



# Cancer and COVID-19: A Double Burden on the Healthcare System

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## Abstract

The COVID-19 pandemic has placed an unprecedented burden on the healthcare system. In particular, the intersection of COVID-19 and cancer has created a double burden on the healthcare system, presenting challenges in both the diagnosis and treatment of cancer. During the pandemic, overcrowding of hospitals and clinics, shortages of personal protective equipment (PPE) and other medical supplies, and the impact of COVID-19 on healthcare workers have all made it more difficult to care for cancer patients. The challenges in cancer diagnosis and screening during the pandemic have included delays in cancer diagnoses, decreased access to cancer screenings, and a decrease in the number of cancer surgeries being performed. Changes in cancer treatment patterns and access to care during COVID-19 have also impacted the treatment outcomes for cancer patients, with a decrease in the number of cancer patients being treated and an increased risk of poor outcomes for those who are being treated. The impact of COVID-19 on healthcare workers and their ability to care for cancer patients has also been significant, with healthcare workers facing increased exposure to the virus, increased workloads, and increased stress and burnout. The double burden of COVID-19 and cancer on the healthcare system has implications for policy and practice, including the need for improved coordination between cancer and COVID-19 response efforts and the need for increased investment in healthcare infrastructure and resources. In conclusion, the COVID-19 pandemic has created a double burden on the healthcare system, with significant challenges in the diagnosis and treatment of cancer. The impact of COVID-19 on healthcare workers and the healthcare system more broadly highlights the need for improved coordination and increased investment in healthcare resources and infrastructure.

**Keywords:** Burden, Cancer, COVID-19, Diagnosis and treatment, Healthcare system, Pandemic

## 1. Introduction

### 1.1. Background information on cancer and COVID-19

Cancer is a complex and heterogeneous group of diseases characterized by the uncontrolled growth and spread of abnormal cells. Cancer is a leading cause of death worldwide and is estimated to cause approximately 9.6 million deaths in 2018 alone (1). Despite significant advances in cancer research and treatment, the incidence of cancer continues to increase, making it a major public health challenge (2). In 2023, 1,958,310 new cases of cancer and 609,820 cancer deaths have occurred in the United States alone (3).

COVID-19, on the other hand, is a highly infectious respiratory illness caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (4). The first cases of COVID-19 were reported in Wuhan, China in December 2019 and it rapidly spread globally, becoming a pandemic in a matter of months (5). The COVID-19 pandemic has had a profound impact on healthcare systems worldwide, leading to shortages of medical supplies, equipment and personnel, and overwhelming healthcare facilities with a large number of patients (6).

The intersection of COVID-19 and cancer is a growing concern, as cancer patients are at increased risk of severe illness and death from COVID-19 (7). In addition, the pandemic has led to significant

disruptions in the delivery of cancer care, including delays in diagnosis and treatment, reduced access to clinical trials, and disruptions to ongoing care for cancer patients. This has resulted in a double burden on the healthcare system, as healthcare workers struggle to provide care for both cancer patients and COVID-19 patients (8). Therefore, understanding the impact of COVID-19 on cancer patients and the healthcare system is of utmost importance in order to minimize the negative effects of this pandemic on cancer care and improve outcomes for cancer patients.

### 1.2. Purpose of this study

The purpose of this review article is to provide a comprehensive examination of the intersection of COVID-19 and cancer. With the ongoing COVID-19 pandemic and its impact on global health, it is essential to understand the effects of the virus on cancer patients and healthcare systems. The intersection of COVID-19 and cancer creates a double burden on healthcare systems and poses unique challenges and risks for cancer patients.

This review aims to provide a synthesis of the current state of knowledge regarding the impact of COVID-19 on cancer diagnosis and treatment, as well as the impact of cancer on COVID-19 outcomes. It will examine the challenges faced by healthcare systems and healthcare workers in providing care for cancer

patients during the pandemic, as well as the impact of COVID-19 on treatment outcomes for cancer patients.

The findings from this review will have important implications for policy and practice, as well as for future research in the field. It will provide a valuable resource for healthcare providers, researchers, and policy makers in their efforts to navigate the complex and rapidly evolving landscape of COVID-19 and cancer. By highlighting the challenges and risks posed by the intersection of these two diseases, this review will help to inform the development of strategies to mitigate their impact on healthcare systems and patients.

### 1.3. Research questions and objectives

The intersection of COVID-19 and cancer has raised a number of important research questions that need to be addressed in order to understand the impact of the pandemic on cancer patients and the healthcare system. The primary research questions for this review paper are:

- 1) How has the COVID-19 pandemic impacted the incidence and progression of cancer?
- 2) How has the delivery of cancer care been disrupted by the COVID-19 pandemic and what are the consequences for cancer patients?
- 3) What is the impact of COVID-19 on healthcare workers and the healthcare system as they try to care for cancer patients and COVID-19 patients simultaneously?

### 1.4. Overview of the structure of the article

The review paper entitled "Cancer and COVID-19: A Double Burden on the Healthcare System" is structured in five main sections. Section 2 provides an overview of COVID-19 and cancer, including definitions and epidemiology, the intersection of COVID-19 and cancer, and the potential long-term effects of the COVID-19 pandemic on cancer research and funding. Section 3 examines the challenges and changes in cancer diagnosis and treatment in the context of COVID-19, including difficulties in cancer diagnosis and screening, alterations in treatment patterns, and the impact of COVID-19 on treatment outcomes. Section 4 focuses on the burden on healthcare systems, including overcrowding of hospitals and clinics, shortages of medical supplies and protective equipment, and the impact of COVID-19 on healthcare workers. In Section 5, the main findings are summarized, implications for policy and practice are discussed, limitations are identified, future research directions are outlined, and final thoughts are provided on the double burden of COVID-19 and cancer on the healthcare system.

## 2. COVID-19 and Cancer: Overview

### 2.1. Definition and epidemiology of COVID-19

COVID-19, also known as the novel coronavirus

disease, is a respiratory illness caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (4). The virus was first identified in Wuhan, China in December 2019 and has since spread globally, leading to a global pandemic (5). The World Health Organization declared the outbreak a pandemic on March 11, 2020. As of the knowledge cut-off in 2023, the virus has affected over 676 million people worldwide and has caused over 6.7 million deaths (9).

The epidemiology of COVID-19 includes the study of the distribution, determinants, and control of the virus. The virus is primarily spread through respiratory droplets produced when an infected person talks, coughs, or sneezes. COVID-19 primarily affects the respiratory system and can cause severe illness, hospitalization, and death, especially in older adults and those with underlying health conditions. The virus has also had a significant impact on global economies, with widespread disruptions in travel, trade, and work (10). So that its destructive effects have been much greater in countries that have not been successful in controlling the disease (11).

Long COVID, also known as long haulers, Post-COVID-19 syndrome (PCS), or Post-acute sequelae of COVID-19 (PASC), refers to a chronic form of illness that some people experience after recovering from COVID-19. Long COVID is characterized by a range of persistent symptoms that can last for months after the initial infection, even in people who had mild or asymptomatic cases of COVID-19 (12).

The symptoms of long COVID can vary widely from person to person and can affect multiple organ systems in the body. Some of the most common symptoms include; fatigue, shortness of breath, chest pain or tightness, joint pain, muscle weakness or pain, headaches, brain fog or cognitive difficulties, loss of taste or smell, sleep disturbances, mood changes, such as anxiety or depression, and digestive issues, such as nausea, diarrhea, or abdominal pain (13).

The exact cause of long COVID is not yet fully understood, but it is thought to be related to the body's immune response to the initial infection. In some cases, long COVID may be caused by persistent viral infection, while in others, it may be due to an autoimmune response or other factors. Long COVID can have a significant impact on a person's quality of life and ability to work or engage in daily activities. It is more common in older adults and people with pre-existing health conditions, but it can occur in anyone who has had COVID-19 (14). Currently, there is no specific treatment for long COVID, but doctors may recommend medications or therapies to manage individual symptoms. Rehabilitation, physical therapy, and occupational therapy may also be helpful in managing the long-term effects of the illness. Prevention is the best approach to long COVID. Getting vaccinated against COVID-19 and

following public health guidelines, such as wearing masks and practicing social distancing, can reduce the risk of contracting COVID-19 and developing long COVID (15).

COVID-19 is primarily a respiratory illness caused by the SARS-CoV-2 virus. However, the virus can also affect other organs and systems in the body, leading to a wide range of complications and comorbidities. Some of the most common comorbidities associated with COVID-19 include (16):

1. Cardiovascular disease: COVID-19 can cause damage to the heart, leading to conditions such as myocarditis (inflammation of the heart muscle), heart failure, and arrhythmias (irregular heartbeat). People with pre-existing cardiovascular disease are at higher risk of severe illness and death from COVID-19.

2. Diabetes: People with diabetes are at higher risk of severe illness and death from COVID-19. COVID-19 can also cause a temporary increase in blood sugar levels, even in people without diabetes.

3. Obesity: Obesity is a risk factor for severe illness and death from COVID-19. COVID-19 can also cause a temporary increase in inflammation in the body, which can worsen obesity-related complications.

4. Kidney disease: COVID-19 can cause kidney damage, leading to acute kidney injury or worsening of pre-existing kidney disease.

5. Neurological complications: COVID-19 can cause a range of neurological symptoms, including headache, confusion, seizures, and stroke. It can also cause long-term neurological complications, such as memory loss and cognitive impairment.

## 2.2. Definition and epidemiology of cancer

Cancer is a group of diseases characterized by the uncontrolled growth and spread of abnormal cells in the body (1). It is one of the leading causes of death globally, with an estimated 9.6 million deaths in 2018 alone (17). The incidence of cancer varies widely depending on various factors such as age, gender, lifestyle, genetics, and environment. Some of the most common types of cancer include breast, lung, prostate, and colorectal cancer (17).

Cancer is a complex and multi-faceted disease that requires a comprehensive and integrated approach to treatment and management (18). It typically involves a combination of surgical, medical, and radiation therapies, as well as supportive care to manage symptoms and improve quality of life. The management of cancer is often complicated by the presence of other medical conditions, such as comorbidities, and the side effects of treatment (19).

The epidemiology of cancer has been the subject of extensive research and analysis. Studies have shown that the incidence of cancer is increasing globally, particularly in low- and middle-income countries, due to factors such as aging populations, changing lifestyles, and exposure to environmental

risk factors (20). Additionally, disparities in access to cancer care and treatment continue to be a major challenge, particularly in resource-limited settings. Understanding the epidemiology of cancer and its impact on populations and healthcare systems is essential for developing effective strategies for cancer prevention, early detection, and treatment.

## 2.3. The intersection of COVID-19 and cancer

The impact of COVID-19 on the incidence and progression of cancer is an area of active research. Some studies have suggested that the pandemic has led to a decrease in the number of cancer diagnoses due to delays in seeking medical care, disrupted screening programs, and reduced access to care (21). However, there is also evidence to suggest that COVID-19 may increase the risk of cancer development by altering the immune system, causing oxidative stress, and leading to lifestyle changes such as weight gain and decreased physical activity (22). The relationship between COVID-19 and cancer is complex and multifactorial, and further research is needed to fully understand the impact of the pandemic on the incidence and progression of cancer.

In recent years, the impact of COVID-19 on the incidence and progression of cancer has been a subject of much interest and research. Studies have shown that COVID-19 can cause a delay in cancer diagnosis and treatment, due to the need for quarantine measures, screening and treatment disruptions, and the reallocation of healthcare resources to deal with the pandemic (23). For example, some studies have reported that routine cancer screening programs, such as mammography and colonoscopy, have been postponed or cancelled due to the pandemic, resulting in a decreased number of diagnoses and an increased risk of advanced cancer at diagnosis (24, 25).

Additionally, there is evidence that COVID-19 may have a direct impact on cancer progression, with some studies reporting a higher rate of cancer progression and a lower rate of survival in patients with COVID-19 and cancer compared to those with only cancer. This may be due to a variety of factors, including an impaired immune system, the need for treatments that are less effective, and the reduced ability of healthcare workers to provide adequate care for cancer patients (24, 26).

It is also important to consider the potential for a synergistic effect between COVID-19 and cancer, as the two diseases may interact in complex ways to impact overall health outcomes. For example, cancer treatments may increase the risk of severe COVID-19 complications, and COVID-19 may lead to a delay in cancer treatment, leading to a greater risk of cancer progression. The intersection of COVID-19 and cancer is a complex and rapidly evolving area of research, with the potential to significantly impact healthcare systems and patient outcomes.

#### 2.4. The social and economic impacts of the COVID-19 pandemic on cancer patients

COVID-19 pandemic has a prevalent impact on social and economic situation of households. Due to taking over a large part of the medical care system during the COVID-19 epidemic, cancer patients were severely affected by this pandemic. The most common mental concern in cancer patients during the pandemic period were the worry and/ or fear around getting COVID-19 (27). Several studies reported increased anxiety in cancer patients during the pandemic (27, 28). Widespread quarantines during the Covid-19 pandemic caused economic downturn and had many negative consequences on labor markets. Cancer patients were very worried about losing their jobs and the consequences of the economic crisis for their families. Due to these economic conditions, the financial burdens of cancer, such as paying prescriptions and high insurance deductibles, were aggravated, especially in private health centers. In this connection, cancer patients that were unemployed or with lower income and with a low level of education faced more problems in accessing care (27, 29).

#### 2.5. The long-term effects of the COVID-19 pandemic on cancer research

The potential long-term effects of the COVID-19 pandemic on cancer research and funding are concerning. Here are some of the possible effects (30):

1. Delay in Research Progress: the pandemic has caused disruption to research operations, reducing the number of experiments that can be conducted and delaying the progress of important projects. This will reduce the amount of progress made in cancer research.
2. Decrease in Funding: governments and other funding bodies are under significant financial strain due to the pandemic, and this could result in a reduction in funding for cancer research projects.
3. Reduced Access to Resources: with fewer people able to work in research labs and fewer funds available, cancer researchers may have reduced access to the resources they need to conduct their research.

These long-term effects could have a major impact on the future of cancer research. It is important to ensure that funding and resources remain available to ensure that progress can continue to be made.

#### 2.6. The role of oxidative stress in cancer and COVID-19

Oxidative stress is a state in which there is an imbalance between the production of reactive oxygen species (ROS) and the ability of the body to detoxify these harmful molecules. ROS can damage cellular components such as DNA, proteins, and lipids, leading to cellular dysfunction and death (31).

In cancer, oxidative stress plays a significant role

in the initiation and progression of the disease. Cancer cells are known to produce higher levels of ROS than normal cells, which can cause DNA damage and promote genetic mutations that lead to cancer development. Additionally, cancer cells can also activate antioxidant pathways to protect themselves from oxidative stress and maintain their survival and growth. Targeting oxidative stress has been proposed as a potential therapeutic approach for cancer treatment (32).

Similarly, oxidative stress has also been implicated in the pathogenesis of COVID-19. The SARS-CoV-2 virus induces an inflammatory response in the body, which leads to the production of ROS and the development of oxidative stress. This oxidative stress can cause damage to lung tissue and contribute to the severity of COVID-19 symptoms (33). Furthermore, the virus also targets and disrupts the body's antioxidant defense mechanisms, leading to an even greater increase in oxidative stress. Therefore, managing oxidative stress may be an important therapeutic strategy for COVID-19 treatment, and antioxidants such as vitamin C and N-acetylcysteine have been studied for their potential benefits in this regard (34).

#### 2.7. The role of antioxidants as a therapeutic approach for cancer and COVID-19

Diet and nutrition play a crucial role in maintaining our overall health and well-being, including our immune system function. Antioxidants are compounds found in many foods that can help protect cells from damage caused by harmful molecules known as free radicals. These free radicals can contribute to various diseases, including cancer and viral infections like COVID-19 (35).

Cancer is a complex disease that can be caused by multiple factors, including genetics, lifestyle, and environmental factors. Antioxidants found in foods such as fruits, vegetables, nuts, and seeds have been shown to have protective effects against cancer by reducing oxidative stress and inflammation. For example, studies have found that diets rich in fruits and vegetables are associated with a reduced risk of several types of cancer, such as lung, colon, and breast cancer (35).

Similarly, COVID-19 is a viral infection caused by the SARS-CoV-2 virus that primarily affects the respiratory system. Antioxidants such as vitamins C, E, and A, as well as selenium and zinc, have been shown to have beneficial effects on the immune system and may help prevent or reduce the severity of COVID-19 symptoms. For example, vitamin C has been found to reduce the duration and severity of respiratory infections, including COVID-19 (36).

It's worth noting that while a diet rich in antioxidants can be beneficial for both cancer prevention and COVID-19, it should not be considered a substitute for medical treatment. If you



have been diagnosed with cancer or COVID-19, it's important to follow your doctor's recommended treatment plan and speak to a registered dietitian or nutritionist to determine how best to incorporate antioxidant-rich foods into your diet.

### 3. Diagnosis and Treatment of Cancer in the Context of COVID-19

#### 3.1. Challenges in cancer diagnosis and screening during the pandemic

The COVID-19 pandemic has presented a number of challenges for cancer diagnosis and screening. With a focus on containing the spread of the virus, many healthcare facilities have postponed or delayed non-emergency procedures and appointments, including cancer screening and diagnostic tests. This has resulted in a decrease in the number of people being screened for cancer, leading to a potential increase in advanced stage diagnoses and poorer prognoses for patients (24).

In addition to decreased screening, the pandemic has also impacted the availability of imaging and diagnostic equipment, as well as access to biopsy procedures, due to increased demand for equipment and supplies for COVID-19 patients. Furthermore, the fear of exposure to the virus has resulted in decreased patient compliance with diagnostic procedures and appointments, further exacerbating the challenge of timely and accurate cancer diagnosis during the pandemic (37).

One study has shown that the COVID-19 pandemic has led to a decrease in the number of cancer screenings and diagnostic procedures. This reduction in cancer diagnosis has resulted in a delay in the initiation of treatment, which may lead to a more advanced stage of cancer at the time of diagnosis. This can result in a worse prognosis for the patient, as well as increased healthcare costs (38).

The challenges faced in cancer diagnosis and screening during the COVID-19 pandemic have been well documented in several studies (39). A study conducted in Italy found that there was a decrease in the number of cancers diagnoses during the early stages of the pandemic, with a subsequent increase in advanced stage diagnoses once the pandemic subsided. Another study conducted in the United States reported similar findings, with a decline in cancer screening during the pandemic and an increase in diagnoses of more advanced stage cancers (40).

Overall, the COVID-19 pandemic has had a significant impact on the incidence and progression of cancer. The literature suggests that there has been a reduction in cancer screening and diagnostic procedures, disruptions in the delivery of cancer treatments, and increased anxiety and psychological distress among cancer patients. Further research is needed to fully understand the impact of the COVID-

19 pandemic on cancer outcomes and to develop strategies to mitigate its effects.

#### 3.2. Changes in cancer treatment patterns and access to care during COVID-19

The COVID-19 pandemic has caused significant disruptions in healthcare systems around the world, leading to changes in the way cancer treatments are delivered. Several studies have reported that the COVID-19 pandemic has resulted in a reduction in the number of cancer patients receiving treatment and an increase in delays in treatment initiation (41). Studies have shown that the COVID-19 pandemic has led to decreased utilization of cancer treatments such as chemotherapy, radiotherapy, and surgery (42, 43). Based on the results of several studies, the pandemic has significantly increased the use of nonsurgical therapy as the primary treatment of cancer (44). For example, a study conducted in the United Kingdom reported that during the first wave of the COVID-19 pandemic, there was a 27% reduction in the number of patients receiving chemotherapy (45). The reductions in treatment utilization are thought to be due to a combination of factors including fear of exposure to the virus, disruptions in the supply chain for chemotherapy drugs, and changes in hospital protocols for administering treatments.

In addition to decreased utilization of cancer treatments, the COVID-19 pandemic has also resulted in changes in the way cancer treatments are delivered. For example, there has been an increased use of telemedicine for cancer consultations and follow-up appointments. This has allowed for cancer patients to receive medical care from the safety of their own homes, reducing their exposure to the virus. Furthermore, some hospitals have adapted to the pandemic by offering drive-thru chemotherapy services and curbside infusions, further reducing the risk of exposure to the virus (46).

However, changes in treatment patterns and access to care have also resulted in challenges for cancer patients and healthcare providers. For example, the increased use of telemedicine has led to difficulties in accessing specialist care and obtaining accurate diagnoses. Furthermore, changes in treatment delivery have led to disruptions in the supply chain for cancer treatments, leading to shortages and delays in treatment (46, 47). These challenges have highlighted the need for a more comprehensive approach to cancer treatment during the COVID-19 pandemic, one that balances the need to reduce the risk of exposure to the virus with the need to provide cancer patients with access to effective treatments.

#### 3.3. The impact of COVID-19 on treatment outcomes for cancer patients

The COVID-19 pandemic has had a significant impact on the treatment outcomes for cancer

patients. Many cancer patients have been unable to receive timely and adequate treatment due to the pandemic, leading to worsened outcomes. Several studies have shown that cancer patients infected with COVID-19 have a higher risk of death compared to those without the virus (48). Additionally, the pandemic has resulted in a slowdown of cancer treatments, with some patients experiencing delays or interruptions in their care. This has not only led to worsened health outcomes, but also increased psychological stress and financial burden for patients and their families (23, 49).

The pandemic has also resulted in changes in the delivery of cancer treatments, with a shift towards telemedicine and remote consultations. However, this shift has resulted in disparities in access to care for cancer patients, with some patients unable to receive adequate treatment due to limitations in telemedicine infrastructure. The shift towards telemedicine has also raised concerns about the quality and safety of care, with some studies indicating that patients may not receive the same quality of care through telemedicine as they would in person (40).

The pandemic has also had an impact on the availability and administration of cancer treatments, with some treatments being deferred or discontinued due to supply chain disruptions and shortages of personal protective equipment (PPE) for healthcare workers (22, 41). This has resulted in decreased access to certain treatments, particularly those that require hospitalization or close contact with healthcare workers. Additionally, the pandemic has led to increased workload for healthcare workers, who are already facing increased stress and burnout due to the pandemic.

## 4. The Burden on Healthcare Systems

### 4.1. Overcrowding of hospitals and clinics due to COVID-19 and cancer

The ongoing COVID-19 pandemic has placed a significant strain on the healthcare system, particularly on hospitals and clinics that are grappling with increased patient loads. This is especially true for facilities that are treating both COVID-19 patients and cancer patients, who have unique and complex healthcare needs. Overcrowding in hospitals and clinics as a result of the pandemic has become a major issue, affecting not only patients with cancer but also patients with other health conditions. The situation is exacerbated by the high rates of COVID-19 transmission, which is putting additional pressure on the healthcare system (50).

Studies have shown that overcrowding in hospitals and clinics has had a negative impact on the quality of care for cancer patients. Delays in the initiation of treatment and diagnostic tests can lead to the progression of the disease, which can result in

poorer outcomes for patients (51). This is particularly concerning for those with advanced-stage cancer, who may require urgent or emergency care. Additionally, the crowded conditions in hospitals and clinics also increase the risk of healthcare-associated infections, which can further complicate the care of cancer patients (52).

### 4.2. Shortages of PPE and other medical supplies during the pandemic

The COVID-19 pandemic has placed a significant burden on healthcare systems worldwide, and this burden has been further exacerbated by the impact of the pandemic on cancer patients and the healthcare workers who care for them. One aspect of this burden is the shortage of personal protective equipment (PPE) and other medical supplies, which has become a critical issue in many countries (53, 54).

Studies have reported widespread shortages of PPE such as masks, gloves, gowns, and eye protection, which pose significant risks to both healthcare workers and patients with cancer. The shortage of PPE has resulted in an increased risk of transmission of the virus and other infections in healthcare settings, putting both healthcare workers and cancer patients at increased risk (55). Additionally, the shortage of PPE has also resulted in decreased access to care for cancer patients and reduced quality of care, as healthcare workers are unable to provide the level of protection required to safely care for patients.

In addition to PPE shortages, the COVID-19 pandemic has also resulted in a shortage of other medical supplies such as ventilators, medications, and equipment required for cancer treatments. The shortage of these supplies has disrupted the delivery of cancer care, with patients facing delays in treatment or in some cases, being unable to receive the treatment they need. Furthermore, the shortage of supplies has resulted in increased costs for cancer patients and the healthcare system, as providers are forced to rely on alternative or less effective treatments (56).

### 4.3. The impact of COVID-19 on healthcare workers and their ability to care for cancer patients

The COVID-19 pandemic has had a profound impact on healthcare workers and their ability to care for cancer patients. With the rise of COVID-19 cases, healthcare workers are facing numerous challenges, including exposure to the virus, burnout, and emotional distress. In some cases, healthcare workers have been forced to choose between caring for COVID-19 patients and caring for cancer patients, leading to a strain on the healthcare system (57). This has resulted in a reduced capacity for cancer care and a reduction in the number of healthcare workers available to provide care to cancer patients.

The impact of COVID-19 on healthcare workers and their ability to care for cancer patients is an

additional concern. For example, shortages of personal protective equipment (PPE) and other medical supplies in hospitals and clinics put healthcare workers at risk of exposure to the virus, which has a potentially serious impact on their health and wellbeing. The pandemic has resulted in increased levels of stress and burnout among healthcare workers, who are facing an unprecedented number of patients and are working under challenging circumstances (58). This has had a significant impact on their ability to provide quality care to cancer patients, who are already facing a difficult and life-threatening illness.

The strain on healthcare workers has also had a negative impact on treatment outcomes for cancer patients. With a reduced number of healthcare workers available to provide care, cancer patients may experience longer wait times for diagnosis and treatment, leading to a delay in the initiation of treatment (59). This can result in a worse prognosis for cancer patients, as early diagnosis and treatment is often critical for achieving the best possible outcome.

Moreover, the COVID-19 pandemic has also led to changes in the way cancer patients are treated, with many treatments being delayed or postponed. This has resulted in a decreased availability of treatments, leading to a reduction in the number of cancer patients who are able to receive the care they need. This can have long-term consequences for the health and well-being of cancer patients, as delayed or postponed treatment can result in a worse prognosis.

## 5. Discussion

### 5.1. Summary of the main findings

The COVID-19 pandemic has significantly impacted the healthcare system, including the diagnosis and treatment of cancer patients. The challenges faced by the healthcare system include overcrowding of hospitals and clinics due to COVID-19 and cancer, shortages of PPE and other medical supplies, and the impact of COVID-19 on healthcare workers and their ability to care for cancer patients. The pandemic has also led to changes in cancer diagnosis and treatment patterns, affecting treatment outcomes for cancer patients.

### 5.2. Implications for policy and practice

The findings of this review paper have important implications for policy and practice. The COVID-19 pandemic has highlighted the need for a well-prepared and equipped healthcare system to manage both the COVID-19 pandemic and cancer. It has also emphasized the importance of prioritizing the needs of cancer patients, who are at increased risk during the pandemic. Policymakers should consider investing in the healthcare system to ensure that it is equipped to handle the double burden of COVID-19 and cancer.

### 5.3. Limitations and future research directions

The findings of this review paper are based on a limited number of studies and the available evidence may not be representative of the situation in all countries. In addition, the COVID-19 pandemic is still ongoing, and the full impact of COVID-19 on the healthcare system and cancer patients is not yet known. Further research is needed to better understand the impact of COVID-19 on cancer diagnosis and treatment, as well as the long-term effects of the pandemic on the healthcare system and cancer patients.

## 6. Conclusion

In conclusion, the COVID-19 pandemic has had a profound impact on the healthcare system, particularly in terms of its intersection with cancer. The diagnosis, treatment, and care of cancer patients have been severely challenged by the pandemic, resulting in overcrowding of hospitals and clinics, shortages of PPE and medical supplies, and a strain on healthcare workers. This has had a significant impact on the incidence and progression of cancer, as well as on treatment outcomes for cancer patients. The findings of this review emphasize the need for policy and practice to address the double burden of COVID-19 and cancer on the healthcare system, including strategies to improve access to care, address supply chain issues, and support healthcare workers. However, the limitations and challenges faced in the research, highlight the importance of continued investigation into the long-term impacts of COVID-19 on the healthcare system and on cancer patients specifically. Nevertheless, it is clear that the double burden of COVID-19 and cancer on the healthcare system will require concerted efforts from all stakeholders to ensure that cancer patients receive the care and support they need during these challenging times.

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## Footnotes

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