Novel coronavirus epidemic: new dimension for disaster management and health resilience

The novel coronavirus (COVID-19) is a new strain of pre-existing coronaviruses that caused the recent pandemic. Coronaviruses are also known to cause diseases like Middle East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS) in humans. The 2019 coronavirus outbreak that originated from Wuhan, China has killed 1018 people globally and infected more than 40,000 people as on 11 February 2020 (ref. 1). It has been declared as a Public Health Emergency of International Concern (PHEIC) by World Health Organization (WHO). COVID-19 is a zoonotic virus, that is, it is transmitted from animals to humans and causes disease. Although the animal source of COVID-19 has not yet been confirmed, it is likely to have originated from a wet market in China. The common signs of infection range from mild respiratory symptoms to severe pneumonia or even death. The disease can be transmitted from person to person via respiratory droplets from an infected person while sneezing, coughing or talking. The current estimates of the incubation period for the disease range from 2 to 14 days[2].

COVID-19 has affected almost 28 countries till now, although China continues to remain the epicentre of the disease. Three confirmed cases have also been recorded in Kerala, India; all in students returning from Wuhan University in China. According to a new model developed by Humboldt University and Robert Koch Institute in Germany, India ranks 17th on the global import risk for coronavirus[3]. The Indira Gandhi International Airport, New Delhi is at high risk for corona transmission followed by Mumbai and Kolkata respectively.

In the recent years, a significant rise in epidemics of emerging and re-emerging infectious diseases has been seen worldwide[4]. In India, there has been an accelerated spread of viral diseases like swine flu, avian flu, chikungunya, nipah virus, zika virus, etc. (Table 1).

The emergence of these new diseases may be attributed to complex phenomena such as the rise in local and international mobility, accelerating climate change and the emergence of new viruses. Regular training programmes on healthcare safety and disaster management, safe biomedical waste disposal, infection control, periodic hospital inventory checks, etc. are essential to increase the resilience of the healthcare system. This becomes more pertinent now as the number of disasters is rising and their health effects, including outbreaks are becoming more complex.

The need to plan for infectious disease outbreaks, whether naturally occurring or caused by bioterrorism, is essential now more than ever. Any such outbreak constitutes a threat to national and international security, with the potential to cause a health disaster. Legal frameworks and protocols need to be developed and adapted to handle emergency situations. This can delineate the scope of the healthcare providers and the Government's responses to public health emergencies.

The Government of India has recently added a new mission on health to the National Action Plan on Climate Change under which the National Health Adaptation Plan is being developed. As infectious disease outbreaks are becoming a regular phenomenon in India, these health emergencies must be addressed in

Table 1. Major viral disease outbreaks in India

Viral disease	Year (month) identified	First observed case in an Indian state	Carrier	Fatality rate (%)	Vaccine availability	Reference
Novel coronavirus (COVID-19)	2020 (January)	Kerala	Seafood market	2.1* (*in China)	No vaccine available	5
Nipah virus	2018 (May)	Kerala	Fruit bats	70	No vaccine available	6, 7
Zika virus disease (ZIKV)	2017 (May)	Bapunagar, Ahmedabad, Gujarat	Mosquitoes – *Aedes aegypti*	8.3	No vaccine available	8
Crimean-Congo haemorrhagic fever (CCHF)	2011 (January)	Ahmedabad, Gujarat	Tick-borne virus (*Nairovirus*) of the Bunyaviridae family	10–40	No vaccine available for either people or animals	9, 10
Swine flu (H1N1)	2009 (May)	Hyderabad, Telangana	Pigs	0.02	Vaccine available	11
Avian (bird) flu (H5N1)	2006 (February)	Navapur, Nandurbar district, Maharashtra	Poultry birds	60	Vaccine available	12
Chikungunya virus (CHIKV)	2006 (October)	Andhra Pradesh, Andaman & Nicobar Islands, Tamil Nadu, Karnataka, Maharashtra, Gujarat, Madhya Pradesh, Kerala and Delhi	Mosquitoes – *Aedes aegypti* and *Aedes albopictus*	9.5	No vaccine available	13, 14

the disaster management and health adaptation plans, accordingly.

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Coronavirus: a novel threat and ICT-based mitigation

Coronavirus, the deadly RNA virus causes severe respiratory illness in humans and sometimes results in death. In December 2019, an outbreak of this virus was reported from Wuhan, China, which has been named the novel coronavirus (2019-nCoV)[1]. During the time of writing this letter, it has become an epidemic in China with more than 1000 lives lost and 40,000 cases detected. The rapid spread of this virus is not only a threat to China, but to the whole world. Recently, some cases have been reported from Singapore, Thailand, Japan, Germany, the United States and India[2]. The World Health Organization (WHO) has declared the 2019-nCoV outbreak as a Public Health Emergency of International Concern[3].

The symptoms of coronavirus infection are similar to influenza, including runny nose, sore throat, cough, dizziness, fever and quick spread from human to human[4]. Researchers are playing a vital role along with the medical professionals to combat this virus. Bats are considered as the host of this airborne virus, as the whole genome sequence is about 96% similar to the bat coronavirus[5]. Phylogenetically, 79.5% nucleotides of 2019-nCoV are similar to the SARS-CoV (severe acute respiratory syndrome related coronavirus)[5]. Several research articles, research bulletins, etc. are now continuously being published with updates about the status of the 2019-nCoV outbreak along with rapid detection and possible treatment methods. CDC has provided a flowchart to identify the virus infection and RT-PCR based assay for its detection.

A recently published report by WHO indicates that a number of countries and geographical regions have been affected by nCoV during December 2019 to the first week of February 2020 (Figure 1)[6]. Figure 2 presents the epidemic curve in China based on the onset of symptoms and reported travel history. The Worldmeter reports that 40,614 such cases have been registered till 10 February 2020 worldwide, and 910 deaths have been recorded[7]. It shows that nCoV cases till 9 February 2020 has $R^2 = 0.6922$ and $R^2 = 0.7052$ for nCoV cases and death polls respectively, in (a) and (b); the difference is 0.0137. It shows how closely the two plots are related. The similarity between the two graphs is 99.9863%. We found the infection rate to be $nCoV_{rate} = 12.977 * \ln(days) - 11.959$ and death rate to be $nCoV_{death} = 295.36 * \ln(days) - 246.32$. From here, we can expect that nCoV infection shall come under control between the second week of March and the first week of April 2020, if appropriate measures are introduced.

We all need to be aware of this epidemic and also be conscious about the challenges brought by the 2019-nCoV infection. We should be updated about the genetic and epidemiological information related to this virus, and also be in contact with the international community support that can control its rapid outbreak and can potentially save lives. We prescribe a list of measures that should be followed by fellow citizens to protect themselves from the nCov infection: (i) avoid close contact with such infected persons, (ii) wash hands frequently, (iii) avoid unprotected contact with animals, (iv) maintain cough etiquette, and (v) contact the respective emergency health department in case of suspected nCoV infection.

We have devised a novel scheme to mitigate such viral infections using the Internet of Things (IoT). The IoT provides a platform to connect heterogeneous things with the internet to disseminate smart services like e-healthcare. In this context, we can foresee IoT as a key enabler to counter nCoV infections by predicting such occurrences far ahead of time. This can be achieved by installing