SARS -CoV2 : The coronavirus

Corona viruses are RNA viruses as are influenza and measles viruses and consist of a family of viruses with a similar physical structure that looks like a golf ball with many small golf tee spikes projecting out from their surface. The result under a microscope gives the virus particle the appearance of having a halo around it, a corona or “crown”. Hence the name. These spikes are “keys” that cause the virus to attach to human cells that express a surface receptor (or “keyhole”), called “angiotensin- converting enzyme 2”, (ACE-2) receptor. The virus attaches to the cell like a lock and key combination, which allows the virus to inject into the cell it’s RNA and so take over the cell function and reprogram the cell to produce many copies of itself. These ACER-2 receptors are numerous in the lungs and distal part of the small bowel.

The coronavirus family tree is like a tree trunk that has 5-6 major branches coming out from the main stem. In turn, these each branch out furthering multiple smaller branches and twiglets. Worldwide over 200 species of coronaviruses are recognised. One such branch causes 10-15% of the common cold syndromes we experience each year. Another major branch has caused the SARS outbreak (Severe Acute Respiratory Syndrome) the world experienced back in 2003-4.

Another branch causes the MERS (Mid Eastern Respiratory Syndrome) that has smouldered on since 2013 (coming from camels). Corona viruses are known to infect a wide range of animal species such as chickens (causes a respiratory illness); cows, cattle, pigs where they can cause diarrhoea; birds, fish, rodents, molluscs camels and bats. These animal species rarely transmit their infections to humans and when they do they rarely are transmitted human to human. In animals they cause both respiratory infections or diarrhoea. The SARS outbreak in 2003 was unusual where a coronavirus spread from bats as the initial source to an intermediate vector, civet cats, and then to humans where they caused severe pneumonia and a fatality rate of around 10%. The outbreak was severe but brief. MERS comes from camels who were infected from bats, and has grumbled on since 2013 causing severe pneumonia and fatality rate of 30-40% The current virus is an off shoot from the SARS virus stem, and is associated with a fatality rate overall of 2.6 - 4%, depending on population mixes. Virus genetic studies are consistent with the recent emergence of a novel (new) corona virus from an animal reservoir, sharing 96% homology with genetic sequences obtained from studies on the coronaviruses associated with a small bat in a cave in China.

Why Bats? First, from an evolutionary perspective, bats are a very ancient species. They have been shown to asymptomatic virus carries, shedding virus in their faeces. They are long lived, living in large colonies and capable of ranging over wide areas. As such they are very effective spreaders of the virus. Humans and bats share a common cellular receptor for the virus to attach to (ACE-2). Most likely another animal species has acted as a link between bats and humans but that story will only unfold with time.

The current virus is officially called SARS CoV-2, causing a severe pneumonia - like illness called COVID-19 as the coronavirus (CoV) was first isolated and identified in 2019.
Early reports from China linked this emergent new form of pneumonia to a seafood market in Wuhan that also traded in the “wet meat” market of wild animals. Initial studies only found linkage to the market in 46% of cases indicating that right from the start human to

human spreading was occurring. The pattern of illness that has emerged, based on WHO provided information reveals that 82% of infections are mild, 15% are severe (requiring ICU level of care), and 3% are critical. Mortality overall varies from 2.6% to 4%, but has been shown to be age dependant: for those in their 70's fatality rises to 8%, and to 15% for those in their 80"s. One of the reasons that Italy has been so severely effected is that their population >70 yrs is around 38% whereas in NZ we have around 14%.

For children aged 0-9yrs, fatality is <1%, and remains so for 10-19yrs . Up to age 35yrs fatality rate has been consistently nearly zero. Recent figures from an analysis of their first 4226 cases confirms fatality rate is age related with those at highest risk being those over 85 yrs (10-27%), followed by 3-11% for those aged 65-84, 1-3% for persons aged 55-64 yrs, and less than 1% for those aged 20-54 yrs, with no fatalities among persons less than 19yrs age. In particular reports noted " no ICU admissions or deaths were reported among persons aged less than 19 yrs."

In the report from the USA 508 out of 4226 cases required hospital level care for breathlessness, with less than 1% of those under 19yrs age needing hospital care. No ICU admissions were reported from this age group. Clearly, children and young adults cope with this infection very well, but experience from SARS has shown that children are common and easy viral disperses and transmitters. Measures such as social distancing (maintaining a distance of 1-2 metres between persons) is necessary to interrupt transmission.

Children are less likely to adhere to this than adults. **The aim of Public Health is to slow the spread of virus, protect the healthcare system from the danger of overload** which is common when there is widespread community transmission of virus and protect vulnerable older persons and those with impaired immune systems. Patients who require ventilation in ICU are likely to occupy a ventilator for 7-10 days and so overload easily if community outbreak occurs.

Data from multiple sources (China, Europe, USA) show underlying co-morbid conditions common in the elderly account for the increase in mortality that is age related. Among critically ill older persons, co-morbid conditions are seen in 76% of this with severe disease, compared with 37% of those with severe illness but no co-morbid condition.The conditions associated with increased severity of outcome/fatality include Heart failure, Ischaemic heart disease, high blood pressure, cerebrovascular disease (stroke), Diabetes (especially if poorly controlled), chronic obstructive lung disease (COPD or "smoker's lung"), kidney disease, and underlying malignancies.

SYMPTOMS: Fever >38C 83-98%
Cough (mainly dry) 46-82%
Muscle aching, fatigue 11-44%
Breathless 31%
Diarrhoea 8-10%
Increased sputum production in only 12%
Sore throat 5%
Runny nose, chest pain in 1-4%

With the situation we are in currently, at a time that the usual winter coughs and colds start to confound the situation, the onset of an illness with temperature less than 38C

degrees along with sore throat, runny nose and moist cough points towards a winter cold rather than COVID-A9. *If in doubt a medical consult is needed.*

Breathlessness develops in around 55% and is a symptom indicating a need for further medical evaluation. Early on SARS-CoV2 can be detected in nose and throat swabs along with blood and some anal swabs. The latter show increasing positive swabs over time as the throat swab rate falls off. Whether this is infectious virus remains to be sorted out. Current tests are for the presence of the virus coat, but do not indicate the virus is present as an infectious state. Only growing the virus in tissue culture can do this but such tests are expensive and slow. Instead, detection of the coat of the virus can be done quickly and is safe to do in the laboratory, and is the preferred means of testing during an outbreak.

As the illness progresses, multi -organ dysfunction develops with dropping blood pressure, renal failure and liver dysfunction. Death is often due to overwhelming bacterial super-infection.

All evidence points to the predominant mode of transmission as being airborne, like measles, Tb, and chickenpox, along with contact transmission from the hands. SARS-CoV2 can survive hours to several days (2) on hard surfaces such as door handles, possibly longer on plastic table tops and benches, but data in this regard is sketchy and very preliminary testing is done using detection of the virus coat rather that virus culture which is the only way to confirm the virus is infectious rather than dead.

When comparing “infectiousness” of various conditions we look at the “Reproductive rate”(Ro) of the infectious agent. SARS-CoV2 has a Ro of 2.6-3.0, meaning on average each infected person infects a further 2.6-3 persons. For Influenza the Ro is around 1.6 (SARS-CoV2 is clearly much more readily transmitted), while for Smallpox and Chickenpox the Ro is around 5.The Spanish flu of 1918 was 2.0 and managed to claim over 50million lives worldwide.

The time of onset of symptoms after exposure is 2-7 days (mean 5 days). During this time the person is able to spread virus with cough or sneezes, even though they are well. Kissing, sharing drinking vessels, would also likely spread virus while the role of contacts by fingers and hands remains as yet undefined but possible. Coughing spreads the virus by producing an invisible spray of fine moist droplets that can float in the air and if inhaled or come into contact with our mucosal surfaces such as eyes, nose or mouth could transmit the virus. Studies on the common cold have shown we need a radius of space 1-2 metres around the coughing person if this mode of transmission is to be prevented. Hands that have picked up virus and come into contact with the “T” central area of our face (eyes, nose and mouth) will likely also result in virus transmission.

SO——WHAT CAN I DO???

1) **Stay at home**, NO visitors allowed in. Currently the number of cases are doubling every 3 days worldwide and in NZ. Social isolation is a rather blunt Public Health intervention, likely to work only very early on in an outbreak, before community transmission becomes significant. This is the current situation in NZ, and the Governments response has been timely and highly likely to be effective. It is up to US to make it so by adhering to the rules clearly laid down.

2) **Adhere to social distancing rules** if you need to go out. Maintain a gap of 1-2 metres from any other person not living in the same house as you are. In each house only one designated person should go to supermarkets or pharmacies, and then only at least every2-3 days. Practise hand hygiene as soon as the house is entered.

3) **Practice cough etiquette** by coughing or sneezing into a disposable tissue if available or the elbow if not.

4) **Wash hands frequently**, especially before food preparation, eating any food, after going to toilet or playing with pets, and after any contact with persons from outside your home. Experience with infection controlling hospitals has shown that **20secs is necessary to remove contamination organisms**. The R) hand washes the L) hand well, BUT L) hand is not so good with the R). Most of us are R) handed, which is more likely to have come into contact with virus. Areas that studies show are less well covered are a) fingertips and under the nails, b) thumbs, c) web spaces between fingers.

A good rule is to ensure all of these areas are covered 5 times during the hand wash.

PARENTS: DO NOT ASSUME your children wash their hands adequately. Check them daily by timing them. Make this a game and reward efforts. This is the essential defence strategy for your home to practice. Keep monitoring until you are satisfied.

If a family member develops symptoms of COVID-19 infection, isolate them in a single room while seeking medical advice. Masks have a role when a person develops symptoms and hand washing must be intensified after any contacts with the person. If masks cannot be obtained there are patterns available on the internet for making your own cloth masks at home. If possible get the unwell family member to use a dedicated bathroom and /or toilet.

For household/bathroom environmental cleaning the best agent to use is household bleach diluted 1 part in 10 with water. This means putting 1ml of bleach into 9mls of water to make a total of 10mls diluted bleach. Most household bleach is 3-5% hypochlorite so a 1:10 dilution is effective (Janola , Demestos etc). Surfaces should be wiped over with this solution which should be allowed to remain visibly moist for at least 30-60 secs before being wiped over with another damp cloth to remove excess residual bleach solution. The time is important to allow contact with the bleach to damage the virus coat and so kill it. Critical areas such as kitchen benches, dining tabletops, bathroom horizontal surfaces should be treated at least daily. Bleach can cause rusting of metals containing iron, so removal by wiping down with the damp cloth is important. This also prevents skin irritations.

If we adhere to the Public Health precautions widely advocated, we have an excellent chance of limiting the spread of this virus in our society and preventing many deaths. How effective these measures are depends on how compliant we are with Government recommendations. Our Public Health units are doing an excellent job. Prevention yet remains an achievable goal, but only if we all pull together. If this fails we can expect to see our hospitals fail under the huge load they will have to carry. The current situation in Italy remains a stark warning to us all.

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