

**Novel Coronavirus: An Update on Taking Preventive Measures to Combat the Threat of the Novel Corona Virus in Dental Care Setting**

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**Abstract**

A novel  $\beta$ -coronavirus (2019-nCoV) cause severe pneumonia in seafood market of Wuhan city, China, which is rapidly spreading to other countries. The natural host of this virus could be the bat as 2019-nCoV showed 96.3% of whole-genome identity to Bat CoV RaTG13. The person-to-person transmission routes include direct transmission, such as dry cough, sneeze, droplet inhalation transmission, and contact transmission, such as the contact with oral, nasal, and eye mucous membranes. It can also be transmitted through saliva. The dental professionals in dental practice expose to high risk of 2019-nCoV infection due to the face-to-face communication with the patients

and the exposure to saliva, blood, and other body fluids. Thus, present review article recommends the infection control measures during dental practice to totally block the person-to-person transmission routes in dental care settings and hospitals.

**Keywords:** Pandemic, SARS-CoV, aerosols, pneumonia and droplet.

**Introduction**

The novel corona virus (2019-nCoV initially than renamed as COVID-19 officially by WHO) is associated with person to person transmission in various parts of the world spreading at an alarming rate.<sup>1</sup> A highly infectious outburst of pneumonia originated in Wuhan City, China in

December 2019. The pneumonia infection has expeditiously spread from Wuhan to other provinces and then to involve 199 Countries and territories with dreadful extent of the disease which was initially thought to be endemic then exploded into disastrous pandemic disease showing terrifying results. World Health Organization has announced a public health emergency of international concern over this worldwide pneumonia outbreak on 30th January 2020.<sup>2,3</sup>

### History

The 2019 novel coronavirus (2019-nCoV) or the severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) are enveloped  $\beta$ -corona, positive sense-RNA and non-segmented viruses of 60-140 nm in diameter with a crown like projections on its surface as the name suggests. Coronaviruses (CoV) are divided into four genera, including  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$  CoV.  $\alpha$ - and  $\beta$ -CoV infects mammals, while  $\gamma$ - and  $\delta$ -CoV tends to infect birds. Previously, 6 CoVs are identified as human susceptible virus, among which  $\alpha$ -CoVs HCoV-229E and HCoV-NL63,  $\beta$ -CoVs HCoV-HKU1 and HCoV-OC43 causes respiratory symptoms which is mild and similar to a common flu.<sup>4</sup> The  $\beta$ -CoVs, SARS-CoV and MERS-CoV causes severe and potentially fatal respiratory tract infections. The genomic sequence of SARS-CoV-2 is found 96.2% identical to a bat CoV RaTG13, as well as it shares 79.5% identity to SARS-CoV.<sup>5</sup> Based on viral genome sequencing results and evolutionary analysis, bat is suspected to be a natural host of virus origin, and SARSCoV-2 might be transmitted from bats via unknown intermediate hosts to infect humans. It is now reported that SARS-CoV-2 uses angiotensin-converting enzyme-2 (ACE2) receptor to infect humans.<sup>6,7</sup>

### Transmission Dynamics

The mean incubation period of coronavirus is 5.2 days and 95<sup>th</sup> percentile of the distribution at 12.50 day. In initial

stages, the epidemic doubled in size every 7.4 days. The reproductive rate is approximately 2.2, that is each patient can spread infection to 2.2 other people. The majority of early reported cases were related to exposure at the Huanan Seafood Wholesale Market where a huge variety of vertebrate and invertebrate animals, wild caught and farm raised, are sold. But bats are thought to be the primary source and spread to humans via intermediate wild animals. Then exponential increase in non-linked cases by late December was noticed. Spread from person-to-person in close contacts (about 6 feet) mainly by respiratory droplets through contact with mucous membrane of mouth, nose and eyes came into scenario. A familial cluster of cases from Shenzhen and Vietnam became first evidence pointing towards human to human spread. Asymptomatic or mildly symptomatic patients have a potential impact on the spread of pandemic. Efficient human-to-human transmission causes rapid and large scale spread of a respiratory pathogen.<sup>8</sup> The severity of disease is an indicator for virus's ability to spread. There is an inverse correlation between number of mild or asymptomatic cases and one's ability to control an outbreak. A mildly symptomatic or asymptomatic infected person will never seek health care and thus remain undiagnosed, continue working and travelling in crowded places thus rapidly spreading the virus both locally and internationally. Nosocomial transmission is a serious risk for rapid spread too. Another factor is the basic reproduction number of virus,  $R_0$ . When  $R$  is greater than 1, transmission can occur for a longer duration. To break the chain of sustained transmission  $R$  needs to be somewhat less than 1.24. For the current outbreak  $R_0$  is estimated to be 2.2-2.68. We need to prevent little more than half of infections, so that the  $R_0$  can be brought down to below 1.24.<sup>9</sup>

Fortunately, children are less reported for deaths so far, reason being unknown, but unfortunately, the present total cases are found to be 4,539,401 having unfortunate 3,03,555 deaths with recovered 1,711,215 cases and still increasing.<sup>4-6</sup> The mortality rate is 15% and recovery rate 85%. The active cases are 2,524,631 and further splitted into 2 groups: Patients with mild condition that are 2,524,620 (100%) and the patients with serious or critical condition that are 45,559 (2%). The closed cases (2,014,770) are divided into recovered or discharged cases that are 1,711,215 (85%) and the deaths that are 303,555 (15%) and are still increasing (Fig. 1 and 2). The above mentioned data is according to the survey updated on 14 may 2020. The virus was known to be originated in bats and was transmitted to humans through unknown transitional animals in Wuhan, Hubei province, China in December 2019 and till date has found to involve more than 180 countries so far (Fig. 3). However, India have been reported Covid-19 cases involving more than 20 states and Union Territories. Maximum cases are found in Maharashtra and Tamil Nadu (Fig. 4). The worst outcomes of the spread of this fatal outbreak in India can be seen in statistical manner from the beginning till present including number of Confirmed, Active,

Recovered, Deceased and Tested cases in India and still increasing drastically. (Fig. 5)  
[<https://www.worldometers.info/coronavirus/>],  
[<https://www.covid19india.org/>].



Fig. 1: Total cases of life threatening disease with deaths and recoveries

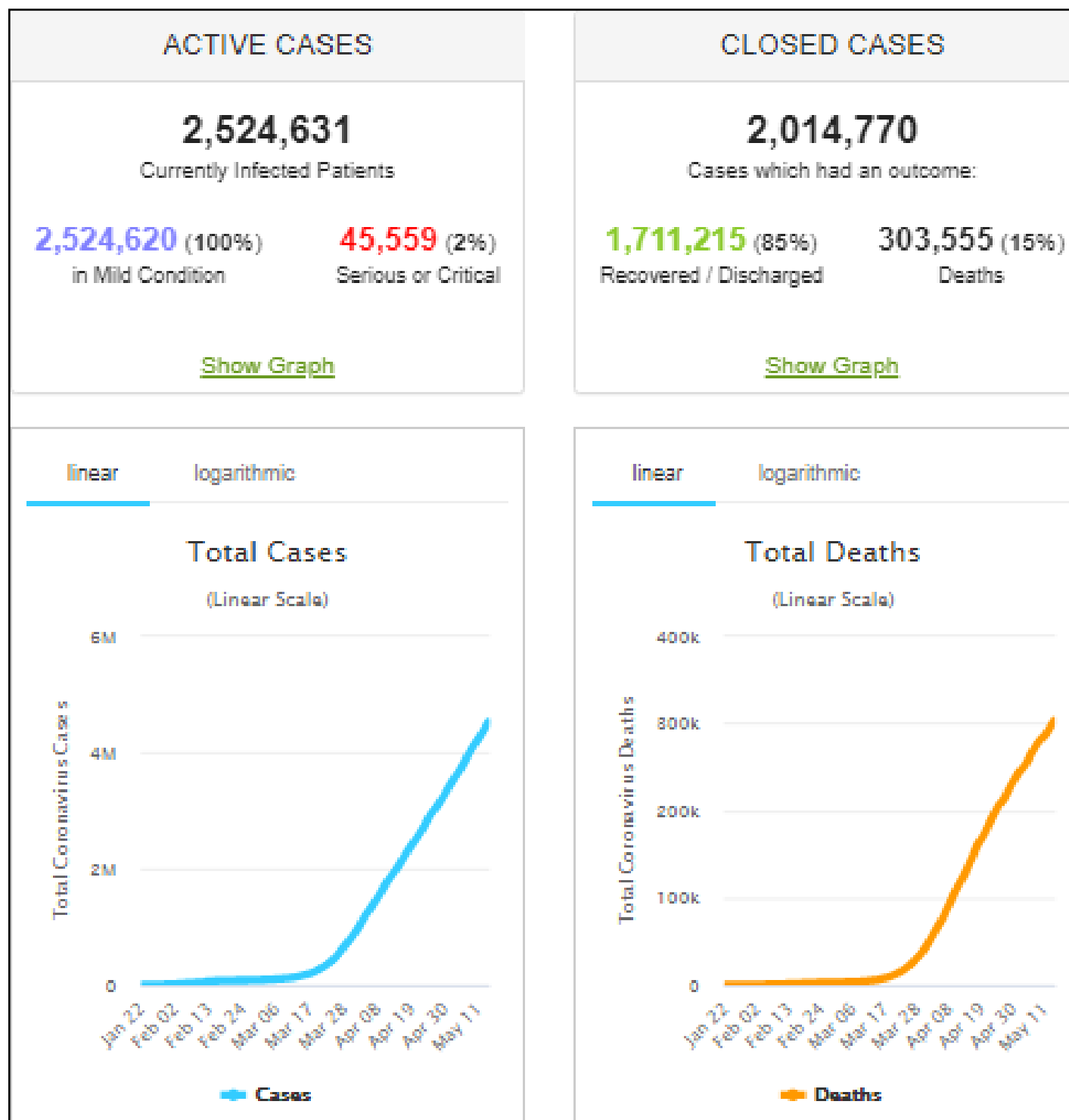


Fig. 2: The sudden outburst of total active cases and closed cases of Covid-19

#	Country, Other	Total Cases	New Cases	Total Deaths	New Deaths	Total Recovered	Active Cases	Serious, Critical	Tot Cases/ 1M pop	Deaths/ 1M pop	Total Tests	Tests/ 1M pop	Population
	World	4,539,401	+17,412	303,555	+473	1,711,215	2,524,631	45,559	582	38.9			
1	<a href="#">USA</a>	1,457,593		86,912		318,027	1,052,654	16,240	4,407	263	10,638,893	32,166	330,753,490
2	<a href="#">Spain</a>	272,646		27,321		186,480	58,845	1,376	5,832	584	2,467,761	52,784	46,752,506
3	<a href="#">Russia</a>	262,843	+10,598	2,418	+113	58,226	202,199	2,300	1,801	17	6,400,000	43,858	145,926,611
4	<a href="#">UK</a>	233,151		33,614		N/A	N/A	1,559	3,437	495	2,219,281	32,713	67,840,351
5	<a href="#">Italy</a>	223,096		31,368		115,288	76,440	855	3,689	519	2,807,504	46,426	60,472,892
6	<a href="#">Brazil</a>	203,165	+247	13,999	+6	79,479	109,687	8,318	957	66	735,224	3,462	212,364,444
7	<a href="#">France</a>	178,870		27,425		59,605	91,840	2,299	2,741	420	1,384,633	21,219	65,255,252
8	<a href="#">Germany</a>	174,975		7,928		151,700	15,347	1,329	2,089	95	3,147,771	37,585	83,749,935
9	<a href="#">Turkey</a>	144,749		4,007		104,030	36,712	963	1,719	48	1,508,824	17,915	84,220,162
10	<a href="#">Iran</a>	114,533		6,854		90,539	17,140	2,758	1,366	82	643,772	7,678	83,850,893
11	<a href="#">China</a>	82,933	+4	4,633		78,209	91	11	58	3			1,439,323,776
12	<a href="#">India</a>	82,103	+106	2,649		27,977	51,477		60	2	2,039,952	1,480	1,378,233,611

Fig 3: Top most countries affected

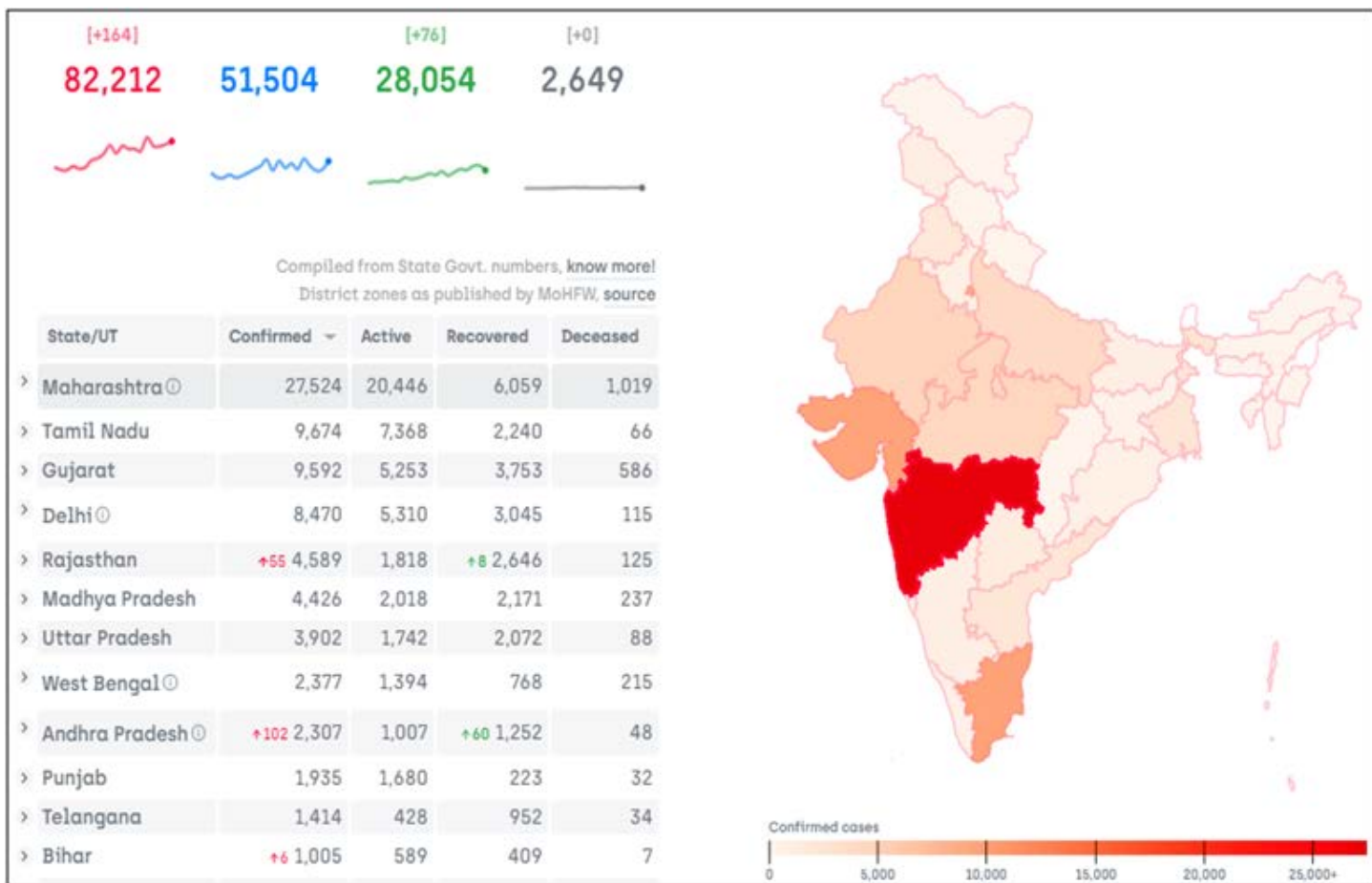


Fig 4: Number of cases in various states of India.



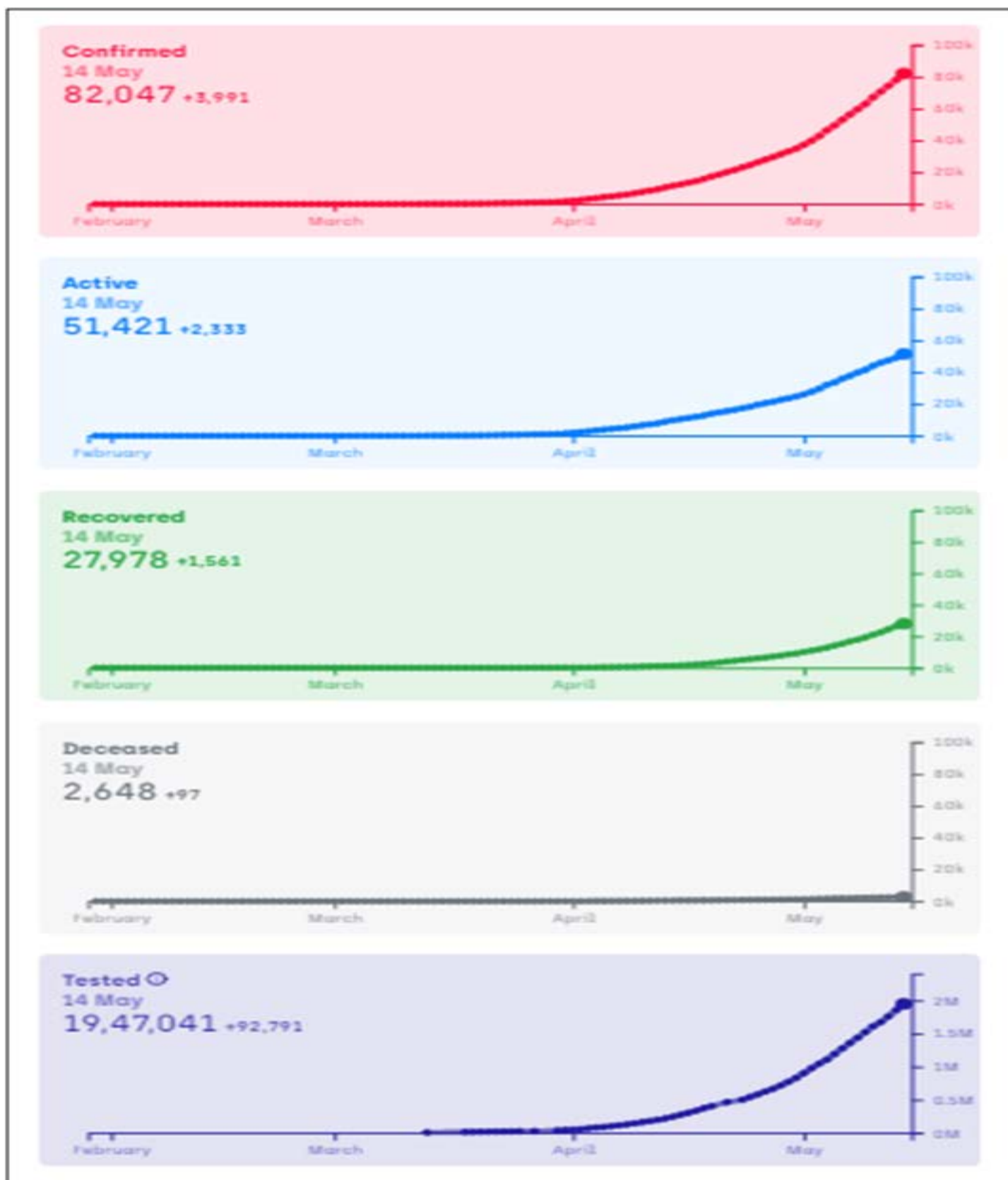


Fig. 5: The statistics presentation of total number of confirmed, active, recovered, deceased and Covid positive patients in India.

## Epidemiology and Pathogenesis

Infection is transmitted via droplets/aerosols released during coughing and sneezing by symptomatic patients but can also occur from asymptomatic people and before onset of symptoms which is susceptible in all age groups. In a study, higher viral loads were seen in nasal cavity as compared to the throat with no significant difference in viral burden between symptomatic and asymptomatic people. One can be infectious as long as the symptoms last and even on clinical recovery. Some persons may act as super spreaders; as a UK citizen attended a conference and infected 11 other people while staying in a resort and upon return to the UK.

The spike protein of the virus is a multi-functional molecular machine that helps the virus entry into host cells (Fig. 6). It binds to a receptor on the surface of host cell through its S1 subunit initially and then fuses viral and host membranes through its S2 subunit subsequently. Two domains in S1 from various viruses recognize a variety of host receptors, resulting in viral attachment. Two different conformations present in spike protein are prefusion and postfusion. The membrane fusion requires trigger in spike protein for transition from prefusion to postfusion conformation.

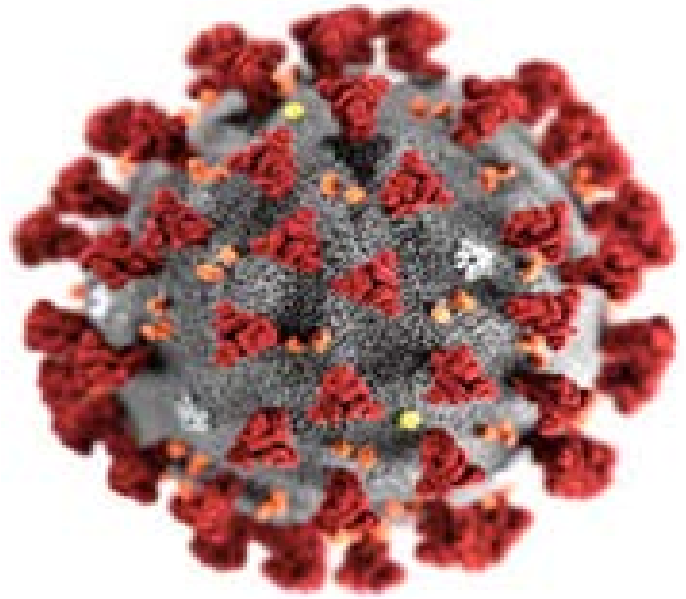


Fig. 6: The 3D microscopic structure of corona virus with “Crown” like projections on surface.

The infected aerosols can spread in 1–2 m radius. The virus can survive on surfaces for days in favourable atmospheric conditions but are destroyed by sodium hypochlorite, hydrogen peroxide etc. Infection is acquired either by inhaling these aerosols or on contact to these surfaces contaminated by them and then touching the nose, mouth and eyes (Fig. 7). The virus is also present in the stool and contamination of the water supply and consequent transportation by means of aerosolization/ feco oral route is also guesstimated. As per current information, trans placental transmission from pregnant women to their foetus has not reported yet babies tested positive after delivery. The incubation period ranges from 2 to 14 d [average 5 d]. Studies suggest angiotensin receptor 2 (ACE2) as the receptor through which the virus enters the respiratory mucosa. The basic case reproduction rate (BCR) is estimated to range from 2 to 6.47 in various



researches. In comparison, the BCR of SARS was 2 and 1.3 for pandemic flu H1N1 2009<sup>10</sup>.

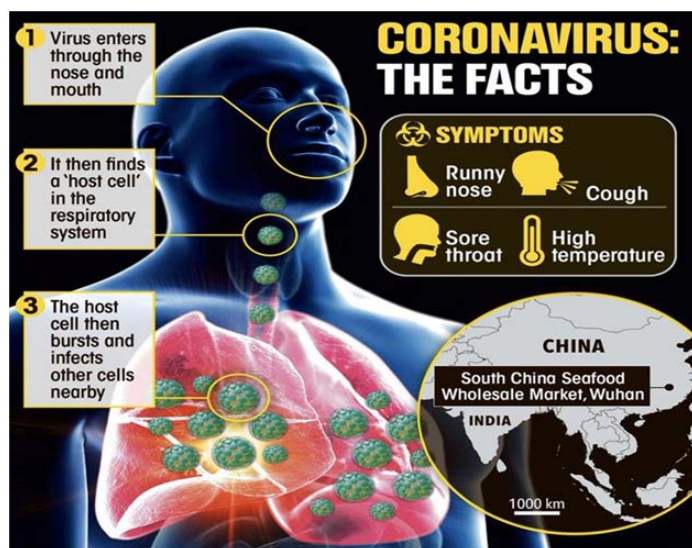


Fig. 7: The mechanism of replication of corona virus after entering into the body

### Possible Transmission Routes of 2019-Ncov In Dental Clinics

Since 2019-nCoV can be transmit directly from one person to another by respiratory droplets, rising evidence reveals that it may also be transmitted by fomites.<sup>11,12</sup> To *et al.* in their study reported the presence of live virus in the saliva of infected individuals<sup>11</sup>. Furthermore, it has also been confirmed that this virus enters into cell through the same path as SARS coronavirus, *ie.* through ACE2 cell receptor.<sup>13</sup> ACE2+ cells present throughout the respiratory tract, as well as the cells morphologically similar with salivary gland duct epithelium in human mouth. ACE2+ epithelial cells of salivary gland ducts were demonstrated to be a class early targets of SARSCoV infection, and 2019-nCoV is likely to be the same situation, although no research has been reported yet.<sup>14</sup>

Dentists as well as patients can be exposed to such viruses that infect the oral cavity and respiratory tract. Dental Clinics as well as hospitals are at a high risk of 2019-nCoV infection due to the specificity of its routine procedures, which involves verbal face to face communication with patients, exposure to saliva, blood, and other body fluids. The pathogenic microorganisms may be transmitted in dental setup through inhalation of airborne pathogenic microorganisms that may remain suspended within the air for long periods of duration<sup>15</sup>, direct contact with blood, oral fluids<sup>16</sup>, contact of conjunctival, nasal, or oral mucosa with air droplets and aerosols containing microorganisms generated from an infected individual and propelled a short distance by coughing and talking without a mask<sup>17,18</sup>, and indirect contact with contaminated instruments and environmental surfaces<sup>14</sup>. Infections can be spread through any of these mentioned conditions especially during the outbreak of 2019-nCoV.

### Airborne Spread

The airborne spread of SARS-Cov is well understood in many researches. Many dental research papers show that dental procedures produce aerosols and droplets that are contaminated with virus. These droplet and aerosol are the major important concerns in dental clinics and hospitals, because it is hard to avoid the production of large amounts of aerosol and droplet mixed with patient's saliva and even blood during day to day clinical practice.<sup>17</sup> In addition to the infected patient's cough and breathing, equipment such as high-speed dental airtor which uses high-speed gas to drive the turbine to rotate at high speed

and work with running water. When such devices work in oral cavity, a large amount of aerosol and droplets mixed with the patient's saliva or even blood will be produced. Particles of droplets and aerosols are small enough to stay airborne for a longer period

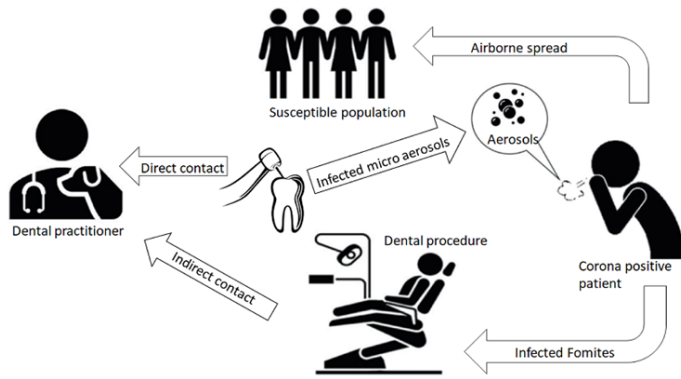


Fig. 8: The predominant unavoidable risk to covid-19 infection in dental profession.

### Contact Spread

A dental professional frequently comes in direct or indirect contact with human fluids, patient materials, and contaminated dental equipment or environmental surfaces which makes a possible route to the spread of viruses. In addition, dental professionals as well as patients have likely contact of conjunctival, nasal, or oral mucosa with droplets and aerosols containing microorganisms generated from an infected individual. Effective infection control strategies are much needed to prevent the spread of 2019-nCoV through these contact routines.<sup>17</sup>

### Contaminated Surfaces Spread

Human coronavirus like SARS-CoV, Middle East Respiratory Syndrome coronavirus (MERS-CoV), or endemic human coronaviruses (HCoV) can remain on surfaces for a longer duration on metal, glass, or plastic.<sup>19,20</sup> Therefore, contaminated surfaces that are frequently contacted in dental clinic settings are a potential source of coronavirus transmission. Clinical practice derived droplets and aerosols from the patients, which is likely to contaminate the whole surface in dental

before they settle on environmental surfaces. Thus, the 2019-nCoV has the potential to spread through droplets and aerosols from infected individuals during dental procedure in dental care setting (Fig. 8).

In addition, it was shown that at room temperature HCoV remains infectious from 2 h up to 9 days, and persists better at 50% compared with 30% relative humidity. Thus, one should keep a clean and dry environment in the dental clinic to decrease the persistence of 2019-nCoV.

### Infection Control in Dental Practice

Dentists along with their team should be aware of the routes of 2019-nCoV spread, identification of such patients and all extra-protective measures that can be adopted during clinical practice to prevent transmission. Below we recommend few preventive measures necessarily to be followed by all dental professionals. The following recommendations are based on recent Guidelines for the Diagnosis and Treatment of Novel Coronavirus

Pneumonia(<http://www.nhc.gov.cn/yzygj/s7653p/202002/3b09b894ac9b4204a79db5b8912d4440.shtml>), The Guideline for the Prevention and Control of Novel Coronavirus Pneumonia in Medical Institutes(<http://www.nhc.gov.cn/yzygj/s7659/202001/b91fdab7c304431eb082d67847d27e14.shtml>) and WHO Guideline (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control>), ECDPC, which is an agency of the European Union, is publishing information about the Coronavirus at <https://www.ecdc.europa.eu/en>.

## Patient Evaluation

At first, dentist should be able to identify a suspected case of COVID-19. If dental professional identifies the patient with suspected 2019-nCoV infection, He/she should not treat the patient in the dental clinic, but immediately quarantine the patient and report to the infection control department as early as possible. The body temperature of the infected patient should be measured. A contact-free digital forehead thermometer is strongly recommended for the screening of patient.

A questionnaire should be asked to screen patients with potential infection of 2019-nCoV before they proceed to the dental chair. These questions should include the following:

- (1) Do you have fever within past 14 days?
- (2) Have you recently experienced dry cough or difficulty in breathing within the past 14 days?
- (3) Have you, travelled to Wuhan nearby areas within past 14 days, or visited any neighbourhood city?
- (4) Have you came in contact with patient with confirmed 2019- nCoV infection within the past 14 days?
- (5) Have you recently came in contact with people who came from Wuhan city or people from the neighbourhood with recent documented fever or respiratory problems within past 14 days?
- (6) Have you recently gone to attend in any social gathering or meetings?

If a patient reply “yes” to any of the above mentioned questions, and his/her body temperature is below 37.3°C, the dentist can postpone the treatment until 14 days after the exposure event. The patient should be instructed to self-quarantine at home and to report if he/she experience fever or flu-like symptom to the local health department immediately.

If a patient says “yes” to any of these questions, and his/her body temperature in digital thermometer is no less

than 37.3°C, the patient should be immediately instructed to quarantined, and the dentist should immediately report to the infection control department of the hospital.

If a patient reply “no” to all the screening questions, and his/her body temperature is below 37.3°C, the dentist can treat the patient with extra protection measures, and avoids aerosol-generating procedures to the best.

## Hand Hygiene

The dental professionals should wash their hands before patient examination, before dental procedures, after touching the patient, and the surrounding dental care setting surface. More caution should be taken for the clinicians to avoid touching their own eyes, mouth, and nose. At present, there is no particular guideline for the protection to dental professionals while treating such infected patients.

Since airborne droplet transmission of infection is considered as the main route of spread, barrier-protection equipment, like protective eyewear, masks, hand gloves, head caps, face shields, and protective outwear, is strongly recommended for all healthcare givers in the clinic/hospital settings during the epidemic period of 2019-nCoV <sup>21</sup>.

Based on the possibility of the transmission of 2019-nCoV infection, three-level protective measures to the dentist are recommended for specific situations.

- (1) Primary protection (standard protection for staff in clinical settings). Wear disposable head cap, surgical mask, and white coat, using protective eye wear or face shield, and disposable latex gloves.
- (2) Secondary protection (advanced protection for dental professionals). Disposable head cap, disposable surgical mask, protective goggles, face shield, and white coat, surgical clothes outside, and disposable latex gloves.
- (3) Tertiary protection (strengthened protection when contact patient with suspected or confirmed 2019-nCoV

infection). Although a patient with 2019-nCoV infection is not expected to be treated in clinic, but if it occurs, and the dental professional cannot avoid such situation, special protective outwear is needed. If protective outwear is not available, working clothes (white coat) with extra protective clothing outside should be worn. In addition, disposable cap, protective eye wear, face shield, disposable surgical mask, disposable latex gloves, and impermeable shoe cover should be worn.<sup>2</sup>

#### **Use of Mouth Rinse before Dental Procedures**

A pre-procedural antimicrobial mouth rinse containing oxidative agents such as 1% hydrogen peroxide or 0.2% povidone is recommended, to reduce the salivary load of oral microbes, including potential 2019-nCoV carriage. A pre-procedural mouth rinse would be most useful and effective in cases where rubber dam cannot be used.

#### **Rubber Dam Isolation**

The use of rubber dams can reduce the production of saliva- and blood-contaminated aerosol, particularly in cases when high-speed hand pieces and when dental ultrasonic devices are used. It has been reported that the use of rubber dam could significantly reduce airborne particles in ~3-foot diameter of the operational field by 70%.<sup>22</sup> When rubber dam is applied, extra high-volume suction should be used during the procedures along with regular suction<sup>23</sup>. If rubber dam isolation is not possible, manual devices such as Carisolv hand scaler, are recommended for caries removal and periodontal scaling, in order to reduce the generation of aerosol.

#### **Anti-Retraction Handpiece**

The high-speed dental hand piece without anti-retraction valves may aspirate and expel the debris and fluids during the dental procedures. More importantly, the microbes, including bacteria and virus, may further contaminate the air and water tubes within the dental unit, and thus can potentially cause cross-infection. One research has shown

that the anti-retraction high-speed dental headpiece can significantly reduce the backflow of oral bacteria and HBV into the tubes of the headpiece and dental unit as compared with the headpiece without anti-retraction function<sup>23</sup>. Therefore, the use of dental hand pieces without anti-retraction function should be prohibited during the epidemic period of COVID-19. Anti-retraction dental headpiece with specially designed anti-retractive valves or other anti-reflux designs are strongly recommended as an extra preventive measure for crossinfection.<sup>24</sup>

#### **Disinfection of the Clinic Settings**

The clinic setup should be cleaned and disinfected in accordance with the protocol for the management of surface cleaning and disinfection released by the centre for disease control. Public areas and appliances should also be cleaned and disinfected, including door handles, chairs, and desks. The elevator should be disinfected regularly.<sup>2</sup>

#### **Management of Medical Waste**

The medical waste (including disposable protective equipment after use) should be transported to the temporary storage area of the medical institute timely. The reusable instrument and items should be cleaned, sterilized, and properly stored in accordance with centre for disease control protocol. The medical and domestic waste generated should be kept in double-layer yellow colour medical waste package bags and “gooseneck” ligation should be used. The surface of the package bags should be marked and disposed according to protocol for the management of medical waste.<sup>2</sup>

#### **Summary**

Since December 2019, the newly discovered coronavirus (2019- nCov) has caused the outbreak of pneumonia in Wuhan and throughout China and now spreading rapidly in India. 2019-nCov enters host cells through human cell receptor ACE2 with higher binding affinity. The rapidly

increasing number of cases and evidence of human-to-human transmission suggested that the virus was more contagious than SARS-CoV and MERS-CoV. By mid-February 2020, a large number of medical staff died while treating patient. Thus we have summarized the possible transmission route in present review. We also reviewed several detailed practical strategies to block virus transmission to provide a reference for preventing the transmission of 2019-nCoV.

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