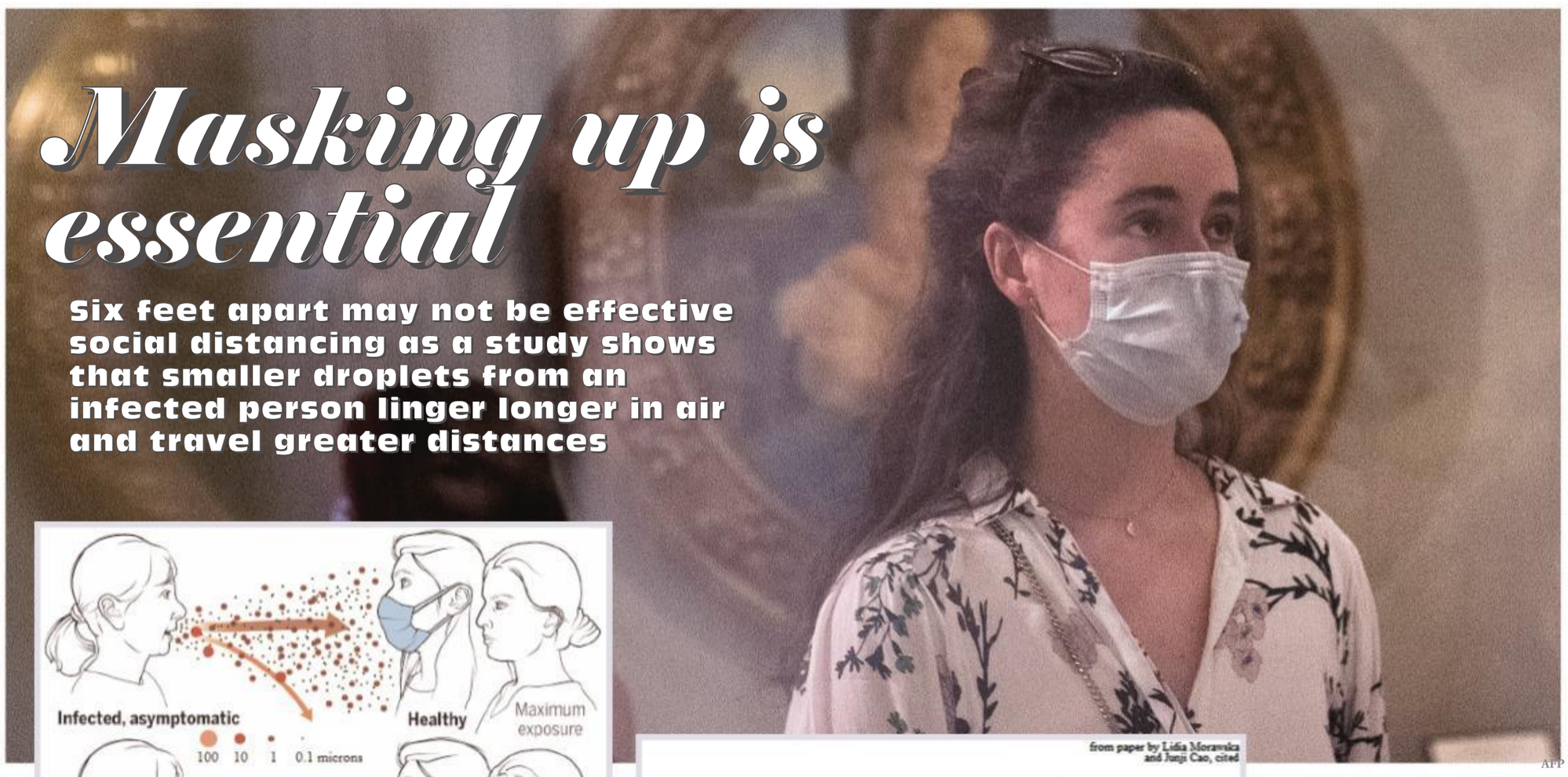
Masking up is essential

Six feet apart may not be effective social distancing as a study shows that smaller droplets from an infected person linger longer in air and travel greater distances



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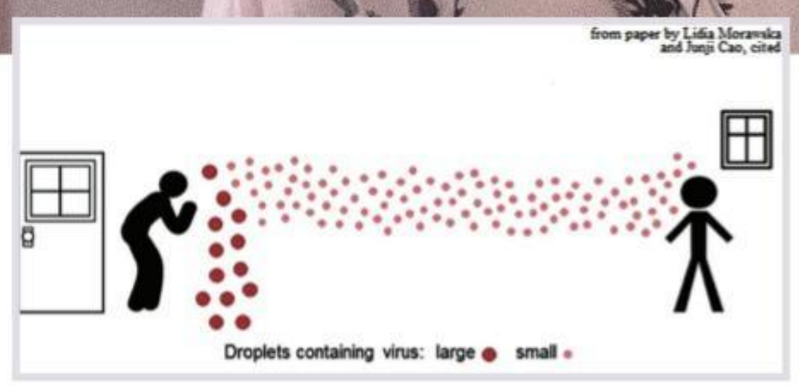


S ANANTHANARAYANAN

Lockdown, in the context of Covid-19, serves a purpose of letting communities get organised. As means of control, however, it is wasteful, as the contact it prevents is mainly between healthy people. The more efficient way is to identify and isolate infected persons.

As the more efficient way has proved out of reach, the fallback is to ensure distance and protection, so that there are barriers to prevent the spread of disease, but allow society to function. The economic and personal costs of lockdown are hence inducing states and communities to relax restrictions and permit a level of commercial activity, albeit with safeguards. Kimberly A Prather, Chia C Wang and Robert T Schooley from the Scripps Institute of Oceanography and the School of Medicine, University of California at San Diego, and the department of Chemistry and the Aerosol Science Research Centre, Sun Yat-sen University, Taiwan, explain in the journal, *Science*, recent findings of how Covid-19 spreads and the extent of precautions that are needed when communities and cities get back to work.

Respiratory infection, the paper says, happens when virus-containing droplets, exhaled when infected persons cough or sneeze, or smaller droplets when they breathe or speak, are transmitted. And the manner of causing infection depends on the droplets' size, the paper says. The larger droplets are five to 10 microns in size, and smaller droplets are suspended in the air, in the form of an aerosol (or a solution in the air). Humans produce respiratory droplets that range from 0.1 micron to a millimetre in size. Droplets larger than five microns stay as droplets, the paper says, because they fall to the ground or other surface before they evaporate. These are the droplets that deposit viruses on different surfaces, where the virus may remain for hours or days. Droplets that are smaller than five microns evaporate, and the viruses they contain stay suspended in the air, as an aerosol. And these particles can stay airborne for hours. While the traditional method of preventing the spread of respiratory diseases has been to contain transmission by larger droplets, the paper cites studies that say much of the transmission of Covid-19 has been through aerosols produced by individuals who may have been asymptomatic. The contact tracing exercises, performed by listing persons who came into "close contact" with one who develops the disease, hence often fail to establish a source (although it alerts those contacts) and it is apparent that many infections were acquired from longer distances, one of the cited studies says.

"In addition to contributing to the extent of dispersal and mode of transmission, the size of respiratory droplets has been shown to affect the severity of disease," the paper says. The influenza virus, when carried in aerosols of less than a micron, is known to cause more severe infection. In Covid-19, the paper says, it is possible that the smallest aerosols reach the deepest parts of the lungs, temporarily bypassing immune responses. The Covid-19 virus, which multiplies three times faster than the SARS virus, can then spread to the pharynx, from where it would enter the environment, when the patient breathes, speaks or laughs – all before the immune system gets active and symptoms begin to show. The paper cites a study, which says undiagnosed cases of Covid-19 infection, with "mild, limited or no symptoms", were responsible for up to 79 per cent of viral infections in Wuhan!

But severity of the disease apart, what current studies of the role of aerosols underline is that transmission through air is a potent route for infection. Much attention so far has been, and correctly, on washing hands, not touching the mouth, nose or eyes and not shaking hands when we meet. And we have been warned to take care of surfaces, particularly metal surfaces, which are called *fomites*, where the virus can live for hours or days. Current studies, however, show that asymptomatic persons, though they do not cough or sneeze, can admittedly be highly infective, passing infection through their breath.

The World Health Organisation guidelines of six feet distancing and hand washing, the paper says, are based on studies which were carried out on respiratory droplets in the 1930s. These studies showed that droplets around 100 microns in size, in coughs and sneezes, quickly fell to the ground. The technology available did not permit study of aerosols. Now we know that a large droplet settles in four to five seconds, but a one micron particle stays airborne for over 12 hours. We also know that coughs and sneezes can deposit droplets 20 feet away and create thousands of aerosols that travel much further. The evidence shows, the paper says, that the six feet prescription may be inadequate in closed spaces, where aerosols accumulate, and drift.

How virus aerosols behave outdoors has not been studied, the paper says. While they would be transported by air movements, they would also be diluted, and sunlight, warmth and humidity may affect them. In polluted environments, viruses could attach to particles, such as of dust, which would keep them for longer in the air and help them spread. There are no studies of how fast viruses lose infectivity, but cases of Covid-19 have been found to be more severe in polluted areas, the paper says.

In enclosed spaces, however, it is clear that the viral load in the air, if there is an asymptomatic person in the room, increases every minute. Much ventilation is thus paramount and then, air-conditioning, which recycles the air, is a true step-in-aid to spreading infection. It is indoors where a well-fitting mask is important, the paper says, and being more than six feet away from another person is not good enough.

"Airborne spread from undiagnosed infections will continuously undermine the effectiveness of even the most vigorous testing, tracing, and social distancing programmes," the paper says. It was this realisation that spurred the WHO to recommend universal use of face masks. Countries that have been most effective in reducing the spread of Covid-19, including Taiwan, Hong Kong, Singapore and South Korea, have implemented universal masking, the paper says. And the paper cites a formal study that shows home-made masks with multiple layers and proper fitting can provide good protection from aerosols.

The high incidence of Covid-19 spread by asymptomatic persons and through aerosols calls into question both the value of testing only persons who show symptoms as well as measures of distancing, when lockdown restrictions are relaxed. The realisation, however, does not reduce the danger from *fomites*, and the need to wash, and not touch. What it adds is the importance of masking and being aware. The last line in our communications is often, "be safe". What would be more practical is to say, "be alert".

The writer can be contacted at response@simplescience.in

Levels of DNA wrapping

Nucleosomes are packed together to form chromatin fibers and chromosomes

TAPAN KUMAR MAITRA

The formation of nucleosomes is only the first step in the packaging of nuclear DNA. Isolated chromatin fibers exhibiting the "beads-on-a-string" appearance measure about 10 nanometre in diameter, but the chromatin of intact cells often forms a slightly thicker fiber about 30 nm in thickness called the 30-nm chromatin fiber. In preparations of isolated chromatin, the 10-nm and 30-nm forms of the chromatin fiber can be interconverted by changing the salt concentration of the solution. However, the 30-nm fiber does not form in chromatin preparations whose histone H1 molecules have been removed, suggesting that histone H1 facilitates the packing of nucleosomes into the 30-nm fiber.

Several models have been proposed to explain how individual nucleosomes are packed together to form a 30-nm fiber. Most early models postulated that the chain of nucleosomes is twisted upon itself to form some type of coiled structure. However, recent studies suggest that the struc-ture of the 30-nm fiber is much less uniform than a coiled model suggests. Instead, the nucleosomes of the 30-nm fiber seem to be packed together to form an irregular, three-dimensional zigzag structure that can interdigitate with its neighbouring fibers.

The next level of chromatin packaging is the folding of the 30-nm fibers into looped domains averaging 50,000-100,000 bp in length. This looped arrangement is maintained by the periodic attachment of DNA to an insoluble network of nonhistone proteins, which form a chromosomal scaffold to which the long loops of DNA are attached. The looped domains can be most clearly seen in electron micrographs of chromosomes isolated from dividing cells and treated to remove all the histones and most of the nonhistone proteins.

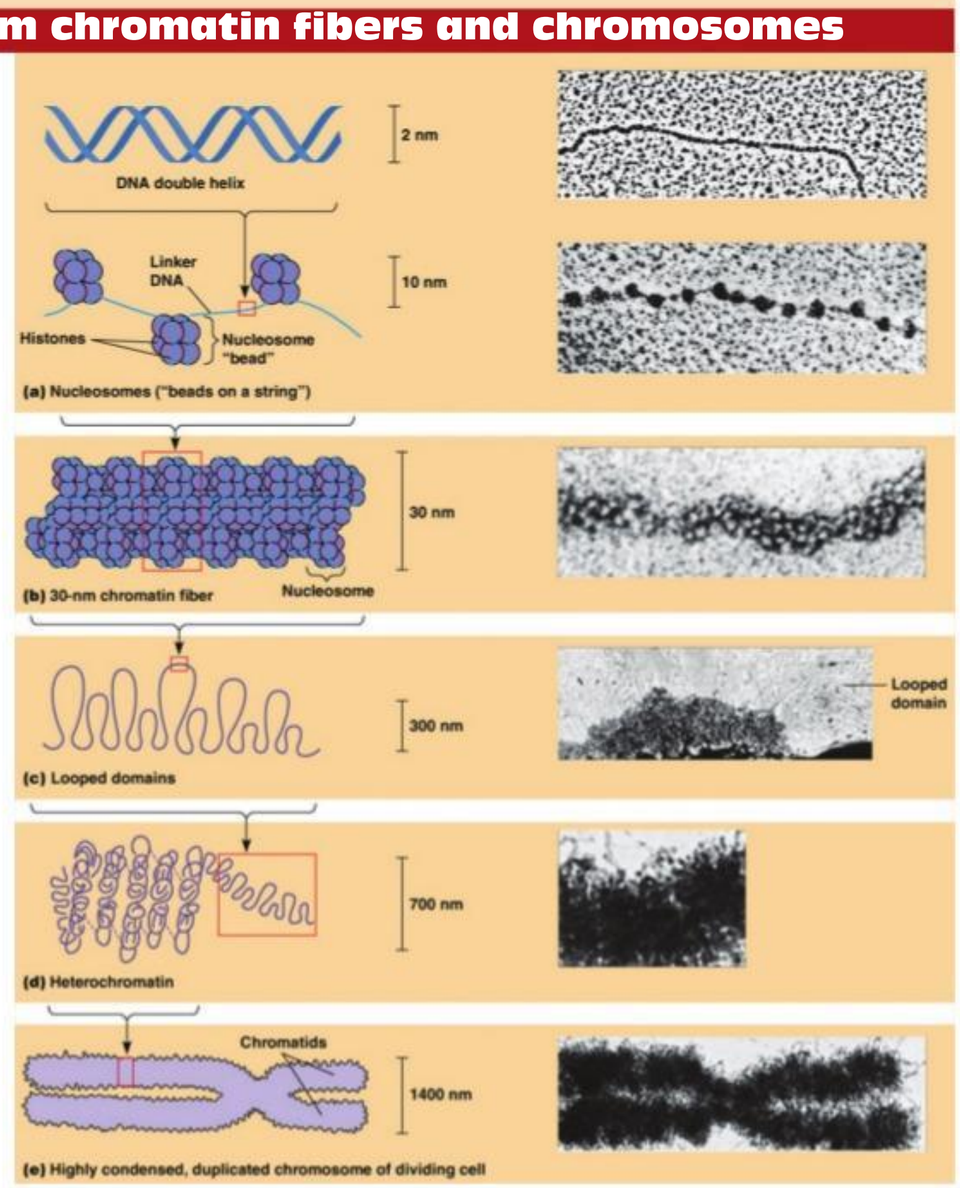
Loops can also be seen in specialised types of chromo-somes that are not associated with the process of cell division. In these cases, the chromatin loops turn out to contain "active" regions of DNA – that is, DNA that is being transcribed. It makes sense that active DNA would be less tightly packed than inactive DNA because it would allow easier access by proteins involved in gene transcription. Even in cells, where genes are being actively tran-scribed, significant amounts of chromatin may be further compacted. The degree of folding in such cells varies over a continuum. Segments of chromatin so highly compacted that they show up as dark spots in micrographs are called heterochromatin, whereas the more loosely packed, diffuse form of chromatin is called euchromatin. The tightly packed heterochromatin contains DNA that is transcriptionally inactive, while the more loosely packed euchromatin is associated with DNA that is being actively transcribed.

Much of the chromatin in metabolically active cells is loosely packed as euchromatin, but as a cell prepares to divide, all of its chromatin becomes highly compacted, generating a group of microscopically distinguishable chromosomes. Because the chromosomal DNA has been recently duplicated, each chromosome is composed of two duplicate units called chromatids.

The extent to which a DNA molecule has been folded in chromatin and chromosomes can be quantified using the DNA packing ratio, which is calculated by determin-ing the total extended length of a DNA molecule and dividing it by the length of the chromatin fiber or chromo-some into which it has been packaged. The initial coiling of the DNA around the histone cores of the nucleosomes re-duces the length by a factor of about seven, and formation of the 30-nm fiber results in a further six-fold condensa-tion. The packing ratio of the 30-nm fiber is therefore about 7x6 = 42. Further folding and coiling brings the overall packing ratio of typical euchromatin to about 750.

For heterochromatin and the chromosomes of dividing cells, the packing ratio is still higher. At the time of cell division, for example, a typical human chromosome mea-sures about 4-5 mm in length, yet contains a DNA mole-cule that would measure almost 75 mm if completely extended. The packing ratio for such a chromosome there-fore falls in the range of 15,000-20,000.

The writer is associate professor and head, department of botany, Ananda Mohan College, Kolkata



PLUS POINTS

Before it disappears

Oxford University scientists working on a coronavirus vaccine have said it may only have a 50 per cent chance of success.

Project leader Professor Adrian Hill, of the university's Jenner Institute, said the realisation of a working vaccine was far from guaranteed and cautioned against "over promising", in an interview with *The Sunday Telegraph*. But the warning has not deterred pharmaceutical giant AstraZeneca, which announced a $1.2bn deal to produce 400 million doses of the vaccine first created in Professor Hill's Oxford lab.

Pascal Soriot, the chief executive of the drug company, told *The Andrew Marr Show* on Sunday that British people would be among the first to gain access to the vaccine, which could be ready by September. Soriot said, "Yes, we have actually received an order from the British government to supply 100 million doses of vaccine, and those will go to the British people.

"And there's no doubt, starting in September, we will start delivering these doses of vaccine to the British government for vaccination."

But Soriot said the vaccine being rolled out in autumn would still depended on two factors – firstly that the drug works, and secondly that there remains a sizeable proportion of the population in the country with Covid-19 – otherwise it will be difficult to demonstrate the efficacy of the inoculation.

He said, "The vaccine has to work and that's one question, and the other question is, even if it works, we have to be able to demonstrate it. We have to run as fast as possible before the disease disappears so we can demonstrate that the vaccine is effective."

The Jenner Institute and the Oxford Vaccine Group began development on a vaccine in January, using a virus taken from chimpanzees. Following an initial phase of testing on 160 healthy volunteers between 18 and 55, the study is now set to progress to phases two and three, which involve increasing the testing to up to 10,260 people and expanding the age range of volunteers to include children and the elderly.

Professor Hill told *The Sunday Telegraph* that if the virus's spread was too low, not enough of the volunteers will catch it and the trial will be unable to definitively say if the vaccine works. "It's a race against the virus disappearing, and against time," Professor Hill said. "We said earlier in the year that there was an 80 per cent chance of developing an effective vaccine by September. But at the moment, there's a 50 per cent chance that we get no result at all.

"We're in the bizarre position of wanting Covid to stay, at least for a little while."

– The independent

'Frozen' lighting

A thunderstorm was captured in a time-lapse photograph in Singapore last week. Paul Lee, 41, used the long-exposure mode on his camera – a setting typically used to show the effect of passing time – to capture the footage of the brewing thunderstorm over the course of an hour. Upon witnessing the first flashes of lightning, he set up his camera on the tripod and triggered its shutter button. By 9.45pm, the results were astounding.

Multiple fiery strokes of lightning and a sky set ablaze – all captured within a single frame. "The sky has been amazingly clear this circuit breaker. Usually it's a little hazy and the lightning strikes are less clear," said Lee, who has a penchant for nature and wildlife photography. The business manager has been dabbling in lightning photography for more than a year now and he considers this photograph to be one of his more successful shots.

Singapore has been named a "lightning capital" for having one of the highest occurrences of lightning activity in the world. According to the National Environment Agency's Meteorological Service Singapore, the country experiences about 185 lightning days and 167 thunderstorm days a year.

–The straits times/ann