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# COVID-19 Pandemic: A Comprehensive Review of Pathogenesis, Variants Virology, Therapeutic Strategies and Impact on Cancer

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**Abstract.** The current COVID-19 outbreak poses the most significant global threat with unknown long-term and short-term consequences on the economy, public health and related healthcare sectors. SARS-CoV-2 is highly infectious and controlled measures in distancing socially and through sterilization must be sustained to neutralize the viral load especially in high risk areas. Now, the world is facing a new threat in the form of a novel Omicron variant of COVID-19 recently detected in Britain which was found to link to travel to southern Africa and was initially named B.1.1.529. This newly identified variant, a highly mutated variant that might be able to escape from vaccines was first identified in Botswana. This comprehensive review will provide the pathophysiological basis of coronavirus, vaccination status, virus strain variation and molecular basis of a virus to shed a detailed spread of the omicron strain that poses a global threat. The virulent nature of the virus and the emergence of new deadly strains led to the development of therapeutic strategies by understanding the pathogenesis of SARS-CoV-2. Globally, therapeutic management strategies are needed as they provide crucial knowledge for the development of rapid diagnostics and treatment options that serve as major interventions for infection control management.

**Keywords:** COVID-19, pandemic, 2019-nCoV, outbreak, coronavirus, 2019-nCoV, SARS-CoV-2, infection, transmission

## Introduction

The initial case of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) outbreak was identified in Wuhan, Hubei province, China (Omari *et al*., 2020). The 2019 novel coronavirus (2019-nCoV) or Wuhan Coronavirus, since its first outbreak from China on 12 December 2019, has infected almost 502,890,926 people worldwide among 244 countries. So, far 6,193,401 people have lost their lives, which keeps rising daily, as per real-time global reports (Data, 2023). The development of the curative and preventive approaches in the treatment of critically ill patients, either in the form of de novo drug discovery or in the form of finding an effective vaccine, exerts immediate implementation of non-therapeutic management would possibly mitigate the outbreak of the pandemic COVID-19. As of 17 August 2022, 12.6 billion vaccine shots have been administered across 184 countries, while the current rate of 9.48 million daily doses was recorded (COVID-19 Report, 2022). In Pakistan, the first case of COVID-19 was reported on 26 February 2020, which later gained momentum, however, the initial spread of COVID-19 in Pakistan was reported from Iran, which turned out to be in a pandemic state due to Islamic gathering events at Raiwind. During the COVID-19 pandemic, various in consistencies, mis-interpretation, mis-reporting and legitimacy of the worldwide resources regarding testing data management have been found. Worldwide travel restrictions have been enforced in eight countries: Botswana, south Africa, Zimbabwe, Lesotho, Eswatini, Namibia, Malawi and Mozambique. In Pakistan so far 30,664 corona virus related deaths were reported, while at least 278,150,849 doses of COVID vaccines has administered.

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## Materials and Methods

**Search strategy and selection criteria.** A systematic search was performed from Google Scholar, Pubmed, Google Web Browser such as research gate, Scihub, Science direct, online COVID databases for specific papers by providing key terms pathogenesis and virology of COVID-19, SARS-CoV-2, therapeutics of COVID-19, vaccine development, molecular biology of SARS-CoV-2, clinical characteristics and epidemiology of coronavirus, variants of coronavirus and COVID-19 impact on cancer etc. The searched literature was screened, analyzed and evaluated critically for the relevant information and facts for the inclusion of contents accordingly. In this study, 59 peer reviewed research articles were selected.

## Results and Discussion

**COVID-19 outbreak.** An outbreak of respiratory illness emerged due to new coronavirus has been officially termed as COVID-19 on February 2020 by World Health Organization (Hertrampf *et al*., 2020; Malik, 2020). Later on, the international virus classification commission classified the provisionally called COVID-19 as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Chen *et al*., 2020; Malik, 2020). In last two decades the other two pandemics due to corona virus family includes severe acute respiratory syndrome coronavirus (SARS-CoV) in 2002 with estimated 8000 people were infected along with 774 mortalities, while the other one was the Middle East respiratory syndrome corona virus (MERS-CoV) in 2012 (Seah *et al*., 2020). On 31$^{st}$ December 2019, WHO confirmed the emergence of 27 pneumonia cases out of which 7 reported cases were severe in nature of unknown etiology from Wuhan city China (Martinez, 2020). Till 7 January 2020, the major causative agent behind reported cases was officially known as corona virus. On 12$^{th}$ January 2020, the publicly available viral sequence of SARS-CoV-2 revealed close resemblance with SARS-CoV (Malik, 2020). In early stages patients suffered with acute respiratory infection, while other patients developed acute respiratory distress syndrome.

The cases of COVID-19 increases globally, while the WHO is monitoring the SARS-CoV-2 spread very closely via a global surveillance system. Till to date, despite the deteriorating trends of SARS-CoV-2 infection globally incredible attempts have been made in terms of new therapeutics, genomic sequencing of virus or ongoing clinical trials of potential anti-viral approved drugs (Moock and Mello, 2020). Since December 2019, more than two years now the world population is still under the potential risk of severe respiratory tract infections. However, agile and continuous evolution of virus has posed a significant challenge on diagnostic and therapeutic development (Zhao *et al*., 2020).

The current worldwide vaccination status of COVID-19 has been depicted in the graph. This graph only provides an approximation of the current scenario till 7$^{th}$ February 2022 from John Hopkins Corona Resource Centre. Worldwide percentage of total population vaccinated varies as shows in colour bar. Each country is coded with a colour and each colour corresponds to the specific percentage of vaccinated people (COVID-19 Data, 2022).

**Vaccination and COVID-19.** So, far global number of vaccinated people exceeds from 4.9 billion people that accounts for world population of almost 63.8 percent. A person who received at least one dose refers as vaccinated person, while someone who either get vaccinated fully by a single or double dose authorized vaccine. The percentage of the total worldwide population that receives at least one dose of COVID-19 vaccine is 66.9% (Abidi *et al*., 2022). The current total doses of COVID-19 vaccines administered in 183 countries reaches up to 12.7 billion (Raymond *et al*., 2022).

Until 7 April, 2021, 46.7% of total population of United Kingdom received single dose, while 8.4% got two doses. In Israel, 61.2% has received a single dose, while 56.5% were completely vaccinated compared to the United States where 32.9% were administered a single dose and 19% had been completely vaccinated. The current estimated rate of vaccination was 7.07 million doses per day. Roughly 21.2 million doses per day is the most recent rate. Within the United States, 613 million doses of COVID vaccines have been given up until now.

Vaccination status among COVID-19 top ten most infected countries have been depicted in the graph against total number of cases. This graph only provides an approximation of the vaccination status in two countries till 22$^{nd}$ November 2021 (GitHub, 2022).

Throughout the last week, booster doses were regulated with 88,505 doses per day. Globally the most recent vaccination rate is 21204028 dosages each day, which covers 2796004 individuals having their first shot, with mentioned rate around 75% of the population has

received at least one dose of the vaccine but nine months will further be required (Teijaro and Farber, 2021). The number of fully vaccinated people around the globe is mentioned as mentioned in Fig. 1. Therefore, till 27 Feb 2024 in India 2.21 billion people that are fully vaccinated compared to Brazil with 418.08 million, Russia 164.20 million, Germany 182.48 million, United Kingdom 149.08 million, United Arab Emirates 24.86 million people are fully vaccinated (WHO, 2024; Tay *et al*., 2020). The vaccination status among top most infected countries has been shown in Fig. 2.

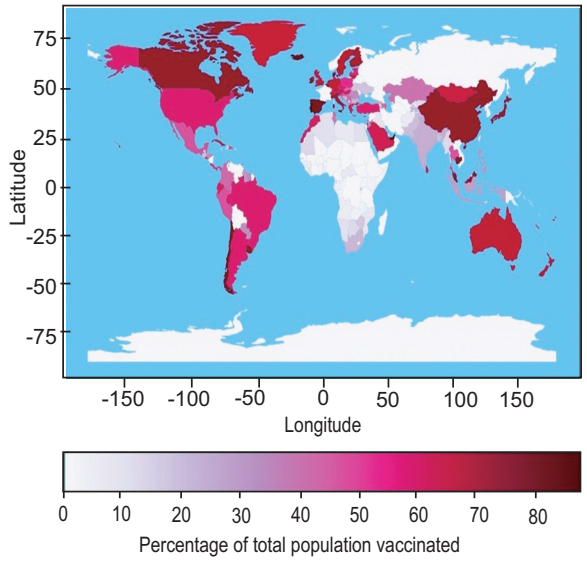


**Fig. 1.** Global status of vaccination.

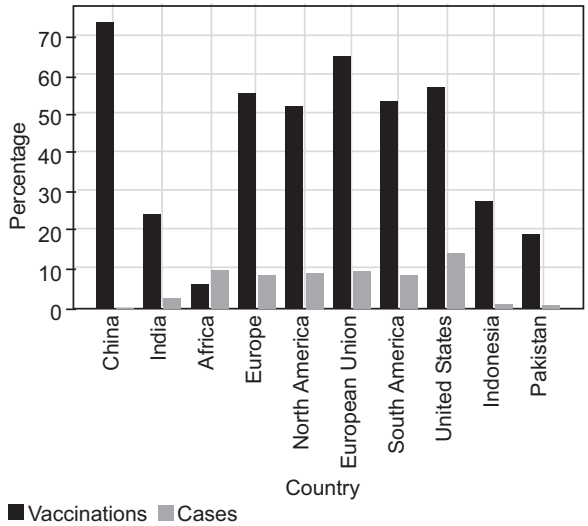


**Fig. 2.** Comparative analysis of vaccination status among top most infected countries.

Vaccination status of India and Pakistan since January 2021 till November 2021 has been depicted in this figure. This graph only provides an approximation of the vaccination status in two countries till 22nd November 2021 (COVID-19 Data, 2022).

By the end of 4 August 2021, 30 million doses of corona vaccine have been administered in Pakistan where almost seven million individuals have received two doses of corona vaccination. The vaccination scenario in Pakistan and India has been depicted in the Fig. 3-4. The vaccination break down of population in Pakistan has been shown in Fig. 5.

This graph shows population vaccination trend against new cases. The percentage of population vaccinated initially goes slowly compared to the rising rate of

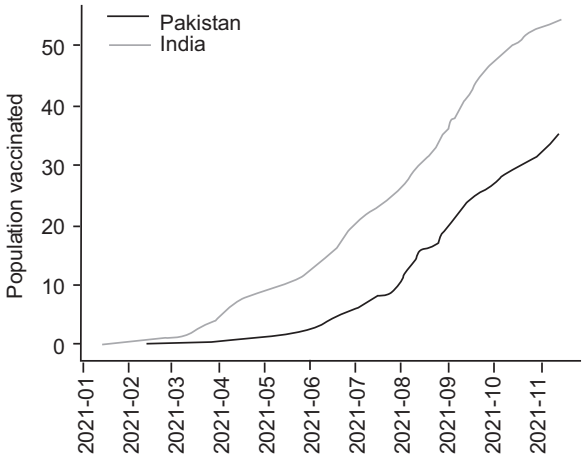


**Fig. 3.** Vaccination scenario in India and Pakistan.

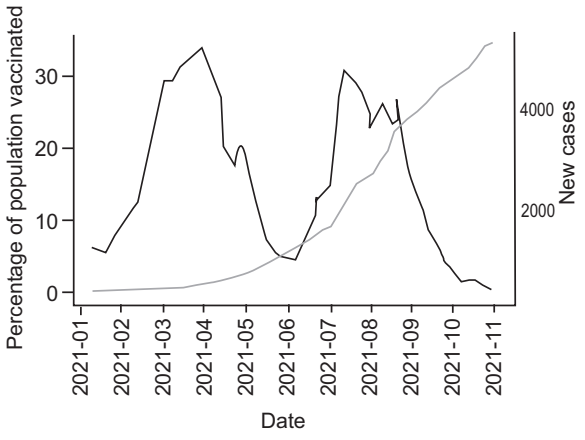


**Fig. 4.** Comparison of a population vaccinated in Pakistan against new cases.

infection that later gained momentum and results in declining the infection rate. This graph only provides an approximation of the vaccination status in two countries till 22nd November 2021 (COVID-19 Data, 2022).

The vaccination scenario of Pakistan has been represented in the Fig. 5A, the overall percentage of unvaccinated people is high compared to partially vaccinated population, 5B, the percentage of population taken booster shot undertaken so far is comparatively low compared to vaccinated percent. This graph only provides an approximation of the vaccination status till April 2022 (COVID-19 Data, 2022).

**Genomic organization of SARS-CoV-2.** The genome of SARS CoV-2 genome possesses high resemblance

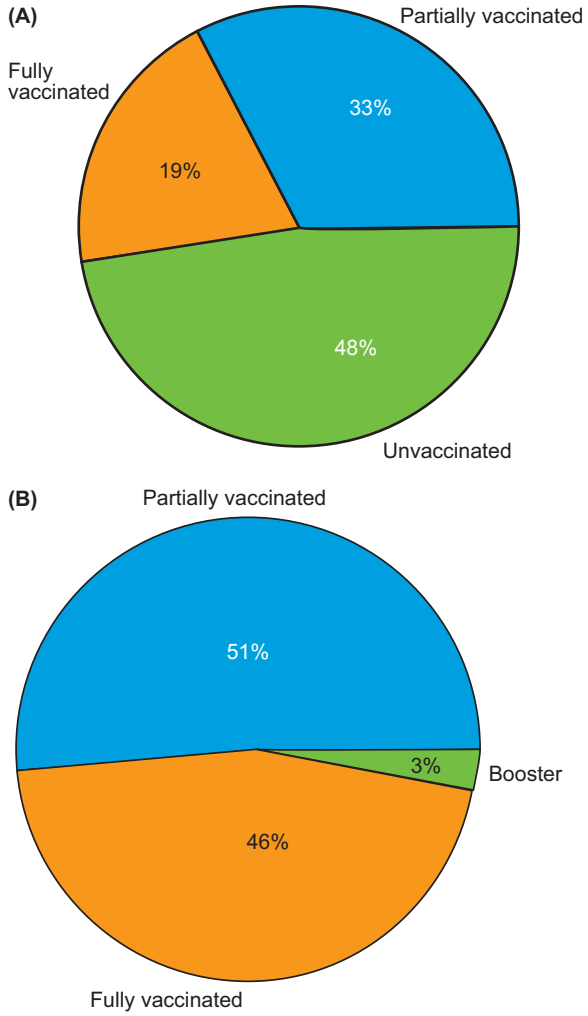


**Fig. 5.** Vaccination breakdown of population in Pakistan.

with SAR CoV and MERS CoV. Due to the genetic diversification of the strain the novel corona virus caused severe respiratory tract infections in humans. The activity of virus is mainly related to the presence of surface S proteins which binds to angiotensin converting enzyme-2 (ACE-2) a cell surface receptor and trans-membrane serine protease (TMPRSS2). The members of corona virus (CoV) family have a history of various epidemics and outbreak in the last decade (Plusa, 2020). The highly infectious member of its family SARS-CoV-2 with devastating rate of mortality and morbidity consist of a single large RNA genome comprises of 27 proteins that includes 15 NSPs (non-structural proteins) termed as (NSP, NSP1-10 and NSP12-16), ORF1a/b at the 5' end, while rest other 4 structural proteins termed as the membrane (M), (S) spike, nucleocapsid (N) and envelope € proteins and 8 accessory proteins (3a, 3b, p6, 7a, 7b, 8b, 9b and orf14) (Chen *et al*., 2020; Lu *et al*., 2020; Wu *et al*., 2020). The NSPs (non-structural proteins) plays crucial role in replication of virus and RNA processing. The helical and symmetrical of 125 nm diameter capsid of corona virus constitute of large single stranded, positive-sense RNA (+ssRNA) of 26-32 Kb in size, considered as the largest available genome among RNA viruses (Zhou *et al*., 2020; Joseph *et al*., 2006).

The envelope N-linked glycosylated (S)spike protein (~150 kDa) consists of two proteolytic activated subunits: $S_1$ subunit (constitute the receptor-binding domain (RBD) and N-terminal domain (NTD) while $S_2$ subunit (composed C-terminal domain (CTD) (Andersen *et al*., 2020; Pourrajab *et al*., 2020). The RBD region of the (S) spike protein is highly variable portion of the viral genome and involves in host receptor interaction, while $S_2$ subunit is mainly involved in membrane fusion. The SARS-CoV-2 RBD interact directly with angiotensin converting enzyme II (ACE2) human receptor protein which is almost similar to SARS-CoV (Ceraolo and Giorgi, 2020; Joseph *et al*., 2006). It is considered that SARS-CoV-2 and SARS-CoV have same pathogenesis based on sharing amino acid similarity of 79.5% (Lu *et al*., 2020). Based on greater affinity of spike protein of SARS-CoV-2 with ACE2 as compared to SARS-CoV and up regulation of ACE2 expression upon SARS-CoV-2 infection could possibly explain its aggressive and infectious nature. The $S_2$ subunits crucial for host entry mainly cleaved by host serine proteases TMPRSSII in SARS-CoV-2 (Pourrajab *et al*., 2020; Wrapp *et al*., 2020).

The sufficiently rich constituent of coronavirus is pre-glycosylated (M) glycoprotein (~25 to 30 kDa) that encode (221–262 amino acids) that exist in dimer (Neuman *et al*., 2011; Armstrong *et al*., 1984). The glyco protein has three trans-membrane domains with larger C-terminal endodomain and smaller N-terminal glycosylated M and E proteins, stability to nucleocapsid (RNA complex with N protein) and internal virions core that aids in completing of viral assembly (Fehr and Perlman, 2015; Nal *et al*., 2005). The M and E proteins constitute envelope of virus and viral like particles (VLPs) released as a result of their interaction. The M protein provides the shape of virion envelope (Malik, 2020; Vennema *et al*., 1996). The E protein expressed exclusively during replication process in infected cell however a very little portion is integrated inside the viral envelope. The E protein is mostly engaged in viral assembly and budding (Nieto-Torres *et al*., 2011). The two domains a C-terminal domain (CTD) and N-terminal domain (NTD) are the major part of the N protein as both play crucial role in RNA binding, budding and viral assembly results in formation of entire virion production (Chang *et al*., 2006; Tooze *et al*., 1984).

**Strain variations: from delta to omicron.** The strains result due to the genetic diversification of the novel Corona virus caused severe respiratory tract infections in humans. The activity of virus is mainly related to the presence of surface S proteins which binds to angiotensin converting enzyme 2 (ACE-2) a cell surface receptor and trans-membrane serine protease (TMPRSS2). The members of corona virus (CoV) family has a history of various epidemics and outbreak in the last decade (Plusa, 2020). The effect on rate of infection caused by several variants of corona virus strains during pandemic has been mentioned in the Fig. 6.

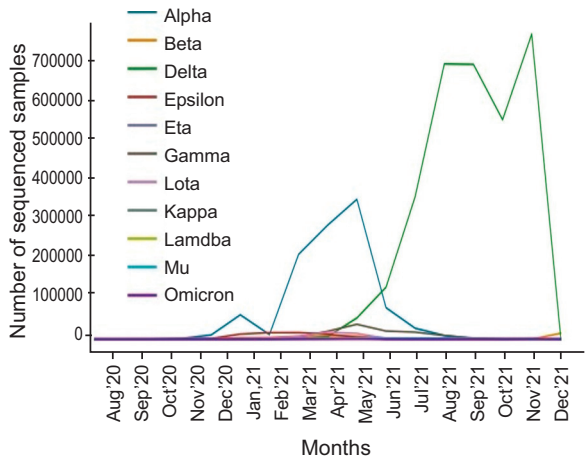


**Fig. 6.** Effect on rate of infection caused by several variants of corona virus strains during pandemic.

**Decipher the SARS-CoV-2: a new member of corona virus family.** The family of zoonotic coronaviruses was identified in 1960s that begins the journey of recognition of human pathogenic coronaviruses family. So, far now seven coronaviruses that infect humans has been identified (Chen *et al*., 2020). The latest member added in this family is the causative agent of current pandemic (COVID-19) is SARS-CoV-2 which is more infectious compared to SARS-CoV and MERS-CoV epidemic in 2002 and 2012 respectively. The members of human coronavirus family that lead to mild diseases are HcoV-OC43, HcoV-229E, HcoV-HKU1 and HcoV-NL63, while pathogenic members include middle east respiratory syndrome coronavirus (MERS-CoV), acute respiratory syndrome corona virus (SARS-CoV) and acute respiratory syndrome coronavirus-2 (SARS-Co V-2) (van der Hoek, 2007). The helical and symmetrical of 125 nm diameter capsid of coronavirus constitute of large single stranded, positive sense RNA (+ssRNA) of 26-32 Kb in size, considered as the largest available genome among RNA viruses. Coronaviruses are enveloped similar to crown like structure with spikes bulging out from the surface looks like a solar virus. Coronaviruses belong to order nidovirales, coronaviridae family and subfamily of Ortho coronavirinae. They are classified into four genera Alpha coronavirus(α-CoV), Betacoronavirus (β-CoV), Gamma coronavirus (γ-CoV), Delta coronavirus (d-CoV) (Neuman and Buchmeier, 2016; Li, 2016). Coronavirus related to subgenus Sarbe covirus of Beta corona virus genus (Bhanushali *et al*., 2020). Although SARS-CoV2 shows 88% sequence homology with bat-derived two CoVs: bat-SL-CoVZC45 and bat-SL-CoVZXC21 (Li, 2016). Although SARS-CoV2 found to be distinct from SARS-CoV and MERS-CoV by showing 79% and 50% homology respectively (Barcena *et al*., 2009). Coronaviruses can also be distinguished into two types based on their target host (human and animals) (Erles *et al*., 2003). Based on MERS-CoV and SARS-CoV it is assumed that SARS-CoV-2 also originated from bats. The closest possible SARS-CoV-2 bat precursor is BatCoV-RaTG13 and SARS-CoV shows 97% and 76% sequence similarity

to SARS-CoV-2 (Barcena *et al*., 2009). The mutation rates of CoVs (coronaviruses) are comparatively high as their ssRNA counter parts. The two major mutating hot spots of SARS-CoV are open reading frame (ORF8) accessory gene and gene of spike (S) protein. However, the S gene of SARS-CoV-2 differs due to the presence of short three insertions in the N-terminal domain and variation in the receptor binding motif in four out of five key residues (Zhou *et al*., 2020; Su *et al*., 2016).

**Governmental measures in flattening the pandemic curve.** Unfortunately, due to pre-dominant potential of SARS-CoV-2, it is impossible to identify the individuals with mild symptoms or pre-symptomatic infections. The best preventive global strategy government has taken to curb the spread of COVID-19 is the implementation of nation wise strict lockdown among susceptible population depending on incidence rate in order to confine and cease the movement of people and all possible activities, social gatherings, closure of educational and training institutes, public and government offices and to some extent limited out-patient department services (Li *et al*., 2020; Liu *et al*., 2020; López and Rodó, 2020). The non-pharmaceutical interventions include the use of protective masks and gloves should be made mandatory at all-time especially during social gatherings with the aim to minimize the risk of infection when one comes in contact with infected people or a symptomatic individuals (Peres *et al*., 2020; Röst *et al*., 2020). These stringent policies turn to be very effective in flattening the curve of the COVID-19 infection and results in fewer deaths. The highly targeted preventive measures are quarantine, contact tracing and increase in testing capacity which governments of all susceptible nations should adopt in order to curb the spread of COVID-19 infection (Ali *et al*., 2020). We should learn and change ourselves with sensible and preventive approach to live in this current situation. By taking care of our own selves we can stop the spread of infection among susceptible population (Flaxman *et al*., 2020). The control and pandemic preventive measures administered by government worldwide has played a significant role in reducing the rate of transmission and mortality.

Comparison of different coronavirus variants with number of cases caused by each strain reported so far has been depicted in the graph. This graph only provides an approximation of the current scenario till 12 December 2021 (Picheta, 2021).

**COVID-19 and cancer.** The immuno-suppressed repute of most cancers' sufferers (either due to illness or the treatment) will increase the threat of infection as related with the general populace. Immuno-suppression may additionally reveal cancer sufferers to severe headaches from an infection, that delays treatment and hospitalizations that ultimately affect disease prognosis (Liang *et al*., 2020). The cancers sufferers faced multiple threat of extreme infections with an ~three to five-fold hike in the risk of mechanical air flow, emergency treatment or risk of death in relation with patients with no history of cancers. The susceptibility of extreme complications of COVID-19 faced by cancer sufferers' can be associated to the immuno-suppressed fame resulting due to the malignant nature and anticancer treatments, including chemotherapy or surgical procedure (Wang and Zhang, 2020). The chemotherapeutic or surgically operated patients within 30 days of getting infected with COVID-19 shows prominent complications than non-infected patients (Kezerashvili *et al*., 2007). The case of 57 years old Chinese male was reported that found to be affected with lung cancers with symptoms of cough, high fever, breath shortness, diarrhea and myalgia followed by diagnosed for COVID-19. The treatment of lung cancer patients with gefitinib (an epidermal growth thing receptor (EGFR) inhibitor) begins in February 2016, followed by simertinib monotherapy, whilst the gefinitib resistance causes mutation EGFR T790M become detected upon sickness development. COVID-19 can be treated with lopinavir/ritonavir (a combination of protease inhibitors normally used to deal with HIV1 contamination). Advanced pneumonia found to be curable after 2 weeks of treatment indicating a potential therapy for COVID-19 (Meini *et al*., 2020). In the mentioned case, on the basis of the affected person's medical condition the continuation of simertinib remedy was allowed regardless of the diagnosis of COVID-19 (Wu *et al*., 2020). In COVID-19 pandemic, the cancer patients are confined access to required fitness care and incapability to acquire necessary clinical offerings in a well-timed fashion, in particular in excessive hazard epidemic areas like Wuhan, China, wherein there's an excessive call for on medical personnel and health care centers (Sun *et al*., 2021). Fitness care companies should take note of the treatment associated destructive outcomes in lung cancer sufferers who are dealt with immune checkpoint inhibitors (which includes severe myocarditis and pneumonitis): such side results may additionally negatively affect the sufferers' survival,

accordingly, it is far essential to identify and treat such conditions directly (Ketkar *et al*., 2019). A currently posted retrospective cohort look at recruited 28 most cancers sufferers with confirmed COVID-19 from three hospitals in Wuhan, China to evaluate the risk elements associated with ICU admission, mechanical ventilation or demise. According to this study COVID-19 inflamed cancer sufferers have a high danger of poor clinical consequences of extreme occasion and mortality (Zumla *et al*., 2016). Cancer treatment within 14 days of COVID-19 prognosis found to restrict chance of several extreme outcomes. Acute respiration distress syndrome (28.6%), septic surprise (3.6%) and acute myocardial infarction (3.6%) are extreme complications within infected population. Surprisingly, 28.6% of the above mentioned study sufferer's evolved COVID-19 infection, while hospitalized that is specifically attributed to the nosocomial transmission (Carter *et al*., 2020). Such findings spotlight the importance of imposing strict contamination control measures and treating cancer sufferers in an outpatient setting in preference to hospitalization. The study suggested that most cancers patients currently on cancers treatments have to go through screening for COVID-19 contamination and keep away from immuno-suppressive remedy in case infection (Wang *et al*., 2020).

**Infection susceptibility to cancer patients.** Cancer patients are also more sensitive to SARS-CoV-2 infection due to their underlying immuno-compromised state (Zhang *et al*., 2020). It's been observed in various reported studies that, the risk of infection to cancer patients is 3.56% higher compared to other diseases (Davis *et al*., 2020, Ritchie, 2020). The study found that up to 4% of infected patients had baseline disease diagnosis and a cancer patient who is seriously infected with COVID-19 usually accounts for up to 20% of the COVID-positive rate (Sha *et al*., 2020). In any case, it is observed that COVID-19 affect all patients with the disease similarly, as some investigations have found that cancer patients with a subset of specific tumors may be at a much greater risk for the infection (Passaro *et al*., 2021). The patients with hematologic, lung or other metastatic malignancies, as well as individuals, who had recently undergone careful resection techniques, were at greater risk of severe disease following SARS-CoV-2 infection (Oh, 2020). It is been observed that patients with non-metastatic malignancy are at a comparable hazard for serious outcomes from COVID-19 as anyone. Age advancement appears to widen the complications of COVID-19 in cancer patients, as the disease rate in cancer patients with COVID-19 is fundamentally more significant as patient age increases (Qin *et al*., 2020). The high susceptibility rate of cancer patients to COVID-19 infection and the side effects of life-threatening disease has prompted several patients to delay their treatment (Patel *et al*., 2021). As reported in a study 9% of patients with lung cellular disintegration withhold their cancer medications of which 80% chose to withhold medications on their own as opposed to clinical or family request. It is reported that a delay of about a month in all types of cancer treatment led to increase patient's mortality and that a delay of more than about a month can be result in significant complications. In such ongoing pandemic cancer patients should continue their standard treatment to avoid worsening their prognosis (Lemos and Silva, 2022; Abid *et al*., 2020, Indini *et al*., 2020, Qin *et al*., 2020; Wang *et al*., 2020).

**Complications of COVID-19 in cancer patients.** The most challenging medical concern is the potential cardiovascular complications that may occur in cancer patients who have been affected by SARS-CoV-2. The risk factors in cancer patients with COVID infection include embolism, stroke, arrhythmias, and other heart wounds. During cancer treatment several different drugs also associated with an increased likelihood of causing specific cardiovascular problems in patients that can be worsened upon COVID-19 infection (Ocanto and Mielgo-Rubio, 2023; Abid *et al*., 2020). The major complications that could happen COVID-19 patients along with malignant growth include blood balance, vessel wall damage and hyper coagulation that leads to the possibility of apoplexy although this synergistic effect of COVID-19 infection with cancer progression induces multiple cardiovascular complications those are still not fully understand. It is generally believe that hyper-inflammatory response due to these can accelerate the risk and damage in cardiovascular system (Qin *et al*., 2020).

**Impact of COVID-19 on cancer patients.** The current data on oncology management is used to determine the adverse impact of the pandemic along with the national death registrations data up to June 2020, to estimate the historical death rate (before pandemic) of cancer patients. Baseline mortality risks for 24 cancers with and without comorbidities related to COVID-19 were obtained from a primary care population of 3,862,012

individuals in England. The percentage of infection in several types of cancers has been mentioned in Fig. 7. During pandemic massive decline in consultation and chemotherapy treatment were observed (Gopalaswamy and Subbian, 2021). The data of meta-analysis showed that the pooled incidence of cancer in COVID-19 patients was 6% (95% CI: 3%–9%), while mortality rate of cancer patients with COVID-19 was much higher than in patients without cancer (Williams, 2018).

Among cancer patients infected with SARS-COX-2, the proportions of lung, colorectal, breast, esophageal, bladder, pancreas, and cervical cancers has been mentioned. These findings were also confirmed by the results of the GEPIA database (NIH, 2022).

According to the data reported there were 3775 patients of whom 63 (1.66%) had cancer. Pooled estimates of ICU admissions for COVID-19 patients with and without cancer were 40% versus 8.42%. The odds ratio for ICU admission between the cancer and non-cancer groups was 2.88 with 95% CI 1.18 to 7.01 (P = 0.026). The pooled mortality estimates for COVID-19 patients with and without cancer were 20.83% versus 7.82%. The odds ratio for mortality between the cancer and non-cancer groups was 2.25% with a 95% CI. The pooled prevalence of cancer patients was 2% (Farhangnia *et al*., 2022).

**Testing data management.** According to the reports of CDC (Centers for Disease Control and Prevention) the statistical reporting of novel corona test combines antibody and viral tests which results in marked discrepancy in country testing data. The mixing of result of two independent tests deviates the original test capacity of the country (Zhang *et al*., 2020). The current COVID-19 Data website does not publicly differentiate the test results between viral and antibody analysis thus leads to misinterpretation of total number of confirmed cases within that region and skewing the total positive rate of the test (Deeks *et al*., 2020).

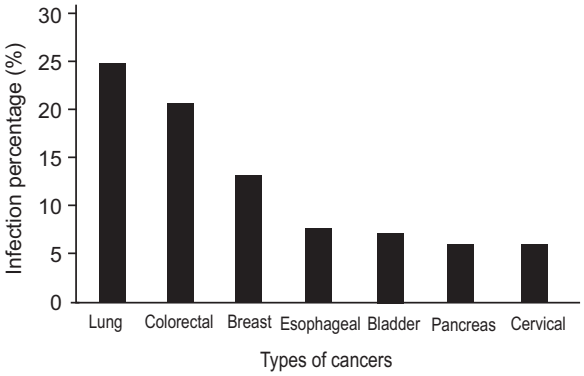


**Fig. 7.** Percent incidence of COVID-19 infection among different types of cancers.

**Worldwide testing scenario update.** To generate the daily testing series, we believe that testing changed equally on a daily basis over any time periods in which countries did not report on a daily basis. Testing data provide the real picture and basic understanding of the spread of the current outbreak thus global dataset on COVID-19 testing is the major reflection of the current scenario of the cases. Country wise variation exist in respect to reporting of the number of people tested, while some other report the number of test (could be higher because repeated testing of the same individual). Thus, the reporting of worldwide testing data is not uniformed and confusion still lies behind the actual test count. Currently worldwide the number of cases reported is low compared to the number of total cases due to the limited testing capacity of the country therefore in such countries actual number of infections are still high than the number of reported cases.

## Conclusion

The current COVID-19 outbreak poses a significant global threat, impacting the economy, public health and the healthcare sector with uncertain long and short term consequences. To address this, there's a need for curative and preventive approaches, including drug discovery and effective vaccines. Implementing non-therapeutic measures like social distancing, hygiene practices and case isolation can help control the spread. The global response involves collaboration across industries, government and academia. Innovative therapeutic approaches, such as immune cell therapy and mesenchymal stromal cell therapy, show promise, undergoing clinical trials for efficacy and safety. The urgent call for innovation highlights the importance of advancing treatment strategies with improved profiles against viral pandemics, including detailed investigations of repurposed drugs with antiviral activity in humans.

**Conflict of Interest.** The authors declare that they have no conflict of interest.

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