honey or juice of vishnu kranthi (*Evolvulus alsinoides*). But the most significant feature of this treatment process is that it can also be used for diagnostic purposes.

The triple symptomatic condition (*Thri-dhōsha*) caused by air (wind), bile and phlegm plus external influences are said to result in 9 forms of small pox. Feverishness, dehydration, joint pains, stiff hair, soreness of eyes, headaches, and cold are some of the common symptoms. The effects of air causing body aches, bile causing a smarting sensation and phlegm becoming thick and dry are the causative factors. These symptoms show painful aggravation of the disease. In all cases of small pox, phlegm and bile need to be coughed out, while blood vessels have also to be cleansed, while inducing vomiting. Thereafter, various decoctions are given, followed finally by the administering of the previously mentioned medicinal preparation (*Pētha Karosena Guliya*)

The following are some of the decoctions given to such patients:

1) Drinking of boiled *valmi – Kohomba* mixture.

2) Administration of *Thorasthavalu sunu* with bee's honey and inducing purging of the patient.

3) A decoction made out of *inguru, thippili, Kohomba, dhummella, kottan, coriander,* and *nelli,* given with bee's honey.

It has been claimed that with this treatment regime, it has been possible to treat and cure 8 forms of small pox.

Potential Methods of Challenging Contagious Diseases

According to a reference in an ola-leaf text known as "*Vydiya Chinthamani Bhaiashadjiya Sangrahawa*", the primary cause of the spread of contagious diseases is the unsatisfactory nature in the conduct and behaviour of people, resulting in the occurrence of toxicity in blood. This ola-leaf text is also said to provide a comprehensive account of symptoms of small pox, in addition to the manner or ways in which the spread of the infection occurs.

For instance, if an uninfected person panics on seeing a small pox patient, he will also get naturally infected due to drop of immunity, while a bold person who attends on a small pox patient is not likely to get infected easily. Nevertheless, direct contact, or inhaling the odour emitted by a small pox patient can result in the transmission of the disease.

It is thus evident that even in the current context in the occurrence

of a contagious disease, there seems to exist an ill-omen and demonic fear. It has been postulated, and expected that the inhuman attitude of the World's powerful nations over the last 500 years or so, may cause inbalance in the nature that burst out in different form of adverse effects.

During epidemilogical period ancient people also used spiritual and religious rituals to prevent contigenesis and control of the diseases.

It had been the practice to seek blessings by organizing drumming ceremonious, incantations of charms and the chanting of the *Ratana Suttra Piritha*, to seek the blessings of the Triple Gem.

In ancient times when such a contagious disease is contracted by one individual, it unavoidably spreads rapidly throughout the hamlet, causing the other residents to flee the village, usually under the hidden threat and influence of unworldly evil spirits. In such instances, it has been the practice for the people to organize various ceremonies which include various types of rituals that comprise *Kem* (a secretive spiritual prescription), charms, incantations, propitiatory offerings etc, seeking blessings of tutelary deities. In the meantime, as special measures to help patients to recover from congestion, and in helping them to increase resilience, resistance and immunity through various herbal decoctions eg. *Cungi*, many other rituals are carried out. This traditional treatment regime includes for instance, the releasing of herbal based fumes, followed by recitation of incantations, and in particular, a charm that is said to be recited 108 times. In addition, it was the practice to provide charmed water as a drink, and subsequently, the charm is cast in an ola leaf to which saffron and sandalwood had been included. This charm is then recited 108 times, and finally rolled into a talisman to be tied on to the right hand. It has been claimed that the following charm has the effect of reducing the body temperature as well as the influence of evil spirits.

ඔං නමෝ නරසිංහාය
හිරණ්‍යකසිපෘවයක්ෂස්ථල විධාරණාය
ත්‍රී භුවනව්‍යපකාය භූතං පූත
පිසාචාස්වාසාකිතීකුලොත්මූලනාය
ස්ථමෙහාත්භවාය සමස්ථදෝසාං
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පට් ඨං ඨං ඒහි රුද්‍රඥාපඨස්වාහං
ඔංහ්‍රිංශීංහුංහුංඒට්ස්වාහු ඔංනමං
සිවසිවාය නමං

The above verse describes the manner of causing the reduction of the body temperature as well as the dispelling of the influence of demons (evil spirits) or germs in modern context. There are similarities and dissimilarities between, the current Corona epidemic and Small pox. Nevertheless, a major impact of these contagious diseases is the creation of a fear psychosis in people.

Such efforts which began during the first half of the 19th Century, were obstructed by the British Colonial government. One such action taken by them was to prevent the use of cannabis. In 1798, Edward Genar, by offering cattle small pox (a type of virus in which the virulence had been reduced), had been able to provide an opportunity to increase one's immunity. In 1886, the British Government by an Act on Immunity, arranged to provide all citizens with the so-called Immunity Management Injection. Later in 1949, they introduced the tuberculosis prevention injection; in 1961 the anti-diphtheria injection; in 1962 the gut polio injection; in 1963 provisionally, the BCG injection, etc. Likewise, for measles and Rubella diseases too injections had been provided, thereby demonstrating to the world that Sri Lanka had taken steps to provide all necessary measures to enhance the immunity factor to the people. Experimental work in the United States had led to the development of even gene-based injections. This had led to the belief that American, Chinese and Russian laboratories may have stored or preserved very old micro-organisms for carrying out various scientific investigations. In fact, today it is being openly discussed as to whether the present pandemic Corona virus had its origin in these laboratories. It cannot therefore be ruled out that the failure of the current efforts to enhance the immunity factor with such anti-virus injections had caused global concern.

It has however to be noted that the natural immunity to diseases that exist in the human body is very strong, and there is no doubt that the present day consumption of artificially formulated food is substantially responsible for the loss of our naturally generated immunity.

Indigenous Knowledge – based Mechanisms for the Prevention of the Occurrence of the New Contagious Disease

It is the common view that diseases such as Malaria and Dengue are mosquito-borne ailments. Hence mosquitoes are the vector carriers of these diseases. Accordingly, destroying the breeding places of mosquitoes is the current process of curtailing the spread of the disease. However, there is no way of treating the distressed condition caused by these diseases. The various viruses that appear from time to time in the world are identified by a variety of names. The current Covid named Corona Virus has been identified SARS-COV2-RNA. It spreads rapidly and almost instantly cause coarseness of the throat, and with time the bronchi are invaded, causing the organs to swell. Subsequently the cavities of the lungs get congested thereby causing breathing difficulties.

1) Traditional Methods in the Prevention of Infectious Diseases

1. Providing food that are known to enhance immunity

- Consuming Cungi (*Kola kenda*) prepared with traditional varieties of rice, such as *Heenati, Ael-Sal, Dhahanala,* as well as cungi prepared from specially recommended medicinal herbs, forms a special treatment regime.

- Consuming a *kurakkan*-based paste (*thalapa*) with a curry made of horse grain (*Kollu*).

2. Protection Measures

- Use of pure water, especially well or stream water. Water from such sources are known to have medicinal properties.

- Tying in the hand a paste made by crushing pieces of Asafetida (*Perumkayam*), garlic, *Sasandha*, and *Burella* leaflets.

- Bathing daily with well or stream water.

- Application on the body of a paste prepared by crushing *eth thōra* in lime juice prior to a bath. Applying sesame (gingelly) oil on the body and remaining exposed to sunshine for some time before taking a bath.

- Those infected should be kept in isolation in the residence as well as arranging for inhalation of steam from water treated with citrus juice.

- To make offerings to deities and utilize "*Kem*" (a secretive treatment) methods, together with the recitation of *Rathana Suthra piritha*

3. Medical Treatment

The traditional treatment schedule includes the partaking of herbal decoctions and medicinal pastes as a primary step for the management of the body temperature. This is usually done according to each patient's air, phlegm and bile status, as observed by the physician. If necessary, the physician will promote the necessary medication to induce purging as well as smoking out of any harmful elements by burning appropriate herbal ingredients, as well as arranging for steam inhalation of boiled citrus (5 types) leaves steam. Other treatment regimens may involve the removal of phlegm using medicinal packs lodged in the mouth; washing out the throat and mouth with the use of gingelly oil and finally permitting the munching of betel leaf with a crushed mixture of areca nut, nut meg, seeds of musk mallow (*Hibiscus abelmoschus*) cardamom, yellow myrobalan (Sinh. *Aralu, Terminalia chebula*).

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The Role of Agriculture in Enhancing Food Security During Pandemic Situations

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Introduction

There were five diseases in Sri Lankan history that our ancestors found to be especially frightening. According to *Mahawamsa* written by Mahanama Thero in the 5th Century AD, a disease named '*Rattakkhi*' (red eye) had spread during the reign of King Sirisanghabodhi. The people who saw the red eyes of one another, were frightened and died, believed to have been devoured by the *yakkha* (demon) who created the disease. The deaths were said to have been controlled finally through an agreement between the king and the *yakkha*. Many believed that this disease might had been a deadly mutant strain of *Vibrio cholerae*. The second disease occurred during the construction of Ruwanweli dagaba which was later identified as smallpox (*vasooriya*). The third disease Rabies was known as hydrophobia in old days and in Sinhala as *jala-bheethika*, because victims often show a great aversion to water in the final throes of death. The fourth frightening disease recorded in history was 'Frankish Sickness', which was a skin disease which became quite common place during the British colonial period. Locally it was known as '*Parangileda*' although it did not have any connection with the Portuguese. The fifth one was named as Cometary Malady, an outbreak of an epidemic affecting both man and beast, following the appearance of a fiery comet with three tails on 7th March, 1615. It was believed that a sort of miasma descended over the land, leading to an epidemic of immense proportions that killed man and beast, birds, and fish. Some scientists believed that comets harbour disease-causing microbes, which could be dispersed to earth as they streak across our skies. Irrespective of the source from which those diseases originated, there are some common features among them:

1) The diseases are pandemic outbreaks with a high prevalence of infection that occur over a wide geographic area, generally affecting a significant proportion of the world's population, usually over a period of several months, sometimes occurring in waves.

2) The causal factor is a virus, which could spread fast through air, water or animal or human beings.

3) People with poor immunity were the most vulnerable.

4) The pandemics end up causing food scarcity.

Currently, some 820 million people around the world are experiencing chronic hunger due to insufficient consumption of caloric energy to live normal lives. Of these, 113 million are coping with severe food insecurity, which require immediate external assistance for survival. These people cannot afford any further disruptions to their livelihoods or access to food that COVID-19 might bring.

Vulnerable groups to COVID-19 include small-scale farmers, pastoralists, fishers, and those who might be hindered from working their land, caring for their livestock, or fishing. They will also face challenges in accessing markets to sell their products or buy essential inputs, or suffer due to higher food prices and limited purchasing power. The food supply chain is a complex web that involves producers, consumers, agricultural and fishery inputs, processing and storage, transportation and marketing, etc.

Informal labourers hardly find jobs in the agriculture sector, where they earn from working opportunities during usual agricultural seasons. Currently millions of children are missing their school meals that they had enjoyed earlier, while many of them are with no formal access to social protection, including health insurance.
Role of agriculture in enhancing food security can be viewed as multifaceted. There is an urgent requirement for food management and production of the most essential food within the country, assuming possible restrictions on imports, and ensuring food security among farm families, including planning marketing mechanisms of expected production, are of particular importance.

Food Availability

As the virus spreads and cases mount, and measures are tightened to curb the spread of the virus, there are countless ways in which the food systems at all levels will be tested and strained in the coming weeks and months. Although production of high value commodities (i.e. fruits and vegetables) has already been affected, they are not as yet noticeable because of the lockdown and disruption in the value chain.

We have already observed the challenges of the logistics involved in the movement of food (not being able to move food from point A to point B), and the pandemic's impact on livestock due to reduced access to animal feed, and the reduced capacity of slaughterhouses' (due to logistical constraints and labour shortages) similar to what happened in China.

As a result of these constraints, it is possible to expect to see disruptions in the food supply chains. Interruptions in transport routes can adversely affect fresh food supply chains, and may also result in increased levels of food loss and waste. Fresh fish and aquatic products, which are perishable need to be sold, processed or stored within a specific time limit.

Transport restrictions and quarantine measures can affect the access of farmers' and fishers' to markets, curbing their productive capacities and hindering them from selling their produce. Shortages of labour could also disrupt production and processing of food, especially in labour-intensive industries (e.g. high-value crops, meat and fish).

In order to avoid disruptions in the food supply chain and food production, the following steps need to be adopted:

1) Keep international trade open with utmost care and take measures to protect the food supply chain (ensuring inputs such as seeds, and assisting smallholder farmers to access markets to sell their produce).

2) Focus on the needs of the most vulnerable, and scale up social protection programmes including cash transfers.

3) Keep domestic food supply value chains alive and functioning.

4) Ensure flow of seeds and planting materials to smallholders. Agricultural supply chains should be kept alive by all means, compatible with health safety concerns.

5) Maintain agricultural activities targeting the seasons as usual. Irrigation scheduling has to be maintained properly.

According to Department of Agriculture, the total rice production covering both the *maha* and *yala* seasons, is expected to be sufficient for the next nine months. Total rice production for this season is 2.97 million Mt.

Paddy production in Batticaloa, Mannar and Ampara Districts had been affected in this period. While this is a substantial loss for a number of local communities, it should not have an adverse impact on overall rice production and the surplus prediction

Dry conditions prevailed in January and February across most of the major rice producing areas. This has meant favourable conditions for paddy harvesting and drying activities

Food Distribution

While currently adequate stocks of most essential goods exist access to these is a major challenge. Access to goods is not uniform across the country due to disruption of distribution channels. The sudden imposition of curfew and its continuation has curtailed the movement of people. As a result, long queues occur during the hours the curfew is lifted. Some goods run out of stock quickly as consumers buy in excess of their needs. In response, the government and the private sector are experimenting with new ways of distribution. One new way of distributing food involves local government authorities, and some supermarkets, which provide home delivery service of essential goods at affordable rates. This procedure is also being used by the LPG gas companies for domestic use. Similar initiatives are available for delivery of pharmaceuticals through state-owned pharmaceutical outlets throughout the country. Several private online purchase platforms have emerged recently, and even some of the leading retail chains have expanded their online platforms. Nevertheless, until recently most online platforms were unable to meet the rising demand even for a limited basket of commodities; where arrangements for deliveries occurred within a couple of hours or took a week to deliver goods. Though such services are welcome, they do face logistics challenges and not all the communities have benefited equally. To ensure food security among vulnerable low-income families and farmers who participate in the Farmer Insurance Scheme, an allowance of Rs. 5,000 is provided as an immediate relief measure.

Another state mechanism involves the purchasing of produce directly from farmers (rice excluded) and distributing directly to vendors who in turn distribute to consumers. Several Government of Sri Lanka (GoSL) actions have ensured access to rice staples, as for instance the declaration of rice milling as an essential service, and the maximum retail price for rice becoming a subject for review for affordability.

Coping up with the Situation

As a country dependant on agricultural food production and about 2.1 million households or about 40 percent of the total population is engaged directly in agricultural or livestock farming, we need to consider the following measures immediately to cope up with the situation that has emerged due to COVID-19 outbreak.

1) We should meet the immediate food needs of the vulnerable population.

Ensure that emergency food needs are met; adjust and expand social protection programmes; scale up nutritional support; support management and prevention of undernourishment; adjust school meal programs so as to continue delivering school meals even when schools are closed.

2) The country should boost its social protection programmes

Ensure multiple payments to help families meet their basic needs by providing complementary entitlements to offset loss of income by small-scale producers. For example, if food insecurity becomes extremely severe, exploring the use of food banks could be an option through donations from individuals, solidarity networks, and non-governmental organizations, thus enabling mobile payment systems to prevent disruptions in delivery of cash entitlements due to restrictions on movement, or alternately injecting funds in the agricultural, fisheries and aquaculture sectors. Sri Lanka has already introduced such protective measures to combat the impacts

of the pandemic on people's livelihoods.

3) The country should gain efficiencies and try to reduce trade-related costs

These include, 1) not to impose measures that would restrict trade and mobility of commodities, 2) reduce food waste and loss, 3) resolve logistic bottlenecks, 4) immediately review trade and policy options and their likely impacts, 5) avoid generalized subsidies for food consumers, 6) reduce restrictions on use of stocks, 7) reduce import tariffs when government thinks it is appropriate to minimize, and temporarily reduce Value Added Tax (VAT) and other taxes.

Overall, avoiding any trade restrictions would be beneficial to keep food and feed supplies, as well as those of agricultural and fishery inputs, from worsening local conditions already strained by COVID-19 response measures.

Policy makers must monitor trends and take care to avoid accidentally tightening food-supply conditions, something that China has managed so far with creative and adaptive methods. Digital technologies have a role to play in anticipating problems and smoothing temporary shortages as well as building the resilience of food chains to avoid similar occurrences in the future. New technologies could facilitate the interface between supply and demand, which would be of great value to highly perishable goods (like fruit, vegetables, fish and aquatic products).

Disruptions to food distribution exist in some parts of the country but no food shortage is imminent in the short run; GoSL is working to deliver essential services and carry out essential trade and distribution. Although agriculture supply chains have been disrupted, proposed GoSL actions should ensure resumption of trade for essential goods. As a precaution, to overcome any shortfalls in food imports, plans exist to cultivate essential field crops domestically.

4) Agricultural Production

Regarding agricultural production activities, farmers and fishermen are not subject to the restrictions of the national curfew in carrying out their livelihood. Nevertheless, movement restrictions of consumers have disrupted normal market practices, so prices for commodities have swung high and low in search of equilibrium between supply and intermittent demand. The decision to lock down the major "economic centers", could impact both farmers and consumers. Much of the agricultural production especially vegetables and fruits are collected at the economic centers. GoSL expects to introduce alternative methods of collection and distribution through government channels.

Products exempted from curfew movement restrictions include fertilizer. The Cabinet of Ministers has approved the purchase of chemical fertilizers. The Department of Agriculture is drafting a cropping plan for the minor seasons, with more emphasizes on import-substituting crops. This is a precautionary measure to face possible export restrictions of other countries and to release the pressure on the rupee exchange rate by reducing imports.

5) Crop production progress and prices at present:

1) Other field crops - Cultivation progress is 118,567 ha, which is 68% from the target.

2) Vegetables – Up country vegetable cultivation progress is on 7,374 ha, which is 50% of the target, low country vegetable cultivation progress is 20,886 ha,

which is 59% of the target.
3) The average price of most rice varieties remain considerably lower than during the same period of last year. This can be attributed to surplus stocks produced during the maha seasons of 2019-2020, as well as the government's paddy purchasing program.

4) The prices of grade-I Samba and grade-I Nadu rice have remained constant at Rs.98/ kg as a result of government price control.

During *yala* 2020 season there would be a series of important interventions and adaptation measures that could be taken in the main agro-ecological areas to support food security:

a) Cropping advisories to farmers through agriculture extension services could be institutionalised for the three main agriculture zones;

b) Major reservoirs are showing very good water levels especially in Kurunegala, Ampara, Anuradhapura, Polonnaruwa, Vavuniya and other agriculture related districts. However, water controls and community mechanisms such as "*Bethma*, can be activated (*Bethma* method is the sharing of the limited extents of land by farmers for sharing water in scarce situations)

c) Food accessibility and purchasing power should be monitored through price and labour market data to monitor the impact of the COVID-19 outbreak and its potential consequences.

Home Gardening

People are facing uncertain and difficult times in the face of the COVID-19 pandemic. The benefits of plants (psychological, health, economic, productive) in this period of forced isolation can be of key importance. If many of us have to self-isolate in urban or suburban environments, we need something to do to keep our bodies

and minds active and fed. In such a challenging scenario, a vegetable garden in home spaces can bring recreational, health, economic and environmental benefits. Regardless of the COVID-19 pandemic, there is untapped potential for this kind of gardens to impact environmental outcomes, public awareness, and market trends. Home vegetable gardens could provide a small-scale approach to the sustainable use of natural resources, leading towards self-sufficiency, self-regulation, sustainability, and environmental protection.

The selection of plant species to cultivate in the home garden should be based primarily on their ability to cope up with the harsh conditions of the environment, such as high winds and irradiance, lack of organic material and nutrients, and intermittent drought. Therefore, careful plant selection should be integrated into the plan. Habitats are unique with harsh environments for established plant communities. This is largely because of increased abiotic stresses, such as disturbance, pollution, drought, radiation, heat and microclimate extremes, but also because of the reduction of colonization and modifications in soil microbial diversity. Another additional difficulty is that there is a rush for vegetable seedlings in garden centres, because many people are now wanting to grow their own food. The spread of COVID-19 has caused panic buying at supermarkets, and consequently so many families are skipping the supermarket and heading to their local garden centre to grow their own food and become self-suff1cient.

It is high time to move back to the traditional home gardens where nutritional food items are found, which promote high immunity. People who are with high immunity levels can get cured soon from COVID-19. Fortunately, traditional food types are nutritious and with a high medicinal value and immunity.

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What have you learnt from the Vidurava 2020 Oct - Dec Q_4 Issue? Scan your own memory!

1] Novel Corona Pandemic: Virus, Disease and Prevention

True or False?

1. When an infection that becomes widespread and affects a whole region, a continent or the world due to a susceptible population, it is called a pandemic.

2. Less serious symptoms of this infection are difficulty of breathing or shortness of breath and chest pain.

3. Although any age group is at risk of getting infected by the virus, it is seen that elderly persons as well as those already having non-communicable disease symptoms are at a much higher risk than the relatively young patients.

4. Sri Lanka instituted a strategy of tracing contacts of known cases, testing them and providing prompt treatment.

5. Any pandemic has a beginning, a period of rapid transmission across the globe reaching a peak, and gradually causing an increase of the number of cases

2] Role of Real –Time Reverse Transcription – Polymerase Chain Reaction in the Detection of COVID-19

True or False?

1. SARS-CoV-2 belongs to a sub-family of the Coronaviridae class of viruses which are capable of infecting mammals and birds.

2. The detection of SARS-CoV-2 viral particles is based on the specific amplification of the unique regions of the viral genome.

3. In Real - Time PCR, the amplification process is monitored at the beginning of each cycle.

4. The quantitative end point for Real - Time PCR is not the threshold cycle (Ct).

5. The RT-q PCR assay is characterized by its high sensitivity and specificity.

3] COVID-19 and Personal Protective Equipment

True or False?

1. During the bubonic plague, doctors wore a wide-brimmed hat and a mask with a protruding beak extending from the nose carrying aromatic herbs.

2. The readiness of the Personal Protective Equipment (PPE) for a given task is achieved via completion of a local hazard analysis and risk assessment.

3. The majority of evidence indicate that transmission of the virus through infected droplets cannot be reduced by wearing face masks.

4. Medical gloves are used by healthcare personnel to prevent them from coming into physical contact with the virus.

5. Masks do not induce contact dermatitis as well as contact urticarial due to adhesives, rubber straps, metals in clips and the possibility of free formaldehyde.

4] Vital Role of ICT for COVID – 19 Response

True or False?

1. In the past, working from home was rare, and was confined to special cases.

2. It is important to develop robust identification systems and access to the internet to enable digital payments.

3. Survey polls have revealed that issues such as poor internet connectivity, lack of good quality devices, as well as cyber security have facilitated the ability of employees to work from home.

4. Traditionally, telemedicine has concentrated on doctor – patient interactions using audio and video communications.

5. Contact tracing is an ineffective tool to rapidly predict the spread of a disease.

5 Traditional Knowledge and Experiences in Contagious Diseases in Ancient Sri Lanka

True or False?

1. Victims of the dreaded contagious diseases in some instances had been placed in isolated jungle huts as a means of preventing contacts with other people.

2. *Thri-dhosha* caused by air, bile, and phlegm plus external influences, are said to result in 9 forms of small-pox.

3. According to a reference in an ola leaf text, the primary cause of the spread of contagious diseases is the satisfactory nature in the conduct and behavior of people.

4. The occurrence of phlegm – based viruses appear in the universe as images of ghostly figures.

5. The traditional treatment schedule excludes the partaking of herbal decoctions and medicinal pastes as a primary step for the management of the body temperature.

6] The Role of Agriculture in Enhancing Food Security During Pandemic Situations

True or False?

1. The food supply chain is a complex web that involves producers, consumers, agricultural and fishery inputs, processing and storage, transportation and marketing.

2. Although production of high value commodities has not been affected, they are not as yet noticeable because of the lockdown and disruption in the value chain.

3. Shortages of labour could also disrupt production and processing of food especially in non labour-intensive industries.

4. One new way of distributing food involves local government authorities, and some supermarkets which provide home delivery services of essential goods at affordable rates.

5. Digital technologies have a role to play in anticipating problems and smoothening temporary shortages as well as building the resilience of food chains to avoid similar occurrences.

Answers

01) 1. True, 2. False, 3. True, 4. True, 5. False
02) 1. True, 2. True, 3. False, 4. False, 5. True
03) 1. True, 2. True, 3. False, 4. True, 5. False
04) 1. True, 2. True, 3. False, 4. True, 5. False
05) 1. True, 2. True, 3. False, 4. True, 5. False
06) 1. True, 2. False, 3. False, 4. True, 5. True