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Circumstance of Omicron Sub Variant BF.7 in India: A Review

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Abstract

The Omicron variant of SARS-CoV-2 has unique changes in the structural amino acid. Thus, Omicron subvariants are different from other coronavirus variants in terms of viral spread, disease severity, vaccine neutralization capacity, and immunity evade. Moreover, Omicron subvariant BF.7 is an offspring of BA.4 and BA.5. Similar S glycoprotein sequences are present among BF.7, BA.4, and BA.5. There is a change in the R346T gene in the receptor binding site of Omicron BF.7 than other Omicron subvariants. A number of new Omicron subvariants, including BQ.1, BQ.1.1, BA.4.6, BF.7, and BA.2.75.2, have appeared as a result of the SARS-CoV-2 virus' ongoing development. All of the novel subvariants that we identified had increased neutralisation resistance, but the BQ.1 and BQ.1.1 subvariants—driven mostly by their respective F486S mutations—and the BA.2.75.2 subvariant—driven primarily by their respective R346T and K444T mutations—were particularly affected. Interestingly, the D1199N mutation decreased the fusogenicity and S processing of the BA.2.75.2 subvariant, whereas the F486S mutation increased both. As a result, there was little overall change. This BF.7 subvariant has created a limitation in current monoclonal antibody therapy. Omicron has mutated since it emerged, and the subvariants are improving in terms of transmission as well as antibody evasion. Therefore, the healthcare authorities should pay attention to the BF.7 subvariant of Omicron.

Keywords: Omicron BF.7, Covid-19, SARS-CoV-2 Omicron, Sub variants

Background

The country identified the novel Coronavirus Disease 2019 (COVID-19) in December 2019 (Tan W *et al.*, 2020). The virus was called severe acute respiratory syndrome coronavirus 2



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(SARS-CoV-2) (Merad M *et al.*, 2022). As of December 23, 2022, SARS-CoV-2 has infected more than 650 million individuals and killed over 6.6 million (WHO, 2022). Although the number of reported cases and confirmed deaths lessened during the middle part of the year, the most recent reports suggest an inevitable outbreak of coronavirus infection once again (Dhama K., *et al.*, 2023; Dewan SMR *et al.*, 2022; Rahman S, *et al.*, 2022; Islam MR *et al.*, 2022). However, confirmed cases and deaths in China, Japan, South Korea, and the USA are now rising again (World meters, 2022) According to a report, the recent upsurge of COVID-19 infection in these regions might be due to the new Omicron subvariant BF.7.10 As of December 25, 2022, Omicron subvariant BF.7 has spread over 90 countries (Mint, 2022). Scientists assume that the newer subvariant of coronavirus may soon spread out to every corner of the world and may create havoc once again. Therefore, the healthcare authorities should take the initiatives to tackle this recent outbreak with proper and scientifically sound measures (Mint, 2022).

China faces a two-million-person mortality risk as a result of the recent spike. Even an e Many nations are concerned about the corona outbreak in China, but India is not seriously threatened. Covid was subject to limitations in China up until a few months ago. The state of medicine in China is deteriorating as a result of inadequate policies. There, Omicron's bf.7 version is also having a significant impact (Rupali Nagulkar *et al.*, 2023).

While this variation had recently arrived in India, it had no impact there. epidemiologist stated that 60% of China's population would contract the disease in the next months. The emergence of this variant has created an obstacle in current monoclonal antibody therapy. The Omicron mutation in RBD and FCS is to blame for its high infectivity compared to the earlier variants. The only positive of Omicron subvariants is that disease severity, hospitalization, and mortality of Omicron are lower than that of earlier strains (Mallapaty S, 2022).

SARS-CoV-2 Mutations

The pathogenicity of a virus may influence by mutations in the viral genome. The ability of a virus to elude the defence mechanism can be significantly affected by the modification of amino acids.¹⁶ This change in viral structural protein can alter the effectiveness of vaccines and preventive measures. SARS-CoV-2 may undergo mutation similar to the other RNA



viruses as it tries to adapt itself to its host (Daria S *et al.*,2022).¹⁶ As a result, several distinct variants may produce from its parental strains.¹⁷ SARS-CoV-2 variants exhibited different characteristics, and some were classified as variants of concern (VOCs) based on their nature. The Alpha (B.1.1.7) strain was the first to be regarded as a VOC in December 2020 (González-Candelas *et al.*.,2021). Then, the COVID-19 associated mortality toll in the two nations was significantly increased by the Beta (B.1.351) strain in South Africa and the Gamma (P.1) strain in Brazil. However, Delta (B.1.617.2) strain reported by India in December 2020 led to a widespread catastrophe and was the deadliest mutant strain of SARS-CoV-2. In November 2021, the Omicron (B.1.1.529) strain was first reported in South Africa. By this time, the WHO identified eight variants of interest (VOIs) that are not treatable to humans.¹⁸ The recent upsurge of COVID-19 might be attributed to the newer subvariant of Omicron BF.7 (BA.5.2.1.7). The frequent mutation associated with coronavirus makes it more concerning compared to other viruses (WHO, 2022).

The spike protein of the virus is the principal focus of the currently administered vaccines. But several portions of the S protein of the Omicron variant have undergone a mutation that has made it unrecognizable to antibodies produced by natural infection or vaccination (Islam MR *et al.*, 2022). Omicron subvariants have better antibody resistance compared to earlier strains. Moreover, Omicron subvariant BF.7 is a descendant of BA.4 and BA.5 (Daria S *et al.*, 2022). Similar S glycoprotein sequences are present among BF.7, BA.4, and BA.5. The only change is the R346T mutation in the receptor binding domain in BF.7 compared to earlier Omicron subvariants (Muik A *et al.*, 2022).

The evolution of SARS-CoV-2

In December 2019, several local health facilities in Wuhan, China, started to report highly contagious pneumonia cases. A new pathogen was isolated from a cluster of these pneumonia patients and named SARS-CoV-2, which shares 89% identical nucleotide sequences with bat SARS-like-CoVZXC21, and 82% with that of human SARS-CoV (Karamitros T *et.al.*,2020). SARS-CoV-2 spread rapidly throughout the world. The World Health Organization (WHO) declared it a global pandemic on March 11, 2020 (Cascella M *et al.*, 2022). To date, the virus has caused epidemics in virtually every country, resulting in more than 490 million confirmed



cases and more than 6 million deaths, making it one of the most serious public health disasters in history.

Four genera comprise the subfamily: Alpha, Beta, Delta, and Gamma. Genomic characterization suggests that Alpha and beta CoV may originate from rodents and bats, whereas delta and gamma CoV may originate from avian species (Cascella M *et al.*, 2022). CoV can cause various diseases in different animals, such as respiratory, intestinal, hepatic and neurological diseases; moreover, it can cross species barriers and cause illness in humans. The manifestations of CoV infection in humans vary from a common cold to severe diseases such as Middle-East Respiratory Syndrome (MERS) and Severe Acute Respiratory Syndrome (SARS). During the course of human history, CoVs have emerged as a major pathogen leading to outbreaks of respiratory disease. MERS-CoV and SARS-CoV are the most virulent and are capable of causing epidemics. The mortality rates of the last SARS-CoV and MERS-CoV epidemics were 10 and 35%, respectively (Wong ACP *et al.*, 2021). SARS-CoV-2 is a novel beta CoV that contains 4 main structural proteins, 16 non-structural proteins, and between 5 and 8 accessory proteins. The main structural proteins are the spike protein (S), the nucleocapsid (N), the envelope glycoprotein (E), and the membrane protein (M) (Jiang S *et al.*, 2020). Although the origin of SARS-CoV-2 is unknown, genomic comparisons have revealed that SARS-CoV-2 shares high homology (96%) with the beta CoV RaTG13 of bats . It is speculated that SARS-CoV-2 transfers from bats to humans via intermediate hosts, such as pangolin (Zhang T *et al.*, 2020; Lam TT *et al.*, 2020).

SARS-CoV-2 evolves quickly to adapt to human hosts, and there are multiple variants that may have characteristics different from those of ancestral strains; this is especially true for the S protein and the RBD (Mohapatra RK *et al.*, 2022). Initially, the evolution of SARS-CoV2 was relatively slow until the emergence of the D614G variant, whose increased transmissibility resulted in it becoming the globally dominant variant (Korber B *et al.*,2020) VOCs often have the following characteristics: enhanced transmissibility or virulence, reduced neutralization by natural antibodies or vaccines, enhanced ability to escape detection, and reduced sensitivity to treatments or vaccines. To facilitate in-depth study of these

emerging variants as either VOCs or variants of interest, the WHO and CDC have respectively established an independent classification system (Casella M *et al.*, 2022).

Global Scenario

Globally, nearly 2.3 million new cases and nearly 15 000 deaths were reported in the last 28 days (24 April to 21 May 2023), a decrease of 21% and 17%, respectively, compared to the previous 28 days (27 March to 23 April 2023) (Figure 1, Table 1). The situation is mixed at the regional level, with increases in reported cases seen in the WHO African and Western Pacific Regions and increases in deaths in the African, the Americas, South-East Asia, and Western Pacific Regions. As of 21 May 2023, over 766 million confirmed cases and over 6.9 million deaths have been reported globally. Reported COVID-19 cases are underestimates of infection rates, largely due to the reductions in testing globally, and potential delays in reporting. During the reporting period (28 days) 161/243 (66%) countries reported at least one case. Data presented in this report are therefore incomplete and should be interpreted in light of changes in testing and surveillance. Additionally, data from previous weeks are continuously being updated to incorporate retrospective changes in reported COVID-19 cases and deaths made by countries (WHO,2023).

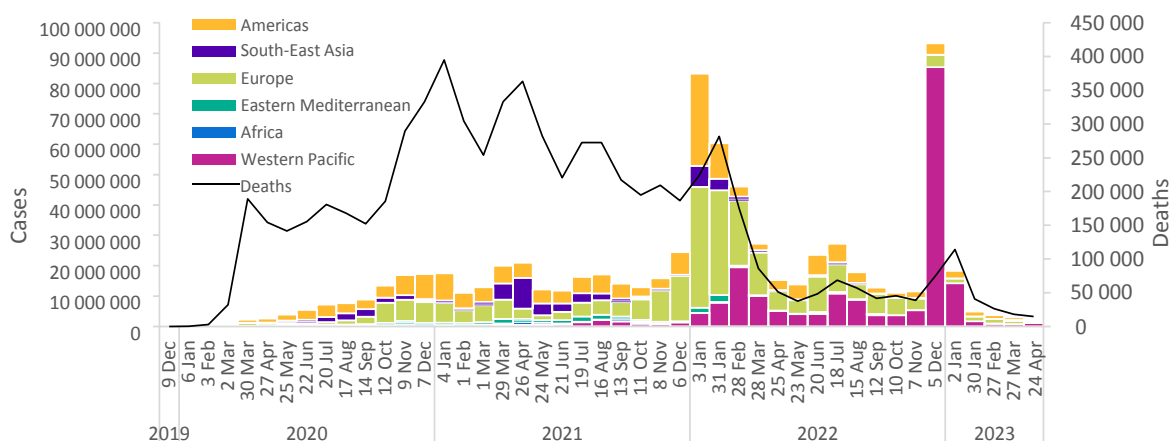


Figure 1. COVID-19 cases reported by WHO Region, and global deaths by 28-day intervals, as of 21 May 2023.

At the regional level, the number of newly reported 28-day cases decreased across four of the six WHO regions: the Eastern Mediterranean Region (-48%), the European Region (-45%),

the Region of the Americas (-41%), and the South-East Asia Region (-31%); while cases increased in two WHO regions: the African Region (+11%), and the Western Pacific Region (+38%). The number of newly reported 28-day deaths increased across four regions: the African Region (+6%), the Region of the Americas (+21%), the South-East Asia Region (+61%), and the Western Pacific Region (+9%); while deaths decreased in two WHO regions: the Eastern Mediterranean Region (-63%), and the European Region (-44%) (WHO,2023).

At the country level, the highest numbers of new 28-day cases were reported from the Republic of Korea(462 726 new cases; +52%), the United States of America (256 909 new cases; -47%), Japan (164 367 new cases; -24%), Brazil (146 105 new cases; -28%), and Australia (125 992 new cases; +49%). The highest numbers of new 28-day deaths were reported from the United States of America (4135 new deaths; -31%), Brazil (1206 new deaths; -7%), France (810 new deaths; -1%), Spain (745 new deaths; +92%), and the Russian Federation (663 new deaths; -33%) (WHO,2023).

Table 1. Newly reported and cumulative COVID-19 confirmed cases and deaths, by WHO Region, as of 21 May 2023.

WHO Region	New cases in last 28 days (%)	Change in new cases in last 28 days *	Cumulative cases (%)	New deaths in last 28 days (%)	Change in new deaths in last 28 days *	Cumulative deaths (%)
Western Pacific	1 052 248 (46%)	38%	203 645 258 (27%)	1 465 (10%)	9%	411 885 (6%)
Europe	572 906 (25%)	-45%	276 366 950 (36%)	5 373 (36%)	-44%	2 237 150 (32%)
Americas	484 889 (21%)	-41%	192 775 054 (25%)	6 655 (44%)	21%	2 954 027 (43%)
South-East Asia	146 614 (6%)	-31%	61 152 597 (8%)	1 143 (8%)	61%	805 869 (12%)
Eastern Mediterranean	26 859 (1%)	-48%	23 374 087 (3%)	330 (2%)	-63%	351 231 (5%)
Africa	6 835 (<1%)	11%	9 530 267 (1%)	19 (<1%)	6%	175 365 (3%)
Global	2 290 351 (100%)	-21%	766 844 977 (100%)	14 985 (100%)	-17%	6 935 540 (100%)



Indian Scenario

Omicron and its sub-lineages continue to be the dominant variants in India. An increase in infection rate has been observed, especially in Western, Southern and Northern parts of India. A newly emerged recombinant variant XBB.1.16 has been observed in different parts of India, accounting for 38.2% of the infection till date. Among the samples collected till the third week of March 2023, XBB continued to be the most commonly circulating Omicron sub-lineages. A few BA.2.10 and BA.2.75 sub-lineage was detected in some part of India, whereas XBB was the most prevalent sub-lineage of omicron variant (INSACOG BULLETIN,2023).

Table 2. Covid -19 sub variants active cases in state wise on Mach 17,2023.

S. No	Name of State / UT	Active Cases		Cured/Discharged/Migrated		Deaths	
							Death During Day
1	Andaman and Nicobar Islands	0		10622		129	
2	Andhra Pradesh	5	3	2324363		14733	
3	Arunachal Pradesh	0		66595		296	
4	Assam	0		738065		8035	
5	Bihar	2		839123		12303	
6	Chandigarh	10	3	98188		1182	
7	Chhattisgarh	3	2	1163658	3	14146	
8	Dadra and Nagar Haveli and Daman and Diu	0		11587		4	
9	Delhi	107	14	1981162	18	26523	
10	Goa*	57	9	255151	2	4013	
11	Gujarat	435	99	1266801	20	11047	
12	Haryana	56	6	1046054	6	10714	



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13	Himachal Pradesh	13 3	7	308607	19	4215	1
14	Jammu and Kashmir	65	15	474710	1	4785	
15	Jharkhand	6	1	437246		5331	
16	Karnataka	58 7	27	4034223	49	40317	1
17	Kerala***	16 25	17	6758761	87	71591	
18	Ladakh	3	2	29194		231	
19	Lakshadweep	0		11363		52	
20	Madhya Pradesh	28	1	1044196	4	10777	
21	Maharashtra	92 6	139	7989703	87	148426	
22	Manipur	0		137775		2149	
23	Meghalaya	0		95163		1625	
24	Mizoram	0	1	238243	1	726	
25	Nagaland	0		35206		782	
26	Odisha	93	8	1327450	3	9205	
27	Puducherry	67	15	173897	2	1976	1
28	Punjab**	62	12	765206	3	19289	
29	Rajasthan	70	14	1305975		9656	
30	Sikkim	4		43825		500	
31	Tamil Nadu	28 4	15	3557074	34	38050	
32	Telangana	28 1	15	837786	42	4111	
33	Tripura	0		107094		940	
34	Uttarakhand	15		441739	2	7754	
35	Uttar Pradesh	61	17	2104570	2	23649	1
36	West Bengal	41	1	2097310	3	21533	
Total		50 26	403	44157685	38 8	530795	4

Kerala- “0 (Zero) new deaths were reported during the last 24 hours. A total of 01 reconciled deaths (as per the ICMR guidelines and falling within 90 days following the date of death) were reported.

India recorded a single-day rise of 796 coronavirus infections today (March 17), while the number of active cases surpassed 5,000 after 109 days, according to Union health ministry data (India TV, 2023). The number of active cases has increased to 5,026, comprising 0.01 per cent of the total infections. The national COVID-19 recovery rate stands at 98.80 per cent, according to the health ministry. The number of people who have recuperated from the disease has surged to 4,41,57,685. The case fatality rate was recorded at 1.19 per cent(India TV, 2023).

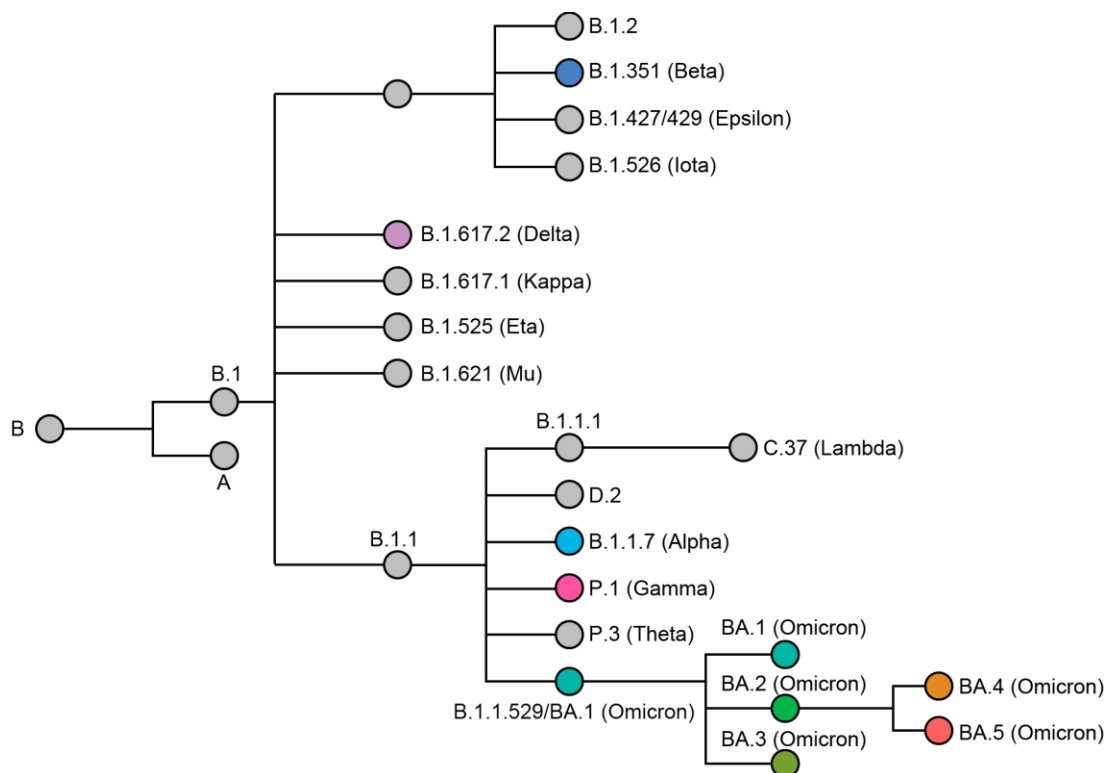


Figure 2. Phylogenetic relationship of named SARS-CoV-2 variants. Variants of concern (VOC) are represented by a colored node. The phylogenetic tree was adapted from data provided by Next Strain, CoVariants (i.e., covariants.org, <http://covariants.org> (accessed on



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18 July 2022)), and Pangolin (i.e., cov-lineages.org, <http://cov-lineages.org> (accessed on 18 July 2022)).

This designation was based on the number of mutations (26–32) in the spike protein relative to previously sequenced isolates, as well as concerning epidemiological reports from South Africa (Callaway, E *et al.*, 2021; Chen, J.; *et al.*, 2022). Omicron has since diversified into five phylogenetically distinct sub-lineages (BA.1 to BA.5) (Figure 2). which are frequently associated with vaccine breakthrough or reinfection of previously infected individuals.

Prevent further covid □ 19 disasters

The BF.7 outbreak can suddenly become a disaster for the entire world. Hence, we should take precautionary steps as quickly as possible. The equal distribution of vaccines can ensure the protection of people worldwide.³³ The poor people have less privilege to better healthcare facilities, and they should get the vaccine as soon as possible before the outbreak of the new variant. The people hesitant to take the vaccine should take it quickly to protect themselves from the virus (Islam MR, 2021).

Researchers should discover the effectiveness of existing COVID □ 19 vaccines against the circulating strains of coronavirus.³¹ Healthcare authorities should increase the vaccination rate across the world. People nowadays tend to avoid healthcare measures due to several factors. But the recent mutation is alarming everyone to continue to follow the health guidelines properly (Daria S *et al.*, 2021). Scientists should keep their eyes on continuous mutation and the nature of newly formed variants. They can perform research to understand the mutated BF.7 strain and to identify effective measures accordingly. As the prolonged outbreaks due to previous variants have weakened the economic status of many families, the government authorities must ensure incentives for poor people if the situation arises (Islam MR *et al.*, 2022; Hossain MJ, *et al* 2022).

As of December 2022, between 27 and 28% of India's eligible population had received the Covid-19 preventive dose. The Covid vaccine and booster injections can help prevent complications brought on by the subvariants. The first and most crucial defence is to wear a mask in busy areas and take booster doses. Social isolation and maintaining good cleanliness



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are two approaches to stop the spread of the variation , With the holiday season soon approaching, those with compromised immune systems should exercise additional caution. You must keep yourself clean. The most effective strategy to lessen Omicron BF risk Test-Track-Treat-Vaccinate is variation . You can schedule a test at home or visit your nearby Metropolis Lab for Covid 19 Testing (Rupali Nagulkar *et al.*, 2023).

Covid -19, critical appraisal and salient counteracting strategies

Chinese strategy to tackle the pandemic seems to have failed on numerous fronts, from possibly the usage of less effective vaccines to the zero-COVID policy, inadequate immunity from past severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections, which probably did not sufficiently allow achieving herd immunity in the population, and lead to BF.7's high transmissibility in the country. Further, China has a high population of the elderly, and many of them have not received the desired booster doses (Chenchula S *et al.*, 2022; Fernandes Q *et al.*, 2022; Ke H *et al.*, 2022; Wong C ,2022; Qu P *et al.*,2023; Graham F, 2022). The initial symptoms of BF.7 subvariant, like , fever, cough, sore throat, running nose, fatigue, vomiting, and diarrhea, are similar to other Omicron subvariants. In countries like India, as the majority of the population has acquired hybrid immunity, both from natural infection of SARS-CoV-2 and Omicron subvariants as well as vaccinations, therefore BF.7 is manifesting differently and causing mild symptoms (Chenchula S *et al.*,2022).

BF.7 is a more dangerous subvariant as it spreads rapidly due to high transmissibility and low incubation period. As per the comparative significant higher R0 value, one BF.7 infected person may spread the virus to nearly 10–18 persons owing to novel mutations gained in the spike protein, possessing a higher affinity for human ACE2 receptor and revealing increased expression of the receptor-binding domain[1]. BF.7 subvariant has shown a 4.4- fold higher neutralization resistance than Omicron as it carries an additional specific mutation (R346T) in viral spike protein, exhibiting that the earlier vaccination may not be quite effective owing to higher antibody-mediated immune evasion than the original D614G variant (Chenchula S *et al.*, 2022; Fernandes Q *et al.*, 2022; Ke H *et al.*, 2022; Wong C ,2022; Qu P *et al.*,2023).

There is an urgent need for strengthening surveillance, tracking, and genomic sequencing of emerging newer Omicron subvariants, especially BF.7, imposing tight vigilance, formulating



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proactive control measures, adopting recommended COVID-19 protective and control strategies, enhancing vaccination campaigns, promoting booster shots, and ensure equal global access to vaccines. BF.7 infection may lead to a serious illness among the nonvaccinated population and vulnerable population, including people with immune-compromised conditions, the elderly (≥ 60 years), children, and those suffering from comorbidities. Hence, booster doses of COVID-19 vaccines are essential to counteract this emerging subvariant by conferring better protection. Notably, the use of face masks, regular hand washing, recommended norms of social or physical distancing, adequate hygiene and disinfection practices, and avoiding crowded places must be again remembered to be strictly followed. This will altogether aid in preventing the further spread of COVID-19 outbreaks by checking any exponential rise in cases owing to BF.7 and other subvariants, reducing disease severity and mortality, and alleviating the extra burden on the healthcare system. We need to be prepared adequately to mitigate the high global health concerns and socioeconomic impacts being imposed from time to time by the SARS-CoV-2, emerging Omicron subvariants, and future subvariants or variants of concern (Kuldeep Dhama *et al.*, 2023)

Omicron BF.7 Safety Measures

Dr. Ghosh advises patients to practise strict cleanliness by washing their hands often and wearing a mask while outside (HT, 2022). The vaccination and booster doses can help reduce death and problems from the sub-variants, but patients with a weakened immune system should take additional precautions. People with compromised immune systems are more likely to be affected by this disease than any other age group. Another benefit of increased exposure to COVID and its variations is that humans are naturally gaining immunity to the virus. “People are better equipped to deal with the virus and problems of the sub-variants have been prevented with the aid of vaccinations and booster doses,” says Dr. Ghosh. A person who wants to help stop the spread of COVID should act in accordance with the norms and regulations set out by local authorities (NDTV, 2022). As the holiday season begins and travel restrictions are lifted throughout the globe, it is crucial to maintain the massive vaccination effort that has been underway.



CONCLUSION

There is no question that the present Coronavirus flare-up is a worldwide general medical problem. How we might interpret the microorganism, what it means for cells and produces sickness, and the clinical elements of illness have all cutting-edge rapidly. Nations from one side of the planet to the other ought to focus harder on sickness observation frameworks and scale up country status and reaction tasks, including setting up speedy reaction groups and improving the capacity of the public research center framework, because of the fast transmission of infections. The financial, clinical, and general wellbeing framework in China as well as, somewhat, in different countries, especially its neighbors, has been scrutinized by this new infection episode. What the infection will mean for our life here in India will just turn out to be clear with time. In this way, zoonotic infection and illness episodes are supposed to endure from here on out. Thus, endeavors ought to be made to foster extensive methodologies to forestall future flare-ups of zoonotic beginning as well as containing this episode.

References

1. Andersen KG, Rambaut A, Lipkin WI, Holmes EC, Garry RF. The proximal origin of SARS-CoV-2. *Nat Med.* (2020) 26:450–2. doi: 10.1038/s41591-020-0820-9 .
2. Cascella M, Rajnik M, Aleem A, Dulebohn SC, Di Napoli R. Features, Evaluation, and Treatment of Coronavirus (COVID-19). *StatPearls.* Treasure Island, FL: StatPearls Publishing. Copyright © 2022, StatPearls Publishing LLC. (2022).
3. Chenchula S, Amerneni KC, Ghanta MK, Clinical virology and effect of vaccination and monoclonal antibodies against SARS-CoV-2 Omicron subvariant BF.7 (BA.5.2.1.7): a systematic review. *medRxiv* 2022. [https:// doi.org/10.1101/2022.12.25.22283940](https://doi.org/10.1101/2022.12.25.22283940).
4. Dhama K, Nainu F, Frediansyah A, . Global emerging Omicron variant of SARS-CoV-2: impacts, challenges and strategies. *J Infect Pub Health.* 2023;16(1):4–14. doi:10.1016/j.jiph.2022.11.024



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Vol.8 Issue. 6, June- 2023, pg. 154-170

ISSN: 2519-9889

Impact Factor: 5.9

5. Dewan SMR, Islam MR. Increasing reinfections and decreasing effectiveness of COVID-19 vaccines urge the need for vaccine customization. *Ann Med Surg.* 2022;84:104961. doi:10.1016/j.amsu. 2022.104961 .
6. Daria S, Bhuiyan MA, Islam MR. Detection of highly muted coronavirus variant Omicron (B.1.1.529) is triggering the alarm for South Asian countries: associated risk factors and preventive actions. *J Med Virol.* 2022;94(4):1267-1268. doi:10.1002/jmv.27503.
7. Daria S, Asaduzzaman M, Shahriar M, Islam MR. The massive attack of COVID-19 in India is a big concern for Bangladesh: the key focus should be given on the interconnection between the countries. *Int J Health Plann Manage.* 2021;36(5):1947-1949. doi:10.1002/hpm.3245.
8. Daria S, Islam MR. The SARS-CoV-2 omicron wave is indicating the end of the pandemic phase but the COVID-19 will continue. *J Med Virol.* 2022;94(6):2343-2345. doi:10.1002/jmv.27635.
9. Fernandes Q, Inchakalody VP, Merhi M, Emerging COVID-19 variants and their impact on SARS-CoV-2 diagnosis, therapeutics and vaccines. *Ann Med* 2022;54:524-40.
10. González-Candelas F, Shaw MA, Phan T, One year into the pandemic: short-term evolution of SARS-CoV-2 and emergence of new lineages. *Infect Genet Evol.* 2021;92:104869. doi:10.1016/j.meegid.2021.104869.
11. Graham F. Daily briefing: China's COVID wave could kill one million people. *Nature* 2022. doi: 10.1038/d41586-022-04541-3.
12. <https://www.indiatvnews.com/news/india/covid-cases-updates-coronavirus-pandemic-india-death-toll-corona-wave-bf7-xbb-omicron-variants-active-tally-2023-03-17-855276>.
13. HT, 2022. Omicron BF.7: Cases of highly infectious strain rise in India; experts on symptoms, precautions and fresh wave. Available at: <https://www.hindustantimes.com/lifestyle/health/omicron-bf-7-cases-of-highly-infectiousstrain-rise-in-india-experts-on-symptoms-precautions>.
14. Hossain MJ, Ahmmmed F, Khan MR, et al. Impact of prolonged COVID-19 lockdown on body mass index, eating habits, and physical activity of university students in Bangladesh: a



Selvaraj Selvamurugan, International Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.8 Issue. 6, June- 2023, pg. 154-170

ISSN: 2519-9889

Impact Factor: 5.9

web-based cross-sectional study. *Front Nutr.* 2022;9:873105. doi:10.3389/fnut.2022.873105

15. Islam MR, Shahriar M, Bhuiyan MA. The latest Omicron BA.4 and BA.5 lineages are frowning toward COVID-19 preventive measures: a threat to global public health. *Health Sci Rep.* 2022;5(6):e884. doi:10.1002/hsr2.884.
16. INSACOG BULLETIN ,27 th March, 2023.
17. Islam MR, Nahar Z, Hossain MS, . Prevalence and associated factors for elevated fear and depressive symptoms among the private service holders in Bangladesh during the Covid-19 pandemic: a cross-sectional study. *Health Science Reports.* 2022;5(5):e795. doi:10.1002/hsr2.795
18. Islam MR, Hossain MJ. Detection of SARS-CoV-2 Omicron B.1.1.529) variant has created panic among the people across the world: what should we do right now? *J Med Virol.* 2022;94(5): 1768–1769. doi:10.1002/jmv.27546
19. Islam MR. Urgent call for mass immunization against coronavirus in Bangladesh. *Sci Prog.* 2021;104(4):003685042110585. doi:10.1177/ 00368504211058562
20. Jiang S, Hillyer C, Du L. Neutralizing antibodies against SARSCoV-2 and other human coronaviruses. *Trends Immunol.* (2020) 41:355–9. doi: 10.1016/j.it.2020.03.007
21. Ke H, Chang MR, Marasco WA. Immune evasion of SARS-CoV-2 Omicron subvariants. *Vaccines (Basel)* 2022;10:1545.
22. Karamitros T, Papadopoulou G, Bousali M, Mexias A, Tsiodras S, Mendis A. SARS-CoV-2 exhibits intra-host genomic plasticity and low-frequency polymorphic quasispecies. *J Clin Virol.* (2020) 131:104585. doi: 10.1016/j.jcv.2020.104585
23. Korber B, Fischer WM, Gnanakaran S, Yoon H, Theiler J, Abfalterer W, et al. tracking Changes in SARS-CoV-2 spike: evidence that D614G increases infectivity of the COVID-19 Virus. *Cell.* (2020) 182(4):812-27.e19. doi: 10.1016/j.cell.2020.06.043.
24. Lam TT, Jia N, Zhang YW, Shum MH, Jiang JF. Identifying SARSCoV-2-related coronaviruses in Malayan pangolins. *Nature.* (2020) 583:282–5. doi: 10.1038/s41586-020-2169-0.



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25. Mohapatra RK, Kandi V, Verma S, Dhama K. Challenges of the Omicron (B.1.1.529) variant and its lineages: a global perspective. *Chembiochem.* (2022) 1:e202200059. doi: 10.1002/cbic.202200059
26. Merad M, Blish CA, Sallusto F, Iwasaki A. The immunology and immunopathology of COVID-19. *Science.* 2022;375(6585):1122-1127. doi:10.1126/science.abm8108.
27. Mallapaty S. Where did Omicron come from? three key theories. *Nature.* 2022;602(7895):26-28. doi:10.1038/d41586022-00215-2.
28. Mint. As Omicron BF.7 surges, here are the top COVID symptoms to watch out for; 2022. Accessed December 29, 2022. <https://www.livemint.com/science/health/as-omicron-bf-7-surges-here-are-the-top-covid-symptoms-to-watch-out-for-11672046682327.html>.
29. Muik A, Lui BG, Diao H, Progressive loss of conserved spike protein neutralizing antibody sites in omicron sublineages is balanced by preserved T cell recognition epitopes. *Immunology.* 2022. doi:10.1101/2022.12.15.520569.
30. NDTV, 2022. Covid Variant 'BF.7' Behind China Surge Found In India: All You Need To Know. Available at: <https://www.ndtv.com/india-news/covid-variant-bf-7-driving-chinasurge-detected-in-india-10-points-3626472>. Accessed on: 22nd December 2022.
31. Qu P, Evans JP, Faraone JN, et al. Enhanced neutralization resistance of SARS-CoV-2 Omicron subvariants BQ.1, BQ.1.1, BA.4.6, BF.7, and BA.2.75.2. *Cell Host Microbe* 2023;31:7-17.e3.
32. Rahman S, Hossain MJ, Nahar Z, Shahriar M, Bhuiyan MA, Islam MR. Emerging SARS-CoV-2 variants and subvariants: challenges and opportunities in the context of COVID-19 pandemic. *Environ Health Insights.* 2022;16:117863022211293. doi:10.1177/11786302221129396.
33. Tan W, Zhao X, Ma X, et al. A novel coronavirus genome identified in a cluster of pneumonia cases Wuhan, China 2019-2020. *China CDC Weekly.* 2020;2(4):61-62.
34. World Health Organization. WHO coronavirus (COVID-19) dashboard. Accessed December 29, 2022. <https://covid19.who.int/>
35. World meters. Covid-19 Coronavirus Pandemic. 2022. Accessed December 29, 2022. <https://www.worldometers.info/coronavirus/>.



Selvaraj Selvamurugan, International Journal of Pharmaceutical Sciences and Medicine (IJPSM),
Vol.8 Issue. 6, June- 2023, pg. 154-170

ISSN: 2519-9889

Impact Factor: 5.9

36. Wong ACP, Lau SKP, Woo PCY. Interspecies jumping of bat coronaviruses. *Viruses*. (2021) 13:11. doi: 10.3390/v13112188.
37. Wong C. Subvariant 'soup' may drive wave. *New Sci* 2022;256:11.
38. WHO, COVID-19 Weekly Epidemiological Update Edition 144 published 25 May 2023.
39. Zhang T, Wu Q, Zhang Z. Probable pangolin origin of SARS-CoV2 associated with the COVID-19 outbreak. *Curr Biol*. (2020) 30:1346– 51.e2. doi: 10.1016/j.cub.2020.03.022 .