

Episode #38 – Post-COVID Syndrome (Long COVID) June 11, 2021

Overview

Post-COVID syndrome[1] refers to the long-term enduring symptoms experienced after SARS-CoV-2 infection. In February 2021, the United States National Institutes of Health (NIH) introduced the term post-acute sequelae of SARS-CoV-2 infection (PASC) to collectively refer to the constellation of symptoms many individuals experience long past the time they have recovered from the initial stages of COVID-19. [1]

Public Health Ontario (PHO) currently uses the term post-acute COVID-19 to describe the persistent symptoms related to a past infection. [2] Other common terms utilized include long COVID; post-acute COVID-19 syndrome; persistent post-COVID syndrome (PPCS); long-term COVID; chronic COVID syndrome; late sequelae of COVID-19; and long haul COVID.

Post-COVID syndrome can range from mild to severely disabling and is an emerging condition that is not well understood. The condition was first described in spring 2020 in the context of a survey of prolonged COVID-19 symptoms, administered by the Patient-Led Research Collaborative. Shortly after the first COVID-19 cases evolved, it was observed that numerous individuals with COVID-19 had symptoms persisting for several weeks after acute infection. [3] [4]

Defining the syndrome

Several definitions have been proposed for post-COVID-19 syndrome. For example, PHO defines the condition as persistent symptoms that develop or last beyond 3 weeks after COVID-19 symptom-onset. The three-week period aligns with evidence live or viable virus is rarely detected past 10 days in mild to moderate cases and rarely detected past 20 days in severe cases. [2]

The United Kingdom (UK) National Institute for Health and Clinical Excellence (NICE) defines the condition as signs and symptoms that develop during or after an infection consistent with COVID-19, continue for more than 12 weeks, and are not explained by an alternative diagnosis. [5] Others have described it as persistent symptoms and/or delayed or long-term complications beyond 4 weeks from the onset of symptoms. [6] [7] However, there is no internationally agreed name or definition for the post-COVID-19 condition as of yet. [8]

[1] For ease of use, this document utilizes the term "post-COVID syndrome" as an internationally agreed upon term has not yet been identified.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Most people with COVID-19 experience mild or moderate illness. Approximately 10-15% of cases progress to severe disease, and about 5% become critically ill. (See chart below for clinical features according to disease severity). Typically, people recover from COVID-19 after 2 to 6 weeks.[2] However, others experience lingering health problems for weeks or months after they have recovered from the acute phase of the illness and are no longer infectious. Even people who were not hospitalized and who had mild illness can experience persistent or late symptoms. The majority of those with long-term symptoms often experience more than one. People living with post-COVID syndrome sometimes describe themselves as "long haulers." [8] [9]

Clinical features in adult COVID-19 cases according to disease severity [10] [11]

Severity	Clinical Features
Asymptomatic	Positive PCR test without clinical manifestations or radiologic findings (e.g., normal chest imaging results)
Mild	Symptoms of acute upper respiratory tract infection, e.g., fever, cough, sore throat, malaise, headache, muscle pain, nausea, vomiting, diarrhea, loss of taste and smell; however, no dyspnea or abnormal chest imaging and hospitalization not required
Moderate	Evidence of lower respiratory disease during clinical assessment or imaging, with an oxygen saturation (SpO_2) ≥90% on room air
Severe	Clinical signs of pneumonia, plus SpO_2 <90% on room air, severe respiratory distress, or respiratory frequency >30 breaths/min
Critical	Respiratory failure, septic shock[3], and/or multiple organ dysfunction

Prevalence of post-COVID syndrome

It is estimated 10% to 35% of individuals not requiring hospitalization experience prolonged illness after COVID-19, regardless of co-morbidities, while incidence rates up to 80% have been reported among hospitalized patients and among patients with severe illness. [12] [13]

Estimated post-COVID syndrome cases*

Resolved COVID-19 cases[4]	10% of resolved cases	35% of resolved cases
Canada ≈ 1,334,000	133,400	466,900
Ontario ≈ 515,000	51,500	180,250

*Estimated number of individuals not requiring hospitalization who could potentially develop post-COVID syndrome

Preliminary results from a nationally representative sample survey by the UK's Office for National Statistics estimated 1 in 5 respondents testing positive for COVID-19 exhibited symptoms for a period of 5 weeks or longer and 1 in 10 respondents exhibited

[2] Refer to Episode #28 – COVID-19: What We Know So Far for additional information on disease severity, duration of illness, and long-term sequelae.
[3] Septic shock occurs in a subset of patients with sepsis and is an underlying circulatory and cellular/metabolic abnormality that is associated with increased mortality. Sepsis is defined as life-threatening organ dysfunction due to dysregulated host response to infection. https://emedicine.medscape.com/article/168402-overview
[4] As of June 5, 2021 https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection.html

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

symptoms for a period of 12 weeks or longer. [14] Other studies indicate approximately a third of people testing positive for SARS-CoV-2 had not returned to their usual state of health when interviewed 3 to 6 weeks after diagnosis. [15] [16]

A study by Logue et al. (2021) found 30% of individuals with COVID-19 had persistent symptoms after nine months. The most common enduring symptoms were fatigue and loss of smell or taste. The majority of participants surveyed (85%) were outpatients with mild illness. [17]

Risk factors for developing post-COVID syndrome
Primary risk factors for persistent post-COVID-19 symptoms were age, presence of comorbidities, increased disease severity during acute infection, and female sex. The presence of comorbidities increased the risk of persistent symptoms by at least 70%. Experiencing more than five symptoms during the first week of illness or being hospitalized were also associated with persistent symptoms. [2] [9] [18]

Aminian et al. (2021) in their retrospective study found moderate and severe obesity (BMI ≥35 kg/m^2) was associated with a greater risk of post-COVID syndrome. Obesity is also a major risk factor for the development of severe COVID-19 infection and mortality. The authors concluded that if future studies confirm obesity is a major risk factor for post-COVID syndrome development, long-term and rigorous follow-up of individuals with obesity after COVID-19 is warranted. [19]

Symptoms

Common reported symptoms after SARS-CoV-2 infection include:

- Fatigue
- Dyspnea (shortness of breath)
- Anosmia (loss of smell) or dysgeusia (loss of taste)
- Headache
- Persistent cough
- Arthralgia (joint pain)
- Chest pain
- Memory or concentration problems (sometimes referred to as “brain fog”)
- Sleep problems
- Myalgia (muscle pain), pins and needles, numbness
- Palpitations
- Depression or anxiety
- Recurrent fever
- Rash
- Diarrhea or abdominal pain
- Dizziness on standing
- Post-exertional malaise (PEM), a worsening of symptoms after physical or mental activities [15] [16] [20] [21] [22]

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Logue et al. (2021) reported the most common persistent symptoms were fatigue and anosmia or dysgeusia. [17]

Results of a study by Nehme et al. (2021) noted participants had one or more enduring symptoms. Fatigue, dyspnea, and anosmia or dysgeusia were the main persistent symptoms. [16]

Tenforde et al. (2020) also found participants with prolonged illness had more than one symptom. Fatigue (71%), cough (61%), and headache (61%) were most commonly reported. [15]

A systematic review and meta-analysis by Iqbal et al. (2021) found there was a broad range of symptoms that persisted beyond the acute phase of COVID-19 in individuals with post-COVID syndrome. Fatigue and sleep disturbance were reported to be the most common symptoms persisting 3 weeks beyond the initial infection, with fatigue, anxiety, and dyspnea the most common symptom beyond 12 weeks. [23]

Other research found the most prevalent persistent symptoms (>21 days since symptom-onset) were:

- Fatigue: 30-78%
- Cough: 20-27%
- Arthralgia and/or myalgia: 19-44%
- Headache: 18-50%
- Dyspnea: 16-55% [2]

Less typical symptoms reported include hair loss, rhinorrhea, pernio[5], chills, flushing, ear pain, and visual impairments. The multitude of documented symptoms, impacting multiple organ systems, illustrates the multifaceted nature of post-COVID syndrome. [24]

Postural orthostatic tachycardia syndrome

Some people with post-COVID syndrome experience symptoms suggestive of postural orthostatic tachycardia syndrome (POTS). POTS is a disorder of the autonomic nervous system, which controls involuntary functions such as heart rate, blood pressure, and vein contractions that assist blood flow.

POTS is characterized by orthostatic intolerance and a rapid increase in heart rate (i.e., a sustained heart rate increment of ≥30 beats/min within 10 minutes of standing or head-up tilt). Cardiologic symptoms include chest pain, palpitations, exercise intolerance, dyspnea, and orthostatic intolerance. Other symptoms may include fatigue, "brain fog," gastrointestinal issues (e.g., abdominal pain, bloating, gastroparesis[6], and

[5] Pernio (also known as chilblains) is the painful inflammation of small blood vessels in the skin typically triggered by cold exposure. Pernio can cause itching, red patches, swelling, and blistering on hands and feet.

[6] Gastroparesis, or delayed gastric emptying, is a disorder where food moves very slowly or does not move from the stomach to the small intestine. https://rarediseases.org/gard-rare-disease/gastroparesis/

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

nausea), chronic pain (e.g., headache, TMJ disorder, and fibromyalgia), blurred vision, dizziness or fainting, anxiety, and sleep abnormalities.

POTS is most frequently seen in young women, often less than 35 years of age. The female to male ratio is 5:1. POTS is less common in young children, but it affects adolescents, and symptoms often develop during puberty. [25] [26]

The cause of POTS is poorly understood. However, episodes often begin after a pregnancy, major surgery, trauma, or a viral illness and may increase right before a menstrual period. [27] [25]

Post-viral infection POTS is not exclusive to SARS-CoV-2. It has been reported after Lyme disease and Epstein-Barr virus infections, for example. One theory is some of the antibodies generated against the virus cross-react and disrupt the autonomic nervous system. Alternatively, COVID-19 related autonomic dysfunction could be mediated by the virus itself. [28]

Miglis et al. (2020) reported a case of a 26-year-old female who developed POTS several months after confirmed SARS-CoV-2 infection. [29]

Johansson et al. (2021) reported a case series of 3 Swedish patients (age range 28 to 42 years) diagnosed with postural orthostatic tachycardia syndrome more than 3 months after mild to moderate COVID-19 infections. [30]

Dani et al. (2021) described a series of individuals with symptoms of POTS after confirmed or suspected SARS-CoV-2 infection. The researchers posited this condition may be related to a virus- or immune-mediated disruption of the autonomic nervous system resulting in orthostatic intolerance syndromes. [28]

The full impact of post-COVID syndrome and POTS is not yet known. It is important for clinicians to recognize POTS can present as a manifestation of post-COVID syndrome. Also, considering there are many treatment options for POTS, a delayed diagnosis can lead to further physical deconditioning and decreased quality of life.

Research on post-COVID syndrome in nonhospitalized individuals*

Country	Study	Sample	Number of cases	Results
United Kingdom	Office for National Statistics (2020)	Population representative	8,193	• 21% had symptoms 5 weeks after infection e.g., fatigue (12%), cough (11%), headache (10%) • 10% had symptoms 12 weeks after infection [14]
	Sudre et al. (2020)	COVID Symptom App users (14% were hospitalized)	4,182	•13% of cases had symptoms lasting 28 days after symptom onset, e.g., fatigue (97.7%), headaches (91.2%)

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

				• 5% of cases had symptoms for over 8 weeks • 2% for over 12 weeks after symptom onset [18]
	Townsend et al. (2020)	Hospital outpatients (44%), hospitalized (56%)	128	• 52% reported persistent fatigue 10 weeks after symptom onset. Fatigue was not associated with initial disease severity [31]
USA	Tenforde et al. (2020)	Hospital outpatients (7% were hospitalized)	292	• 35% had symptoms (e.g., cough, fatigue, dyspnea) after a median of 16 days after testing positively for SARS-CoV-2 infection [15]
	Logue et al. (2021)	Hospital outpatients (9% were hospitalized)	177	• 30% reported persistent symptoms (e.g., fatigue, anosmia, dysgeusia) up to 9 months after illness [17]
Switzerland	Nehme et al. (2020)	Hospital outpatients	669	• About 33% of cases had 1 or more symptoms 30-45 days after diagnosis (e.g., fatigue, dyspnea, anosmia, dysgeusia) [16]
Netherlands & Belgium	Goërtz et al. (2020)▲	Facebook group for individuals with persistent COVID-19 symptoms (5% were hospitalized)	2,113	• Over 99% infected individuals did not fully recover within 12 weeks after symptom onset • Fatigue and dyspnea were the most prevalent symptoms during infection and at follow-up [32]

* Some of the studies included hospitalized patients
▲Included suspected cases

Research on post-COVID syndrome in hospitalized patients postdischarge

Country	Study	Number of cases	Results
Canada	Wong et al. (2020)	78	• 51% had persistently reduced quality of life & 50% had dyspnea 12 weeks after symptom onset [33]
France	Carvalho-Schneider et al. (2021)	130	• 40% reported persistent fatigue & 30% dyspnea 60 days after symptom onset [34]
Italy	Carfì et al. (2020)	143	• 87% had symptoms (32% had 1 or 2 symptoms; 55% had 3 or more symptoms) at 60 days after discharge [21]
United Kingdom	D'Cruz et al. (2020)	119	• 68% reported persistent fatigue, 57% sleep disturbance & 32% dyspnea 60 days after discharge

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

			• depression & anxiety were present in 18% and 22%, respectively; 25% screened positive for post-traumatic stress disorder (PTSD), and 41% reported persistent limitations in everyday life 60 days after discharge [35]
	Arnold et al. (2020)	110	• 74% had persistent symptoms, mainly breathlessness & fatigue & 14% had persistent anomalies on chest X-ray or respiratory function testing at 12 weeks after discharge [36]
USA	Donnelly et al. (2020)	2,179	• 20% were readmitted, 9% died & 27% were readmitted or died within 60 days after discharge [37]
China	Huang et al. (2021)	1,733	• 76% reported persistent symptoms (e.g., fatigue, sleep difficulties), and 50% had residual anomalies on chest imaging 6 months after discharge [38]

Multiorgan effects of COVID-19

Multiorgan effects of COVID-19 have been documented in most, if not all, body systems including cardiovascular, pulmonary, renal, dermatologic, neurologic, and psychiatric. Multisystem inflammatory syndrome (MIS)[7] and autoimmune conditions can also occur after COVID-19. A wide variety of health effects can persist after the acute illness has resolved (e.g., pulmonary fibrosis[8], myocarditis[9]). It is unknown how long multiorgan system effects might last and whether or not the effects could lead to chronic health conditions. [3]

Effects of COVID-19 treatment or hospitalization

The post-COVID conditions can also include the effects of COVID-19 treatment or hospitalization, for example tracheal stenosis[10] from prolonged intubation, severe weakness, and deconditioning. Some of these effects are similar to those from hospitalization for other respiratory infections or conditions. This category can also encompass post-intensive care syndrome (PICS),[11] which includes a range of health effects that remain after a critical illness. These effects can include severe weakness and post-traumatic stress disorder (PTSD). Though the effects of hospitalization may not be unique to COVID-19 illness, they are considered post-COVID conditions if they occur after a documented SARS-CoV-2 infection and persist for more than four weeks. [3]

Pathogenesis

COVID-19 is a multi-system infection. The angiotensin-converting enzyme 2 (ACE2) receptor, which is abundant in cells of most organs, is the main target for SARS-CoV-2 binding and infection. A monocyte-macrophage, CD4, and CD8 cellular response, and a

[7] Refer to Episode #33 – Pediatric Population & COVID-19: Part 1 for more information on Multisystem inflammatory syndrome.
[8] Pulmonary fibrosis is the formation of scar tissue in the connective tissue of the lungs.
[9] Myocarditis is inflammation of myocardium (heart muscle) with necrosis of cardiac myocyte cells. https://www.merckmanuals.com/en-ca/professional/cardiovascular-disorders/myocarditis-and-pericarditis/myocarditis
[10] Tracheal stenosis refers to a narrowing of the trachea.
[11] Refer to page 9 for more information on PICS.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

controlled inflammatory response occurs, which results in an uncomplicated recovery of most patients. A SARS-CoV-2 immune dysregulation, associated with elevated levels of cytokines interleukin-1β (IL-1β), IL-6, IL-2, and IL-10 (i.e., cytokine storm) and profound inflammation, is found in patients with severe life-threatening COVID-19. [12]

The pathogenesis of post-COVID syndrome is multifactorial and more than one mechanism may be implicated in several clinical manifestations. For example, the syndrome may be attributable to symptoms of underlying medical conditions, features of the acute disease state, and symptoms associated with physical deconditioning from precautionary isolation measures and acute illness. Several theories relating to hyperinflammatory state, oxidative stress, cytokine storm, and DNA damage have been hypothesized. However, the pathogenesis of post-COVID syndrome is largely unknown. [23] [39] [40]

Children and post-COVID syndrome

Research demonstrates post-COVID syndrome is not limited to adults. Fatigue, headache, insomnia, trouble concentrating, and cough were the most commonly reported persistent or delayed symptoms in children over 3 weeks since illness-onset[12]. [41]

Ludvigsson et al. (2020) presented a case report of five Swedish children, with a median age of 12 years, who had symptoms persisting for 6-8 months after clinical diagnosis of COVID-19. All had persistent fatigue, dyspnea, heart palpitations, or chest pain; and four had headaches, difficulties concentrating, muscle weakness, dizziness, and sore throats. [42]

A survey by the Office for National Statistics (2021) of 3,489 children with COVID-19 revealed 9.8% of children 2-11 years old and 13.0% of children 12-16 years experienced persistent or delayed symptoms five weeks after initial symptom-onset (or from date of first positive test if asymptomatic). [43]

A cross-sectional study by Buonsenso et al. (2021) included 129 children ≤18-year-old diagnosed with COVID-19. During the acute COVID-19, 33 children (26%) were asymptomatic, and 96 (74%) had symptoms. The results revealed 43% had at least one persistent symptom >60 days after infection. Insomnia, respiratory symptoms (including pain and chest tightness), nasal congestion, fatigue, myalgia, arthralgia, and concentration difficulties were the most frequently reported symptoms. [44]

Say et al. (2021) described clinical outcomes 3-6 months after COVID-19 diagnosis in children. Follow-up data was available for 151 children ≤18 years. A total of 12 (8%) children had post-COVID-19 symptoms. The most common symptoms were mild cough and fatigue. [45]

[12] Refer to Episode #28 – COVID-19: What We Know So Far, Episode #33 – Pediatric Population & COVID-19: Part 1, and Episode #34 – Pediatric Population & COVID-19: Part 2 for more information on COVID-19 in children.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Long-term effects of other coronavirus infections
COVID-19 is a very new disease in comparison with other coronavirus infections. It is difficult to predict the long-term outcomes from SARS-CoV-2; however, researchers are also looking at the long-term effects from other coronaviruses. For example, several studies have examined the long-term health effects of severe acute respiratory syndrome (SARS), the coronavirus that emerged in 2003, and the Middle East respiratory syndrome (MERS), first reported in 2012. [46]

Ngai et al. (2010) found a persistent and significant impairment of exercise capacity and health status in survivors of SARS over 24 months. Health workers who had SARS experienced even more marked adverse impact. [47]

Lam et al. (2009) discovered 40% of people recovering from SARS still had chronic fatigue symptoms 3.5 years after being diagnosed. [48]

A systematic review and meta-analysis by Ahmed et al. (2020) found lung function abnormalities, psychological impairment, and reduced exercise capacity were reported in people with SARS and MERS up to 6 months after hospital discharge. [49]

O'Sullivan (2021) noted SARS and MERS left survivors with persistent fatigue, dyspnea, decreased quality of life, and mental health problems. The long-term respiratory, musculoskeletal, and neuropsychiatric sequelae of SARS and MERS have pathophysiological parallels with post-COVID syndrome. Thus, planning and resources are required to address rehabilitation needs of survivors. [50]

Diagnosis
There is no simple test for diagnosing post-COVID syndrome. It is a clinical diagnosis, based on a history of COVID-19 and a failure to fully recover, with development of symptoms characteristic of the syndrome (e.g., fatigue, anosmia, dysgeusia, dyspnea, brain fog, etc.).

Post-intensive care syndrome
Post-COVID syndrome is different from the post-intensive care syndrome (PICS), which is marked by chronically impaired pulmonary function, neuromuscular weakness, long-term psychological impacts, and reduced quality of life, a pattern also observed in SARS survivors. PICS is common among patients who spent long periods on ventilators and may coexist with post-COVID syndrome in some cases. [51]

Chronic fatigue syndrome
While the symptoms of post-COVID syndrome bear some resemblance to the post-viral symptoms observed in those with chronic fatigue syndrome, post-COVID syndrome seems to manifest as a broader spectrum of symptoms and may potentially be more common, although further study is required to confirm this. Emerging evidence points to post-COVID syndrome having a number of particular features, at least some of which seem to be related to the increased risk of damage to certain tissues, in particular cardiac, vascular, lung, and kidney involvement, with evidence implicating both infection by the virus and the resulting inflammatory response. [51]

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Treatment for post-COVID syndrome
At present, there are no specific treatments for post-COVID syndrome. But recognizing the syndrome is a key step towards targeted treatment. Management focuses on specific treatment of the most distressing symptoms (e.g., fatigue, cognitive impairment, sleep disturbance, etc.) and many individuals are improving with time. Given the complexity and chronicity of the associated symptoms and their impact on several major organ systems, frequent routine follow-up, establishing rapport, and involving a support system serve as the foundation of management of this condition. [40]

Those with a post-COVID condition should speak to their medical provider about managing or treating their symptoms and resources for support. Many large medical centres are opening specialized clinics to provide care for people who have persistent symptoms or related illnesses after they recover from COVID-19. Support groups are available as well. [20]

Post-COVID care centres have been established across Canada, some staffed by an interdisciplinary team of clinicians, such as psychiatrists, geriatricians, occupational therapists, physiotherapists, social workers, pharmacists, and registered nurses. For example, Toronto Rehabilitation Institute's (Toronto Rehab) COVID-19 Rehab clinic has an interprofessional team of clinicians to help those who have recovered from their acute stage of COVID-19, but are living with lingering symptoms such as headaches, brain fog, myalgia, arthralgia, fatigue, and tachycardia. [52]

Post-COVID syndrome and COVID-19 vaccination
Arnold et al. (2021) demonstrated receipt of a messenger RNA or adenoviral vector vaccine was not associated with a decrease in quality of life or worsening of symptoms in individuals experiencing post-COVID syndrome. [53]

Media articles have reported that some people with post-COVID syndrome say their symptoms improved after being vaccinated. [54] [55] Research is underway, with some awaiting peer review, to determine if COVID-19 vaccination eases symptoms of those with the syndrome. [56]

Prevention of post-COVID syndrome
The best way to avoid post-COVID-19 complications is to prevent SARS-CoV-2 infection in the first place by following preventative measures (e.g., wearing face masks, social distancing, hand hygiene, and other public health advice) and getting vaccinated.

Implications of post-COVID syndrome
Care for individuals with post-COVID syndrome will likely place added stresses on the healthcare and social support systems, including increased emergency department visits, outpatient and inpatient care, and rehabilitation involving multidisciplinary teams.

Healthcare workers recovering from COVID-19 and experiencing persistent symptoms can also place added stress on the healthcare system. In addition to healthcare implications, there are economic implications for those unable to work or new requirements for social supports and disability insurance.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

To date, there is evidence COVID-19 can lead to decreased health-related quality of life (e.g., decreased ability to perform daily tasks, reduced capacity for physical activity, missing work and school). Given the wide variety of persistent symptoms, guidance is currently being developed for the assessment and management of individuals with post-acute COVID-19. [2]

Additional research

COVID-19 can result in prolonged illness, even in children and young adults without underlying chronic medical conditions. Much is still unknown about how COVID-19 affects people over time and more research and multi-year studies are needed to understand:

- Long-term effects of COVID-19
- Why symptoms persist or recur
- How these health problems affect individuals, families, and society
- Clinical course and likelihood of full recovery
- Implication of long-term health effects on return to school and work [8]

Take home messages

It is essential to be aware and knowledgeable of post-COVID syndrome. Conducting a thorough medical history is critical to identify clients with this syndrome and refer accordingly. Treatment of the syndrome will be multidisciplinary. This should include oral health professionals to help improve and maintain oral health to decrease systemic inflammation. Being mindful that appointment lengths may need to be adjusted for those who are experiencing chronic fatigue is also important.

References

[1] National Institues of Health, "NIH launches new initiative to study “Long COVID”," 23 February 2021. [Online]. Available: https://www.nih.gov/about-nih/who-we-are/nih-director/statements/nih-launches-new-initiative-study-long-covid. [Accessed 4 June 2021].

[2] Public Health Ontario, "Persistent symptoms and post-acute COVID-19 - What we know so far," pp. 1-21, 9 April 2021.

[3] Centers for Disease Control and Prevention, "Post-COVID Conditions," 8 April 2021. [Online]. Available: https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html. [Accessed 5 June 2021].

[4] Patient-Led Research Collaborative, "Report: What does COVID-19 recovery actually look like?," 11 May 2020. [Online]. Available: https://patientresearchcovid19.com/research/report-1/. [Accessed 5 June 2021].

[5] National Institute for Health and Care Excellence, "COVID-19 rapid guideline: managing the long-term effects of COVID-19," 18 December 2020. [Online]. Available: https://www.nice.org.uk/guidance/ng188. [Accessed 2 June 2021].

[6] S. Datta, A. Talwar and J. Lee, "A proposed framework and timeline of the spectrum of disease due to SARS-CoV-2 infection: Illness Beyond acute infection and public health implications," *JAMA,* vol. 324, no. 22, pp. 2251-2252, 18 November 2020.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

[7] A. Nalbandian, K. G. A. Sehgal, M. Madhavan, C. McGroder, J. Stevens, J. Cook, A. Nordvig, D. Shalev, et al., "Post-acute COVID-19 syndrome," *Nature Medicine,* vol. 27, pp. 601-615, 22 March 2021.

[8] World Health Organization, "Update 54 – Clinical long-term effects of COVID-19," 19 March 2021. [Online]. Available: https://www.who.int/publications/m/item/update-54-clinical-long-term-effects-of-covid-19. [Accessed 1 June 2021].

[9] National Collaborating Centre for Environmental Health, "The Basics of SARS-CoV-2 Transmission," 21 March 2021. [Online]. Available: https://ncceh.ca/documents/evidence-review/basics-sars-cov-2-transmission. [Accessed 1 June 2021].

[10] National Institutes of Health, "Clinical Spectrum of SARS-CoV-2 Infection," 21 April 2021. [Online]. Available: https://www.covid19treatmentguidelines.nih.gov/overview/clinical-spectrum/. [Accessed 1 June 2021].

[11] Government of Canada, "Clinical management of patients with COVID-19: Second interim guidance," 17 August 2020. [Online]. Available: https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/clinical-management-covid-19.html. [Accessed 1 June 2021].

[12] A. Maltezou, A. Pavli and A. Tsakris, "Post-COVID syndrome: An insight on its pathogenesis," *Vaccines,* vol. 9, no. 5, pp. 1-12, 12 May 2021.

[13] T. Greenhalgh, M. Knight, C. A'Court, M. Buxton and L. Husain, "Management of post-acute covid-19 in primary care," *BMJ,* vol. 370, pp. 1-8, 11 August 2020.

[14] Office for National Statistics, "The prevalence of long COVID symptoms and COVID-19 complications," 16 December 2020. [Online]. Available: https://www.ons.gov.uk/news/statementsandletters/theprevalenceoflongcovidsymptomsandcovid19complications. [Accessed 31 May 2021].

[15] M. Tenforde, S. Kim, C. Lindsell, E. Rose, N. Shapiro, C. Files, K. Gibbs, H. Erickson, J. Steingrub, H. Smithline, M. Gong, M. Aboodi, M. Exline, D. Henning, J. Wilson, A. Khan, N. Qadir, S. Brown, I. Peltan, T. Rice, D. Hager, A. Ginde, et al., "Symptom Duration and Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network - United States, March–June 2020," *Morbidity and Mortality Weekly Report,* vol. 69, no. 30, pp. 993-998, 31 July 2020.

[16] M. Nehme, O. Braillard, G. Alcoba, S. Perone, D. Courvoisier, F. Chappuis, I. and Guesseous, "COVID-19 symptoms: Longitudinal evolution and persistence in outpatient settings," *Annals of Internal Medicine,* vol. 174, no. 5, pp. 723-725, May 2021.

[17] J. Logue, N. Franko, D. McCulloch, D. McDonald, A. Magedson, C. Wolf and H. Chu, "Sequelae in adults at 6 months after COVID-19 infection," *JAMA Network Open,* vol. 4, no. 2, pp. 1-4, 19 February 2021.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

[18] C. Sudre, B. Murray, T. Varsavsky, M. Graham, R. Penford, R. Bowyer, J. Pujol, K. Klaser, et al., "Attributes and predictors of long COVID," *Nature Medicine,* vol. 27, pp. 626-631, 10 March 2021.

[19] A. Aminian, J. Bena, K. Pantalone and B. Burguera, "Association of obesity with post-acute sequelae of COVID-19 (PASC)," *Diabetes, Obesity and Metabolism,* 1 June 2021.

[20] Mayo Clinic, "COVID-10 (coronavirus): Long-term effects," 6 May 2021. [Online]. Available: https://www.mayoclinic.org/diseases-conditions/coronavirus/in-depth/coronavirus-long-term-effects/art-20490351. [Accessed 1 June 2021].

[21] A. Carfi, R. Bernabei and F. Landi, "Persistent symptoms in patients after acute COVID-19," *JAMA,* vol. 324, no. 6, pp. 603-605, 9 July 2020.

[22] Centers for Disease Control and Prevention, "Long-Term Effects," 8 April 2021. [Online]. Available: https://www.cdc.gov/coronavirus/2019-ncov/long-term-effects.html. [Accessed 1 June 2021].

[23] F. Iqbal, K. Lam, V. Sounderajah, J. Clarke, H. Ashrafian and A. Darzi, "Characteristics and predictors of acute and chronic post-COVID syndrome: A systematic review and meta-analysis," *EClinicalMedicine,* vol. 36, no. 100899, pp. 1-13, 22 May 2021.

[24] S. Yong, "Long COVID or post-COVID-19 syndrome: putative pathophysiology, risk factors, and treatments," *Infectious Diseases,* pp. 1-18, 22 May 2021.

[25] National Institutes of Health, "Postural orthostatic tachycardia syndrome," 1 January 2017. [Online]. Available: https://rarediseases.info.nih.gov/diseases/9597/postural-orthostatic-tachycardia-syndrome#ref_3390. [Accessed 6 June 2021].

[26] John Hopkins Medicine, "Postural Orthostatic Tachycardia Syndrome (POTS)," 2021. [Online]. Available: https://www.hopkinsmedicine.org/health/conditions-and-diseases/postural-orthostatic-tachycardia-syndrome-pots. [Accessed 7 June 2021].

[27] D. Goldstein, "The possible association between COVID-19 and postural tachycardia syndrome," *Heart Rhythm,* vol. 18, no. 4, pp. 508-509, 10 December 2021.

[28] M. Dani, A. Dirksen, P. Taraborrelli, M. Torocastro, D. Panagopoulos, R. Sutton and P. Lim, "Autonomic dysfunction in 'long COVID': rationale, physiology and management strategies," *Clinical Medicine,* vol. 21, no. 1, pp. e63-e67, January 2031.

[29] M. Miglis, T. Prieto, R. Shaik, S. Muppidi, D. Sinn and S. Jaradeh, "A case report of postural tachycardia syndrome after COVID-19," *Clinical Autonomic Research,* vol. 30, no. 5, pp. 449-451, 3 September 2020.

[30] M. Johansson, M. Ståhlberg, M. Runold, M. Nygren-Bonnier, J. Nilsson, B. Olshansk, J. Bruchfeld and A. Fedorowski, "Long-haul post–COVID-19 symptoms presenting as a variant of postural orthostatic tachycardia syndrome: The Swedish experience," *JACC Case Reports,* vol. 3, no. 4, pp. 573-580, April 2021.

[31] L. Townsend, A. Dyer, K. Jones, J. Dunne, A. Mooney, F. Gaffney, L. O'Connor, D. Leavy, K. O'Brien, J. Dowds, J. Sugrue, D. Hopkins, et al., "Persistent fatigue

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

following SARS-CoV-2 infection is common and independent of severity of initial infection," *PLOS ONE,* vol. 15, no. 11, pp. 1-12, 9 November 2020.

[32] Y. Goërtz, M. Van Herck, J. Delbressine, A. Vaes, R. Meys, F. Machado, S. Houben-Wilke, C. Burtin, R. Posthuma, F. Franssen, N. van Loon, B. Hajian, Y. Spies, H. Vijlbrief, A. van ’t Hul, D. Janssen and M. Spruit, "Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome?," *ERJ Open Research,* vol. 6, no. 4, pp. 1-10, 26 October 2020.

[33] A. Wong, A. Shah, J. Johnston, C. Carlsten and C. Ryerson, "Patient-reported outcome measures after COVID-19: A prospective cohort study," *European Respiratory,* vol. 56, no. 5, pp. 1-4, 26 November 2020.

[34] C. Carvalho-Schneider, E. Laurent, A. Lemaignen, E. Beaufils, C. Bourbao-Tournois, S. Laribi, T. Flament, N. Ferreira-Maldent, F. Bruyère, K. Stefic, C. Gaudy-Graffin, L. Grammatico-Guillon and L. Bernard, "Follow-up of adults with noncritical COVID-19 two months after symptom onset," *Clinical Microbiology and Infection,* vol. 27, no. 2, pp. 258-263, 1 February 2021.

[35] R. D'Cruz, M. Waller, F. Perrin, J. Periselneris, S. Norton, L. Smith, T. Patrick, D. Walder, A. Heitmann, K. Lee, R. Madula, W. NcNulty, P. Macedo, R. Lyall, G. Warwick, J. Galloway, S. Birring, A. Patel, I. Patel and C. Jolley, "Chest radiography is a poor predictor of respiratory symptoms and functional impairment in survivors of severe COVID-19 pneumonia," *ERJ Open Research,* vol. 7, no. 1, pp. 1-13, 8 February 2021.

[36] D. Arnold, F. Hamilton, A. Milne, A. Morley, J. Viner, M. Attwood, A. Noel, S. Gunning, J. Hatrick, S. Hamilton, K. Elvers, C. Hyams, A. Bibby, E. Moran, H. Adamali, J. Dodd, N. Maskell and S. Barratt, "Patient outcomes after hospitalisation with COVID-19 and implications for follow-up: results from a prospective UK cohort," *Thorax,* vol. 76, no. 4, pp. 399-401, 2021.

[37] J. Donnelly, X. Wang, T. Iwashyna and H. Prescott, "Readmission and death after initial hospital discharge among patients with COVID-19 in a large multihospital system," *JAMA,* vol. 325, no. 3, pp. 304-306, 14 December 2020.

[38] C. Huang, L. Huang, Y. Wang, X. Li, L. Ren, X. Gu, L. Kang, L. Guo, M. Liu, X. Zhou, et al., "6-month consequences of COVID-19 in patients discharged from hospital: A cohort study," *The Lancet,* vol. 397, no. 10270, pp. 220-232, 16 January 2021.

[39] A. Bektas, S. Schurman, C. Franceschi and L. Ferrucci, "A public health perspective of aging: Do hyper-inflammatory syndromes such as COVID-19, SARS, ARDS, cytokine storm syndrome, and post-ICU syndrome accelerate short- and long-term inflammaging?," *Immunity & Ageing,* vol. 17, no. 23, pp. 1-10, 24 August 2020.

[40] S. Vehar, M. Bourshra, P. Ntiamoah and M. Biehl, "Post-acute sequelae of SARS-CoV-2 infection: Caring for the ‘long-haulers’," *Cleveland Clinic Journal of Medicine,* vol. 88, no. 5, pp. 267-272, May 2021.

[41] Public Health Ontario, "Pediatric post-acute COVID-19 and multisystem inflammatory syndrome in children (MIS-C) – What we know so far," pp. 1-21, 4 May 2021.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

[42] J. Ludvigsson, "Case report and systematic review suggest that children may experience similar long-term effects to adults after clinical COVID-19," *Acta Paediatrica,* vol. 110, no. 3, pp. 914-921, 17 November 2020.

[43] Office for National Statistics, "Prevalence of ongoing symptoms following coronavirus (COVID-19) infection in the UK: 1 April 2021," 1 April 2021. [Online]. Available: https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/bulletins/prevalenceofongoingsymptomsfollowingcoronaviruscovid19infectionintheuk/1april2021. [Accessed 5 June 2021].

[44] D. Buonsenso, D. Munblit, C. De Rose, D. Sinatti, A. Ricchiuto, A. Carfi and P. Valentini, "Preliminary evidence on long COVID in children," *Acta Paediatrica,* pp. 1-4, 9 April 2021.

[45] D. Say, N. Crawford, S. McNab, D. Wurzel, A. Steer and S. Tosif, "Post-acute COVID-19 outcomes in children with mild and asymptomatic disease," *The Lancet,* vol. 5, no. 6, pp. e22-e23, 1 June 2021.

[46] M. Honigsbaum and L. Krishnan, "Taking pandemic sequelae seriously: From the Russian influenza to COVID-19 long-haulers," *The Lancet,* vol. 396, no. 10269, pp. 1389-1391, 12 October 2020.

[47] J. Ngai, F. Ko, S. Ng, K. To, M. Tong and D. Hui, "The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status," *Respirology,* vol. 15, no. 3, pp. 543-550, 29 March 2010.

[48] M. Lam, Y. Wing, M. Yu, C. Leung, R. Ma, A. Kong, W. So, S. Fong and S. Lam, "Mental Morbidities and Chronic Fatigue in Severe Acute Respiratory Syndrome Survivors: Long-term Follow-up," *JAMA Internal Medicine,* vol. 169, no. 22, pp. 2142-2147, 14 December 2009.

[49] H. Ahmed, K. Patel, D. Greenwood, S. Halpin, P. Lewthwaite, A. Salawu, L. Eyre, A. Breen, R. O'Connor, A. Jones and M. Sivan, "Long-term clinical outcomes in survivors of severe acute respiratory syndrome and Middle East respiratory syndrome coronavirus outbreaks after hospitalisation or ICU admission: A systematic review and meta-analysis," *Journal of Rehabilitation Medicine,* vol. 52, no. 5, pp. 1-11, 31 May 2020.

[50] O. O'Sullivan, "Long-term sequelae following previous coronavirus epidemics," *Clinical Medicine,* vol. 21, pp. e68-e70, January 2021.

[51] Rajan, S, K. Khunti, N. Alwan, C. Steves, T. Greenhalgh, N. MacDermott, A. Sagan and M. McKee, "In the wake of the pandemic: Preparing for long COVID, Policy Brief 39," World Health Organization: Regional Office for Europe, 2021.

[52] UHN Foundation, "Helping COVID-19 “Long Haulers”," 30 March 2021. [Online]. Available: https://uhnfoundation.ca/stories/helping-covid-19-long-haulers/. [Accessed 5 June 2021].

[53] D. Arnold, A. Milne, E. Samms, L. Stadon, N. Maskell and F. Hamilton, "Symptoms after COVID-19 vaccination in patients with persistent symptoms after acute infection: A case series," *Annals of Internal Medicine,* 25 May 2021.

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

[54] B. Goodman, "Some With Long COVID See Relief After Vaccination," Medscape, 17 March 2021. [Online]. Available: https://www.medscape.com/viewarticle/947592. [Accessed 5 June 2021].

[55] M. Guenot, "A woman who had crippling long COVID for 8 months says it vanished after getting vaccinated. There is no clear scientific reason why.," Business Insider, 17 March 2021. [Online]. Available: https://www.businessinsider.com/woman-says-her-severe-long-covid-vanished-after-vaccine-2021-3. [Accessed 5 June 2021].

[56] J. Kingsland, "Vaccination may ease symptoms of long COVID," Medical News Today, 26 May 2021. [Online]. Available: https://www.medicalnewstoday.com/articles/vaccination-may-ease-symptoms-of-long-covid. [Accessed 5 June 2021].

Client Resources

Covid Long-Haulers Support Group Canada

Canada's largest online support group, founded by long haul survivors to connect those with long COVID to support and information.
Website: https://covidlonghaulcanada.com/
Facebook: https://www.facebook.com/groups/920314451799658
Twitter: https://twitter.com/susiegoulding9?s=20

Additional Resources

In the wake of the pandemic: Preparing for long COVID, Policy Brief 39, Rajan; S; Khunti, K; Alwan, N; Steves, C; Greenhalgh, T; MacDermott, N; Sagan, A; McKee, M. World Health Organization, 2021
https://www.who.int/docs/default-source/coronaviruse/risk-comms-updates/update54_clinical_long_term_effects.pdf

Persistent symptoms and post-acute COVID-19 in adults - What we know so far, Public Health Ontario, April 9, 2021, p 1-21
https://www.publichealthontario.ca/-/media/documents/ncov/covid-wwksf/2020/07/what-we-know-covid-19-long-term-sequelae.pdf

Post-COVID Conditions: Information for Healthcare Providers, Centers for Disease Control and Prevention, April 8, 2021
https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/post-covid-conditions.html

Post-acute COVID-19 syndrome, Nalbandian, A; Sehgal, K; Gupta, A; Madhavan, M; McGroder, C; Stevens, J; Cook, J; Nordvig, A; Shalev, D; Tejasav, S; et al. *Nature Medicine*, Volume 27, March 22, 2021, p 601-615
https://www.nature.com/articles/s41591-021-01283-z

Post-COVID syndrome: An insight on its pathogenesis, Maltezou, H; Pavli, A; Tsakris A. *Vaccines*, Volume 9, Issue 5, May 12, 2021, p 1-12
https://www.mdpi.com/2076-393X/9/5/497/htm

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Management of post-acute covid-19 in primary care, Greenhalgh, T; Knight, M; Court, C; Buxton, M; Husain, L. *BMJ*, Volume 370, August 11, 2020, p 1-8 https://www.bmj.com/content/370/bmj.m3026

Symptom duration and risk factors for delayed return to usual health among outpatients with COVID-19 in a multistate health care systems network - United States, March-June 2020, Tenforde, M; Kim, S; Lindsell, C; Rose, E; Shapiro, N; Files, C; Gibbs, K; et al. *Morbidity and Mortality Weekly Report*, Volume 69, Issue 30, July 31, 2020, p 993-998 https://www.cdc.gov/mmwr/volumes/69/wr/mm6930e1.htm

COVID-19 symptoms: Longitudinal evolution and persistence in outpatient settings, Nehme, M; Braillard, O; Alcoba, G; Perone, S; Courvoisier, D; Chappuis, F; Guessous, I. *Annals of Internal Medicine*, Volume 174, Issue 5, May 2021, p 723-725 https://www.acpjournals.org/doi/10.7326/M20-5926

Sequelae in adults at 6 months after COVID-19 infection, Logue, J; Franko, N; McCulloch, D; McDonald, D; Magedson, A; Wolf, C; Chu, H. *Jama Network Open*, Volume 4, Issue 2, February 19, 2021, p 1-4 https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2776560

Attributes and predictors of long COVID, Sudre, C; Murray, B; Varsavsky, T; Graham, M; Penfold, R; Bowyer, R; Pujol, J; Klaser, K; Antonelli, M; et al. *Nature Medicine*, Volume 27, March 10, 2021, p 626-631 https://www.nature.com/articles/s41591-021-01292-y

Association of Obesity with Post-Acute Sequelae of COVID-19 (PASC), Aminian, A; Bena, J; Pantalone, K; Burguera, B; *Diabetes, Obesity and Metabolism,* June 1, 2021 https://dom-pubs.onlinelibrary.wiley.com/doi/10.1111/dom.14454

Persistent Symptoms in Patients After Acute COVID-19, Carfi, A; Bernabei, R; Landi, F. *JAMA*, Volume 324, Issue 6, July 9, 2020, p 603-605 https://jamanetwork.com/journals/jama/fullarticle/2768351/

Characteristics and predictors of acute and chronic post-COVID syndrome: A systematic review and meta-analysis, Iqbal, F; Lam, K; Sounderajah, V; Clarke, J; Ashrafian, H; Darzi, A. *EClinicalMedicine*, Volume 36, Article No. 100899, June 1, 2021, p 1-13 https://www.thelancet.com/journals/eclinm/article/PIIS2589-5370(21)00179-6/fulltext

The possible association between COVID-19 and postural tachycardia syndrome, Goldstein, D; *Heart Rhythm*, Volume 18, Issue 4, April 1, 2021, p 508-509 https://www.heartrhythmjournal.com/article/S1547-5271(20)31141-3/fulltext

Autonomic dysfunction in 'long COVID': Rationale, physiology and management strategies, Dani, M; Dirksen, A; Taraborrelli, P; Torocastro, M; Panagopoulos, D; Sutton, R; Lim, P. *Clinical Medicine*, Volume 21, Issue 1, January 2021, p e63-e67 https://www.rcpjournals.org/content/clinmedicine/21/1/e63

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

A case report of postural tachycardia syndrome after COVID-19, Miglis, M; Prieto, T; Shaik, R; Muppidi, S; Sinn, D; Jaradeh, S. *Clinical Autonomic Research*, Volume 30, September 3, 2020, p 449-451
https://link.springer.com/article/10.1007/s10286-020-00727-9

Long-haul post-COVID-19 symptoms presenting as a variant of postural orthostatic tachycardia syndrome: The Swedish experience, Johansson, M; Ståhlberg, M; Runold, M; et al. *JACC Case Reports*, Volume 3, Issue 4, April 2021, p 573-580
https://www.jacc.org/doi/10.1016/j.jaccas.2021.01.009

Post-COVID syndrome: An insight on its pathogenesis, Maltezou, H; Pavli, A; Tsakris A. *Vaccines*, Volume 9, Issue 5, Article No. 497, May 12, 2021, p 1-12
https://www.mdpi.com/2076-393X/9/5/497/htm

A public health perspective of aging: Do hyper-inflammatory syndromes such as COVID-19, SARS, ARDS, cytokine storm syndrome, and post-ICU syndrome accelerate short- and long-term inflammaging? Bektas, A; Schurman, S; Franceschi, C; Ferrucci, L. *Immunity & Ageing*, Volume 17, Article No. 23, August 24, 2020, p 1-10
https://immunityageing.biomedcentral.com/articles/10.1186/s12979-020-00196-8

Post-acute sequelae of SARS-CoV-2 infection: Caring for the 'long-haulers', Vehar, S; Boushra, M; Ntiamoah, P; Biehl, M. *Cleveland Clinic Journal of Medicine*, Volume 88, Issue 5, May 2021, p 267-272
https://www.ccjm.org/content/88/5/267

Pediatric post-acute COVID-19 and multisystem inflammatory syndrome in children (MIS-C) – What we know so far, Public Health Ontario, May 4, 2021, p 1-21
https://www.publichealthontario.ca/-/media/documents/ncov/covid-wwksf/2021/05/wwksf-children-long-term-sequelae.pdf?la=en

Case report and systematic review suggest that children may experience similar long-term effects to adults after clinical COVID-19, Lugvigsson, J. *Acta Paediatrica*, Volume 110, Issue 3, November 17, 2020, p 914-921
https://onlinelibrary.wiley.com/doi/10.1111/apa.15673

Preliminary evidence on long COVID in children, Buonsenso, D; Munblit, D; De Rose, C; Sinatti, D; Ricchiuto, A; Carfi, A; Valentini, P. *Acta Paediatrica*, April 9, 2021, p 1-4
https://onlinelibrary.wiley.com/doi/10.1111/apa.15870

Post-acute COVID-19 outcomes in children with mild and asymptomatic disease, Say, D; Crawford, N; McNab, S; Wurzel, D; Steer, A; Tosif, Shidan, *The Lancet Child & Adolescent Health*, Volume 5, Issue 6, June 1, 2021, p e22-e23
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(21)00124-3/fulltext

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

6-month multidisciplinary follow-up and outcomes of patients with paediatric inflammatory multisystem syndrome (PIMS-TS) at a UK tertiary paediatric hospital: A retrospective cohort study, Penner, J; Abdel-Mannan, O; Grant, K; Maillard, S; Kucera, F; Hassell, J; Eyre, M; Berger, Z; Hacohen, Y; Moshal, K. *The Lancet Child & Adolescent Health*, May 24, 2021, p 1-10
https://www.thelancet.com/journals/lanchi/article/PIIS2352-4642(21)00138-3/fulltext

The long-term impact of severe acute respiratory syndrome on pulmonary function, exercise capacity and health status, Ngai, J; Ko, F; Ng, S; To, K; Tong, M; Hui, D, *Respirology*, Volume 15, Issue 3, March 29, 2010, p 543-550
https://onlinelibrary.wiley.com/doi/full/10.1111/j.1440-1843.2010.01720.x

Mental morbidities and chronic fatigue in severe acute respiratory syndrome survivors: Long-term follow-up, Lam, M; Wing, Y; Yu, M; Leung, C; Ma, R; Kong, A; So, W; Fong, S; Lam S. *JAMA Internal Medicine*, Volume 169, Issue 22, December 14, 2009, p 2142-2147
https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/415378

Long-term clinical outcomes in survivors of severe acute respiratory syndrome (Sars) and middle east respiratory syndrome (Mers) coronavirus outbreaks after hospitalisation or ICU Admission: A systematic review and meta-analysis, Ahmed, H; Patel, K; Greenwood, D; Halpin, S; Lewthwaite, P; Salawu, A; Eyre, L; Breen, A; O'Connor, R; Jones, A; Sivan, M. *Journal of Rehabilitation Medicine*, volume 52, May 25, 2020, p 1-11
https://www.medicaljournals.se/jrm/content/html/10.2340/16501977-2694

Long-term sequelae following previous coronavirus epidemics, O'Sullivan, O; *Clinical Medicine (Lond)*, Volume 21, Issue 1, January 2021, p e68-e70
https://www.rcpjournals.org/content/clinmedicine/21/1/e68

Assessment of the frequency and variety of persistent symptoms among patients with COVID-19: A systematic review, Nasserie, T; Hittle, M; Goodman, S. *JAMA Network Open*, Volume 4, Issue 5, May 26, 2021, p 1-19
https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2780376

Post-COVID-19 syndrome: The persistent symptoms at the post-viral stage of the disease. A systematic review of the current data, Salamanna, F; Veronesi, F; Martini, L; Landini, M; Fini, M. *Frontiers in Medicine*, Volume 8, Article No. 653516, May 4, 2021, p 1-30
https://www.frontiersin.org/articles/10.3389/fmed.2021.653516/full

A Review of Persistent Post-COVID Syndrome (PPCS), Oronsky, B; Larson, C; Hammond, T; Oronsky, A; Kesari, S; Lybeck, M; Reid, T. *Clinical Reviews in Allergy & Immunology*, February 20, 2021, p 1-9
https://link.springer.com/article/10.1007/s12016-021-08848-3

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Long COVID or post-COVID-19 syndrome: Putative pathophysiology, risk factors, and treatments, Yong, S. *Infectious Diseases*, May 22, 2021, p 1-18
https://www.tandfonline.com/doi/full/10.1080/23744235.2021.1924397

Postdischarge symptoms and rehabilitation needs in survivors of COVID-19 infection: A cross-sectional evaluation, Halpin, S; McIvor, C; Whyatt, G; Adams, A; Harvey, O; McLean, L; Walshaw, C; Kemp, S; Corrado, J; Singh, R; Collins, T; O'Connor, R; Sivan, M. *Journal of Medical Virology*, Volume 93, Issue 2, July 30, 2020, p 1013-1022
https://onlinelibrary.wiley.com/doi/full/10.1002/jmv.26368

Long COVID syndrome following infection with SARS-CoV-2- A devastating influence on health status in some affected individuals, Soni, S; Nimbalkar, S. *Journal of Clinical and Diagnostic Research*, Volume 15, Issue 2, February 2021, p 17-21
https://www.jcdr.net/article_fulltext.asp?issn=0973-709x&year=2021&volume=15&issue=2&page=LE17&issn=0973-709x&id=14571

Living with Covid19, National Institute for Health Research, October 15, 2020
https://evidence.nihr.ac.uk/themedreview/living-with-covid19/

Living with Covid19 – Second review, National Institute for Health Research, March 16, 2021
https://evidence.nihr.ac.uk/themedreview/living-with-covid19-second-review/

Post-acute effects of SARS-CoV-2 infection in individuals not requiring hospital admission: a Danish population-based cohort study, *The Lancet Infectious Diseases*, Lund, L; Hallas, J; Nielsen, H; Koch, A; Mogensen, S; Brun, N; Christiansen, C; Thomsen, R; Pottegård, A. May 10, 2021, p 1-10
https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(21)00211-5/fulltext

Persistent neurologic symptoms and cognitive dysfunction in non-hospitalized Covid-19 "long haulers", Graham, E; Clark, J; Orban, Z; Lim, P; Szymanski, A; Taylor, C; DiBiase, R; Jia, D; Balabanov, R; Ho, S; Batra, A; Liotta, E; Koralnik, I. *Annals of Clinical and Translational Neurology*, Volume 8, March, 23, 2021, p 1073-1085
https://onlinelibrary.wiley.com/doi/10.1002/acn3.51350

A prospective study of long-term outcomes among hospitalized COVID-19 patients with and without neurological complications, Frontera, J; Yang, D; Lewis, A; Patel, P; et al. *Journal of the Neurological Sciences*, Volume 26, Article 117486, July 15, 2021, p 1-8
https://www.jns-journal.com/article/S0022-510X(21)00180-5/fulltext

Four-month clinical status of a cohort of patients after hospitalization for COVID-19, The Writing Committee for the COMEBAC Study Group, *JAMA*, Volume 325, Issue 15, March 17, 2021, p 1525-1534
https://jamanetwork.com/journals/jama/fullarticle/2777787

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA

Frequent and persistent salivary gland ectasia and oral disease after COVID-19, Gherlone, E; Polizzi, E; Tetè, G; De Lorenzo, R; Magnaghi, C; Querini, P; Ciceri, F. *Journal of Dental Research*, Volume 100, Issue 5, March 3, 2021, p 464-471 https://journals.sagepub.com/doi/10.1177/0022034521997112

Persistent Post–COVID-19 interstitial lung disease. An observational study of corticosteroid treatment, Mayall, K; Mukherjee, B; Castanheira, A; Lam, J; Benedetti, G; Mak, S; Preston, R; Thillai, M; Dewar, A; Molyneauz, P; West, A. *Annals of the American Thoracic Society,* Volume 18, Issue 5, May 2021, p 799-806 https://www.atsjournals.org/doi/10.1513/AnnalsATS.202008-1002OC

Respiratory and psychophysical sequelae among patients with COVID-19 four months after hospital discharge, Bellan, M; Soddu, D; Balbo, P; Baricich, A; et al. *JAMA Network Open*, Volume 4, Issue 1, January 27, 2021, p 1-12 https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2775643

6-month neurological and psychiatric outcomes in 236 379 survivors of COVID-19: A retrospective cohort study using electronic health records, Taquet, M; Geddes, J; Husain, M; Luciano, S; Harrison, P. *The Lancet*, Volume 8, Issue 5, May 1, 2021, p 416-427 https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366(21)00084-5/fulltext

Prevalence and 6-month recovery of olfactory dysfunction: a multicentre study of 1363 COVID-19 patients, Lechien, J: Chiesa-Estomba, C: Beckers, E; Mustin, V; Ducarme, M; Journe, F; Marchant, A; Jouffe, L; Barillari, M; Cammaroto, G; Circiu, M; Hans, S; Saussez, S. *Journal of Internal Medicine*, January 5, 2021, p 1-11 https://onlinelibrary.wiley.com/doi/10.1111/joim.13209

Persistent nasal inflammation 5 months after acute anosmia in patients with COVID-19, Hua-Huy, G; Lorut, C; Aubourg, F: Morbieu, C; Marey, et al. *American Journal of Respiratory and Critical Medicine,* Volume 23, Issue 10, May 15, 2021, p 1319-1322 https://www.atsjournals.org/doi/10.1164/rccm.202011-4258LE

Neuropsychiatric and cognitive sequelae of COVID-19, Kumar, S; Veldhuis, A; Malhotra, T. *Frontiers in Psychology*, Volume 12, Article 577529, March 2, 2021, p 1-6 https://www.frontiersin.org/articles/10.3389/fpsyg.2021.577529/full

Symptoms and functional impairment assessed 8 months after mild COVID-19 among health care workers, Havervall, S; Rosell, A; Phillipson, M; et al. *JAMA*, Volume 325, Issue 19, April 7, 2021, p 2015-2016 https://jamanetwork.com/journals/jama/fullarticle/2778528

Post-infection depressive, anxiety and post-traumatic stress symptoms: A prospective cohort study in patients with mild COVID-19, Ismael, F; Bizario, J; Battagin, T; et al. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, Volume 111, December 20, 2021, p 1-8 https://www.sciencedirect.com/science/article/pii/S0278584621001007

Disclaimer: This document is educational and not intended to provide clinical advice nor should it be used as a replacement for professional dental or medical advice. Dental hygienists are encouraged to consult with CDHO practice advisors and refer to CDHO guidelines. Dental hygienists are responsible for the decisions they make and for the consequences associated with those decisions. © ODHA