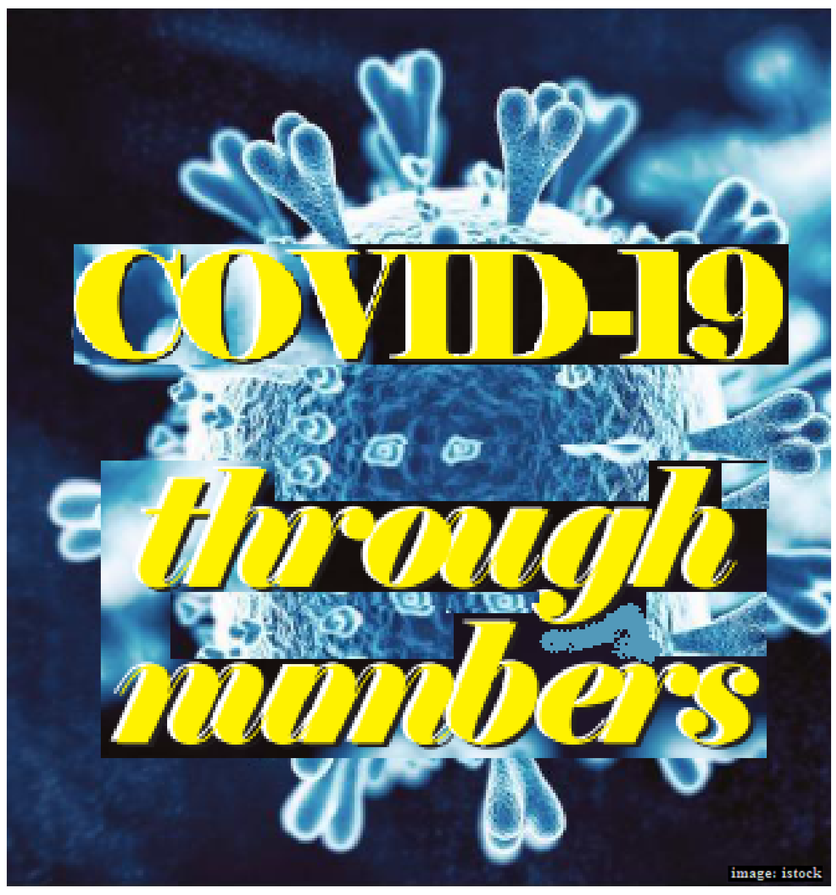

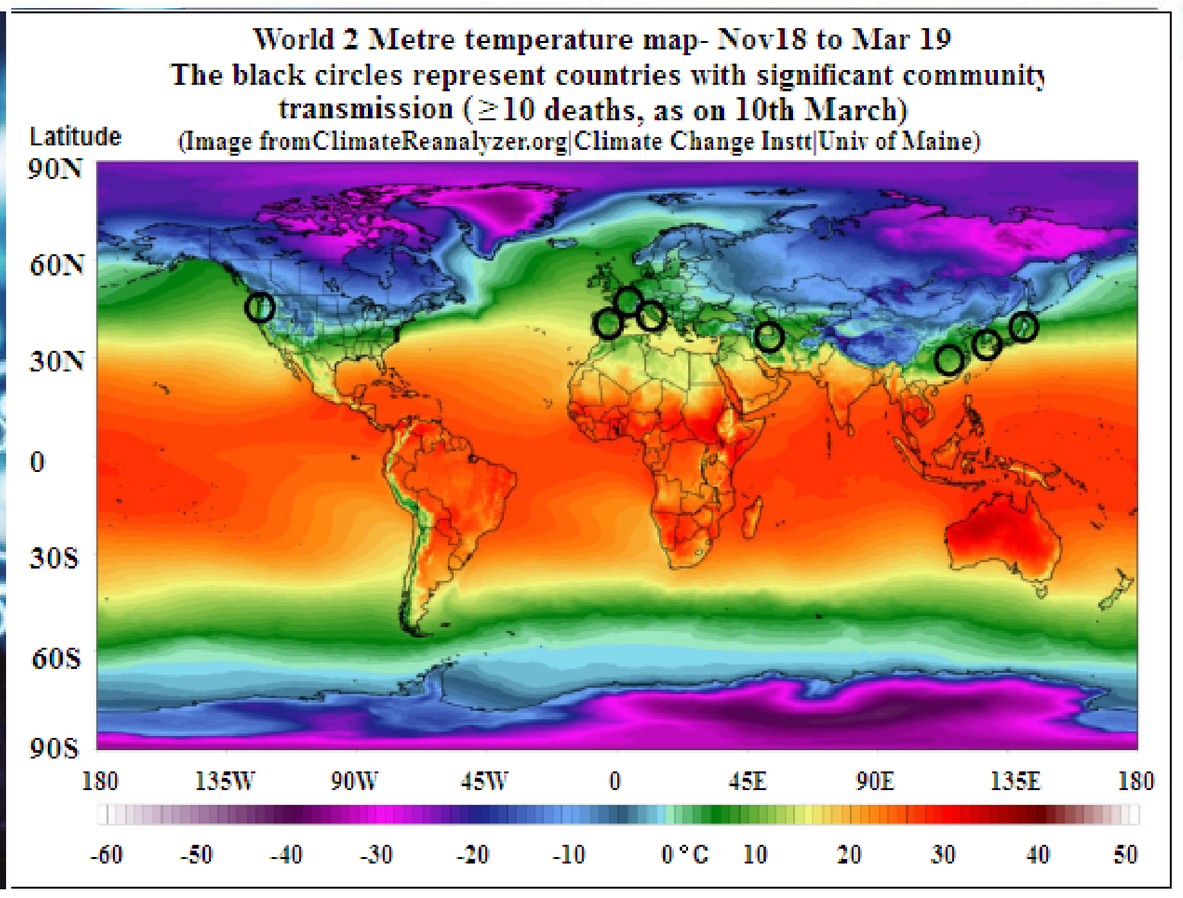

Limiting the spread of an epidemic needs strategic action

S ANANTHANARAYANAN

Administrations around the world have devised ways to control the spread of Covid-19. They have uniformly found isolation, and cutting the transmission chain, to be the only answers.

The growth in the numbers has been described as exponential. When we say a quantity is increasing "exponentially", we mean that the quantity is increasing like a bank deposit with "compound interest" – the increase in the balance becomes greater every year. And this is because the increase is based not on what was deposited, but the balance at the start of each year.

In the case of Covid-19, we are told that each case, while it lasts, would infect some 2.3 other cases, on the average. One case would hence be 2.3 cases at the end of two weeks. Two weeks later, the number would grow to 2.3 x 2.3 = 5.29. And two weeks later, we would have 5.29 x 2.3 = 12. This means one case that we started with has grown to 12 in six weeks. Two weeks later, the number is 28 and in another two weeks, it swells to 148. In the same period that a single case grew to 148, these 148 would grow to 21,915.

We can see that as long as each case infects even just a little more than one other, the numbers can rise very fast. And with even low levels of consequences, like death or need for onerous medical care, large numbers would not be acceptable.

Exponential increase takes place when things multiply by reproduction, like microbes in laboratory culture, or weeds in a pond. And as long as the culture tray, or the pond, has space for expansion, the growth stays exponential. However, when the space available begins to shrink, the population consumes resources and the rate of increase reduces.

In the case of Covid-19, persons who are infected would not reduce the potency of the virus. The rate of spread, however, would still fall, when the infection has progressed, because some of the 2.3 persons who could be infected may be already infected, or have just recovered and are able to resist infection. Exponential growth can be displayed in the form of a picture, where the curve grows increasingly steep, to show the increasing rate of change as the numbers grow higher. But towards the end, the limiting features kick in and the rate of increase falls, and the curve "flattens".

A few years ago, Colin Adams, a professor of mathematics, examined the same question in his book, *Zombies and Calculus*. In place of Covid-19, there was a virus that changed people into zombies – or humans, with all the organs of humans, but devoid of rational thinking, and driven by a compulsion to bite and infect other humans. These other humans then turn into zombies and go out to infect more humans.

The action is in a small liberal arts college in Massachusetts, where zombies are at large, and a professor of mathematics guides the community to survive and overcome the attack. While the book brings in many features of mathematics to help in the struggle, a significant point it makes is that as more humans are infected and the number of zombies increases, there are less targets the zombies can hit and the rate of spread must fall. The book resolves the problem with the zombies being limited to one area of the Earth, while normal humans occupy another area effectively with the zombie population being excluded from society.

In the case of Covid-19, unlike zombies, infected persons do not continue to be infective and sources of infection are those that were recently infected. Nevertheless, as this number keeps increasing, there have been estimates that at current rates, just millions of people would need to be infected before the curve begins to flatten. In any case, if the current rates persist, nearly such numbers are expected to be reached by July, when, possibly, there would be some relief because the weather in the northern hemisphere is warmer.

If there is, in fact, inactivity of transmission during a few months of warm weather, we could expect that the virus itself would not survive, and hence would not resume when the weather cools. But even if this were to come about, the numbers that are being projected, and hence the number of fatalities, are much higher than countries in the world are considering.

One reason that such large numbers may not come about is that the factor of 2.3, which is the rate at which an infected person infects others, can be effectively controlled. It is the change of this factor that is now being pursued, through measures of isolation, quarantine of those who are or may be infected, shut-down of establishments or occasions where people congregate, limiting travel and ensuring hygiene and measures like washing hands. If the factor of 2.3 is brought down to less than one, the number of infected persons would begin to fall, and the fall could be made faster by further reduction of the factor.

The problem, of course, is to know the real numbers. On one hand, China, with strictly enforced disciplines, mass testing and widening the criteria of being considered infected, even at the cost of inflating the cases reported, has brought the numbers under control.

In India, on the other hand, there is limited testing and the low numbers of infected persons that are being reported are considered to be unrealistic. The tests were done only on persons who had returned from specified countries and those who are known to have been in contact with them, in cases where they show symptoms. This would not indicate presence of the infection in the country or the progression due to communication by infected persons to others.

The Indian Council for Medical Research says we have the capacity to do 10,000 tests a day, but had only done some 17,000 tests, with the 433 positives (as on 23 March evening). Why did we not expand the range of those who are tested? The ICMR says this is because 500 tests on persons with respiratory disease, but no record of exposure to Covid-19, resulted in no positives.

Dr Ramanan Lakshminarayan, director of The Center for Disease Dynamics, Washington and a lecturer at Princeton University, said in an interview that the assumption is almost definitely incorrect. He believes the virus is in the community and estimates 300-500 million cases in India by July this year. He recommends an immediate, national shutdown for two weeks. More testing has started, many places have locked down and it may be national by the time this article appears.

On the more hopeful side, one reason why the presence of the virus in the community may not be as high as feared is that Indians, for all the crowding and population, have less mobility than people in Europe or in the US.

On another note of hope, is a paper by Mohammad M Sajadi, Parham Habibzadeh, Augustin Vintzileos, Shervin Shokouhi, Fernando Miralles-Wilhelm and Anthony Amoroso, from Maryland, Baltimore, Arlington (Texas) and Iran. The team analyses the temperature, humidity and latitude at places where Covid-19 has significant community presence, and finds that these places lie along a narrow belt, the green belt in the picture, that stretches from Japan to the State of Washington in the US. During the months to come, the susceptible belt, with temperature of five-10°C, would move northward, or further away from the Indian subcontinent.

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Reducing contamination

Here's how to clean your house to prevent the spread of coronavirus and other infections

BRETT MITCHELL

As the coronavirus pandemic spreads across the world, it's a good time to understand how cleaning can help prevent the spread of disease and what you can do to cut the risk of infection in your home.

Coronavirus is mainly transmitted from person to person via tiny droplets of saliva or other bodily fluids that float in the air after a cough or sneeze. Contaminated objects and surfaces can also be important in the transmission of disease. It's not entirely clear what role they play in transmitting the new coronavirus, but they play an important one for related viruses such as Sars and Mers.

However, it makes sense that something contaminated with the virus could pass it on, for example if a person touches it and then touches their nose, mouth or face.

So, if someone at risk of having the virus has been in your home, cleaning to reduce the amount of contamination on surfaces may help cut down your risk of further transmission of coronavirus. (It will also cut the risk of transmitting other pathogens.)

What's the difference between cleaning and disinfection?

There's a useful to distinction to make between cleaning and disinfection. Cleaning means physically removing organic matter such as germs and dirt from surfaces. Disinfection means using chemicals to kill germs on surfaces. Cleaning is very important, because organic matter may inhibit or reduce the disinfectant's ability to kill germs.

How long will coronavirus survive in my house?

We are not exactly sure how long this coronavirus will survive on surfaces. If it is similar to other coronaviruses, it could survive a few hours - potentially up to several days. How long it survives could depend on temperature, humidity and what the surface is made of.

What could be contaminated in my house?

It's hard to say exactly. When someone coughs or sneezes, especially if they don't cover their mouth, it is likely surfaces close to them will be contaminated.

Hands are often responsible for transferring pathogens from one place to another, so items that people often touch are at greatest risk of being contaminated.

Frequently touched items may include TV remotes, fridge doors, kitchen cupboards, kitchen surfaces, taps and door handles. And of course, there are devices such as phones and iPads -- but these may not be shared or touched by others frequently.

What should I use to clean and how?

The coronavirus is a delicate structure and it is vulnerable in the environment. Both heat and detergents, including soap, can stop it functioning.

Contaminated surfaces:

If a surface becomes contaminated or you think it could be, cleaning it with a common household disinfectant will kill the virus. Remember to wash your hands after cleaning (or use an alcohol-based hand sanitiser) and avoid touching your eyes, mouth or nose. There are many options for what to use to clean, including paper towels, cloths or disposable wipes.

How you clean is important. You don't want to "recontaminate" surfaces while cleaning. Working from one side of a surface to the other helps with this, using an "S" shape to clean.

If you are reusing a cloth, remember to wash it afterwards and let it dry. Laundering cloths in the washing machine with normal washing liquid is also likely to kill the virus, particularly on a hot wash.

Dishes and cutlery:

Washing with hot water and detergent is fine for dishes and cutlery. A dishwasher is even better, because it can use hotter water than your hands will tolerate.

Clothing and linen:

Use the warmest setting possible to wash contaminated laundry and make sure you allow it to dry completely. You may not want to ruin clothing or other materials, so always look at the manufacturer's instructions. Laundry from someone who is sick can be washed with other people's items. If you are handling contaminated items such as towel or sheets, avoid shaking them before washing, to reduce the risk of contaminating other surfaces.

And remember to wash your hands immediately after touching any contaminated laundry.

PREVENTION IS BEST

Remember that surfaces play a role in transmitting pathogens, so preventing them from becoming contaminated in the first place is as important as cleaning. There are some things you can do to reduce the amount of contamination of surfaces in your house:

- cover your cough and sneezes, ideally with a tissue but otherwise into your elbow, and wash your hands immediately
- wash your hands often, especially after going to the bathroom and before eating.

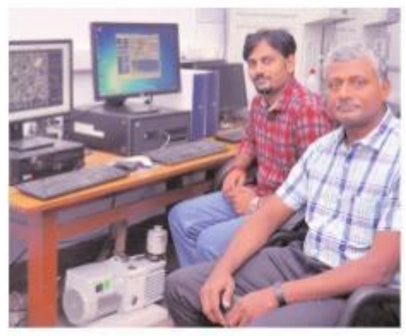
What do I do if someone in my home is sick?

It may be wise to think about which room in your home could be used to care for a sick member of your family. If possible, the ideal room is one that that is separate from other parts of your home and has a separate bathroom. Cleaning this room when someone is sick also requires some thought. Further advice on caring for someone with coronavirus at home is available online from the health department.

The writer is professor of nursing, University of Newcastle, Australia. This article first appeared on www.theconversation.com

PLUS POINTS

Eco - friendly concrete



Researchers at the Indian Institute of Technology Madras have provided clarity on the link between microstructural development and durability performance of concrete through their investigation on concrete with ternary blended (three component) cements, which will help the construction industry to produce more eco-friendly concrete than available now.

Concrete is the most widely used construction material in the world -- seven cubic kilometres of concrete are manufactured each year, which works to one cubic metre of concrete for every human on Earth.

Modern concrete includes chemical and mineral additives that impart unique properties. It is common today to find the cement in it to be a mixture of two or three different ingredients. The current research study deals with the exploration of properties of a three-component cement. The study unravels the complex nature of interactions of this three-component system involving ordinary cement, limestone powder and calcined clay, called LC3, which leads to the production of highly durable concrete in aggressive environments such as sea water.

The researchers adopted a fundamental approach based on cement chemistry and identified the chemical composition of the blended cement system as a critical factor in the development of nanoscale pore structure, which is the key to concrete durability. The evolution of pore structure decides the permeability of concrete to water and aggressive chemicals – the finer the pore structure, the lesser the permeability. Ternary blended systems such as LC3 impart a finer pore structure to concrete at early ages, which is not possible with plain cement or even fly ash blended cement. Further, the unique reaction chemistry of the three components in LC3 results in a complex arrangement of cement reaction products, which make the concrete microstructure denser and helps to attain strength and durability at an early age.

The research has been published recently in the peer-reviewed journal Cement and Concrete Research. The paper has been co-authored by Yuvaraj Dhandapani, PhD candidate, IIT Madras, and professor Manu Santhanam, head, department of civil engineering, IIT Madras.

Starry secrets

Scientists from the University of Sheffield in the UK have discovered a pulsating ancient star in a double star system, which will allow them to access important information on the history of how stars like our Sun evolve and eventually die.

An eclipsing binary, or double star system, is made up of two stars orbiting each other and periodically passing in front of each other as seen from the Earth. White dwarf stars are the burnt out cores left behind when a star like the Sun dies. This particular white dwarf could provide key insights into the structure, evolution and death of these stars for the first time.

Most white dwarfs are thought to be made primarily of carbon and oxygen, but this particular white dwarf is made mostly of helium. The team think this is a result of its binary companion cutting off its evolution early, before it got a chance to fuse the helium into carbon and oxygen.

The pulsations from this star were discovered using Hipercam, a revolutionary high-speed camera, which can take one picture every millisecond simultaneously in five different colours and is mounted on the 10.4m Gran Telescopio Canarias, the world's largest optical telescope on La Palma, Spain.

Steven Parsons, from the University's department of physics and astronomy, who led the study, said, "Determining what a white dwarf is made of is not straightforward because these objects have about half of the mass of the Sun, packed into something about the size of the Earth. The gravity causes all of the heavy elements in the white dwarf to sink to the centre, leaving only the lightest elements at the surface and so the true composition of it remains hidden underneath."