Learning from history: Coronavirus outbreaks in the past

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"Those who cannot remember the past are condemned to repeat it."

-George Santayana

Coronaviruses were considered relatively harmless pathogens until they caused three major outbreaks of severe respiratory disease in the last 20 years. The current pandemic has compelled us to scrutinize the break-outs that have occurred in the past and imposed global threat time and again.

Coronavirus is a single stranded enveloped RNA virus that belongs to the subfamily Coronavirinae. Based on the genomic structure, 4 subtypes of this zoonotic virus have been recognized- alphacoronavirus, betacoronavirus, gammacoronavirus and deltacoronavirus. Alphacoronavirus and betacoronaviruses infect only mammals whereas gammacoronavirus and deltacoronavirus infect mainly birds. Out of the former group, seven viruses are known to cause human disease. Four of these viruses, HCoV 229E, HCoV OC43, HCoVNL63 and HCoVHKU1, cause mild infections whereas three, SARS-CoV, MERS-CoV and the recently identified SARS-CoV2 cause serious respiratory illnesses in humans (Marra et al., 2003).

All human coronaviruses have originated from animals. SARS-CoV, MERS-CoV, SARS-CoV2, HCoV 229E, HCoVNL63 have originated from bats whereas HCoV OC43 and
HCoVHKU1 originated from rodents. Domestic animals, by acting as intermediate hosts, enable virus transmission from the natural hosts to humans.

The pathogenicity of coronavirus was recognized way back in 1960 when it was identified as a cause of common cold. Till the year 2002 it was considered as a non-fatal virus not severely pathogenic to humans. However, RNA viruses have a high rate of mutation and evolve into novel viral strains and this led to the first coronavirus outbreak which started in the form of severe atypical pneumonia in November 2002 in Guangdong Province of Southern China (Zhong& Zeng, 2003).

The infection rapidly spread to involve the health care workers who were looking after the affected patients. It swept across the globe when an infected doctor travelled to Hongkong in February 2003 and transmitted the infection to other health workers and guests staying in the same hotel. These patients brought infection back to their home countries that is Singapore, Vietnam and Canada. Subsequently, World Health Organization (WHO) issued a global alert about this novel infection and named it Severe Acute Respiratory Syndrome (SARS). The number of infected patients increased to 8098 by July 2003 with 774 deaths in 29 countries over five continents (Bell, Jenkins& Hall, 2003). The major disease load was confined to Asia with China and Hongkong accounting for 84% of all cases. After extensive research by scientists all over the world, the causative agent was identified as SARS-CoV by the WHO on April 16, 2003. With vigorous quarantine measures, collaborative efforts and health education the pandemic came under control in June 2003 and was declared to be over in 2004 leaving behind important lessons to be learnt from this first 21st century outbreak.
Almost a decade later, in the year 2012, a new coronavirus emerged in the middle east that caused an illness similar to SARS. First case of infection was reported on 13 June, 2012 in Jeddah in Saudi Arabia. Similar to SARS, it spread rapidly to health care workers suggesting human to human transmission. The disease had a fatal outcome in immunocompromised patients and had a high mortality rate of 33% and was named as Middle East Respiratory Syndrome (MERS). It rapidly spread to adjacent countries Qatar, Kuwait, Bahrain, Tunisia and Jordan. The disease has been identified in 26 countries with 1621 confirmed cases and 584 deaths, with maximum cases in Saudi Arabia. Though there is an association between bats and coronaviruses, studies have shown that MERS-CoV is not transmitted through bats. Studies done on camels using anti MERS-CoV antibodies have supported the theory that dromedary camels are the main source of transmission to humans (Aleanizy et al., 2017; Haagmans et al., 2014).

Just a few years after the MERS outbreak, history repeated itself in a belligerent way in December 2019 in Wuhan, the largest metropolitan area in China’s Hubei province, where a cluster of patients were admitted to hospital with a diagnosis of ‘pneumonia of uncertain etiology’. The first case was reported to the WHO country office in China on December 31, 2019. By January 2, 2020, 41 patients were identified as having the novel infection which was later identified and named as COVID-19, an acronym for coronavirus disease 2019. Studies done till date have shown that COVID-19 has developed from bat origin coronaviruses and forms a new clade belonging to the Betacoronavirus 2B lineage with a close resemblance to the SARS-CoV (Yan et al., 2020; Conforti et al., 2020). Though bats are the initial source of infection, what caused the “zoonotic spill” to humans remains to be determined. Research is
underway to identify the possible intermediary hosts. 55% of cases of the 425 patients reported with Novel Coronavirus Infected Pneumonia (NCIP) in Wuhan were linked to the Huanan wholesale seafood market raising doubts of a plausible role of food borne transmission (Li et al., 2020). Human to human transmission is via droplets and fomites during close unprotected contact.

At the time of writing of this article COVID-19 has affected 129288 people worldwide in over 118 countries causing 4749 deaths forcing WHO to declare it as a pandemic due to the speed and scale of transmission.

Three major epidemics in the last two decades (Fig 1) have left many questions unanswered. Apart from the research questions regarding the pathogenesis and spread of disease we really need to introspect whether urbanization and globalization are disturbing the nature’s balance? In this era, any infectious disease can spread on a massive scale within days to cause global threat.

References


Figure 1. History of Coronavirus outbreaks

2002

2012

MERS

MERS-CoV

NCIP

SARS-CoV2 (COVID-19)

2019