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A Protocol For Treating Post-COVID Condition Patients In Dental Settings

by

Peggy Joann Lelesi, RDH, BS

A thesis

submitted in partial fulfillment

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Committee Approval

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of PEGGY JOANN LELESI find it satisfactory and recommend that it be accepted.

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Human Subjects Committee Approval

January 9, 2023

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Dental Hygiene
MS 8048

RE: Study Number IRB-FY2023-106: A PROTOCOL FOR TREATING POST-COVID CONDITION PATIENTS IN DENTAL SETTINGS

Dear Ms. Lelesi:

Thank you for your responses to a previous review of the study listed above. I agree that this study qualifies as exempt from review under the following guideline: Category 3.(i)(A). Research involving benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection.
The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects.
This letter is your approval, please, keep this document in a safe place.

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You are granted permission to conduct your study effective immediately. The study is not subject to renewal.

Please note that any changes to the study as approved must be promptly reported and approved. Some changes may be approved by expedited review; others require full board review. Contact Tom Bailey (208-282-2179; fax 208-282-4723; email: humsubj@isu.edu) if you have any questions or require further information.

Sincerely,

Ralph Baergen, PhD, MPH, CIP
Human Subjects Chair

Acknowledgement

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Table of Contents

A Protocol For Treating Post-COVID Condition Patients in Dental Settings

Thesis Abstract – Idaho State University (2023

The purpose of this study was to test a protocol for assessing and treating patients with Post-COVID Conditions (PCC) in the dental practice setting. A qualitative exploratory research design was used to conduct the study. A PCC assessment and treatment protocol (ATP) was used by dental hygienists in clinical practice in California for 6 weeks. Practitioners were then invited to participate in individual interviews; online individual interviews were comprised of 20 dental hygienists recruited via purposive sampling. Fifty-six participants completed the six-week PCC ATP protocol, and twenty participants were interviewed. Four themes were identified: awareness, accessibility, resources, and complications. Within the theme of accessibility, the subthemes of ease of use and guidance emerged. The theme, complications yielded three subthemes: time, clinician hesitation, and patient lack of cooperation. This study demonstrated a PCC ATP created awareness of the varied symptoms of PCC and is a useful resource for clinical practitioners.

Key Words: covid-19, sars-cov-2, dental care, long covid, and post covid

Chapter 1: Introduction

Background

The challenges of the COVID-19 pandemic have been further complicated by prolonged health consequences experienced after resolution of the acute phase of infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Several terms have emerged in the nomenclature as descriptors of the various signs and symptoms following the acute phase of infection with SARS-CoV-2. Two of the more common terms are: post-COVID conditions (PCC) and long COVID (Centers for Disease Control and Prevention [CDC], 2022b). For the purposes of this research, the term PCC was used. The CDC describes PCC as the long-term effects following infection with SARS-CoV-2 (CDC, 2022b). The symptoms of PCC may differ in severity and may present complications for patients seeking routine oral health care. Oral health care providers (OHCP) will benefit from a protocol to guide the assessment and treatment of patients presenting with PCC in the oral health setting.

First identified in 2019 in Wuhan, China, SARS-Co-V-2 emerged as the coronavirus strain responsible for the coronavirus disease 2019 (COVID-19) pandemic. On January 30, 2020, the World Health Organization (WHO) announced that the outbreak is a "public health emergency of international concern" (2020a). On March 11, 2020, the Director-General of the World Health Organization pronounced COVID-19 as a pandemic (WHO, 2020b). Health care professionals (HCPs) began developing vaccines, treatment protocols, and preventive recommendations to protect individuals around the world from this highly infectious disease. As treatments and vaccines emerged, the HCPs employed these tools to manage the spread of this deadly disease. As of July 2022, Worldometer reported over 574 million infections and over 6 million deaths worldwide (2022a). With approximately 6.11 million vaccine doses being

administered daily, nearly 70% of the world's population has received at least one dose (Ritchie et al., 2020). Despite widespread vaccinations and preventive measures, SARS-CoV-2 continues to mutate and spread (Zawbaa et al, 2022).

SARS-CoV-2 is a new virus which developed directly or indirectly from a β-coronavirus discovered in infected bats and pangolins in Asia and Southeast Asia (Morens et al., 2020). Spread of the virus is associated with either "transmission of a bat coronavirus to humans or indirect transmission to humans via an intermediate host such as a Malaysian pangolin (*Manis javanica*)" (Morens et al., 2020). Despite the lack of information pointing to the absolute source, scientists have learned much about the epidemiology of SARS-CoV-2.

The disease caused by SARS-CoV-2 is COVID-19 (WHO, 2022a). COVID-19 is a respiratory illness which is contagious in humans with aerosols and respiratory droplets being the primary mode of transmission (CDC, 2021; Zawbaa, 2022). Airborne aerosols and droplets containing the virus spread to others in close contact. There are three primary routes of transmission:

- breathing in droplets (aerosols) containing the virus from an infected individual
- droplets or particles containing the virus being spread to eyes, nose, or mouth from the cough or sneeze of an infected individual
- contact with infected hands touching the eyes, nose, or mouth (CDC, 2021; Halaji et al., 2021; Zawbaa, 2022)

Upon transmission to a host, SARS-CoV-2 enters human lung cells via the angiotensin-converting enzyme-2 receptor (ACE2) (Halaji et al., 2021; Ni et al., 2020; Zawbaa et al, 2022). Utilizing ACE2 receptors on other cells, the virus can spread to other organs resulting in multi-organ disease (Ni et al., 2020). While most individuals with COVID-19 will experience mild to

moderate symptoms, those with underlying health conditions or older people are more likely to develop severe illness which may result in death (Halaji et al., 2021; WHO, 2022a).

Individuals with COVID-19 may encounter a variety of health effects ranging from mild symptoms to severe illness with the onset within 2-14 days following exposure (CDC, 2022a; Halaji et al., 2021). Common symptoms reported during the acute phase of COVID-19 are cough, fever, chills, headache, loss of taste/smell, difficulty breathing, shortness of breath, fatigue, muscle/body aches, sore throat, congestion, runny nose, nausea, vomiting, or diarrhea (CDC, 2021; Halaji et al., 2021). Some individuals experience no symptoms and may unknowingly spread the virus (Ravindra et al., 2022) Along with health risks associated with a primary infection with SARS-CoV-2, reports of protracted symptoms and new medical conditions have emerged (CDC, 2022b). Symptoms which persist for four or more weeks after the primary SARS-CoV-2 infection are described as PCC (CDC, 2022b). According to data gathered by the CDC, symptoms of PCC can range in severity and last weeks, months, or years (2022b). Symptoms associated with PCC include fatigue, malaise, cough, dyspnea, tachycardia, chest pain, brain fog, headache, peripheral neuropathy, depression, anxiety, PTSD, muscle or joint pain, abdominal pain, nausea, diarrhea, loss of taste/smell, tinnitus, fever, or rashes (CDC, 2022b).

A person previously infected with SARS-CoV-2, whether the disease is mild or severe, can develop PCC (CDC, 2022b). Additionally, unvaccinated individuals who acquire COVID-19 may be at higher risk of developing PCC in comparison to those who are vaccinated (CDC, 2022b). In some cases, individuals presenting with PCC may not have tested positive for the virus or known they were infected (Bulut & Kato, 2021; CDC, 2022b). Certain people may be at higher risk for developing PCC which include those who experienced more severe COVID-19

illness, those who had existing health conditions (prior to their COVID-19 diagnosis), unvaccinated individuals, and those who developed multisystem inflammatory syndrome (MIS) during or after COVID-19 infection (CDC, 2022a). Furthermore, some individuals experience new health conditions following a COVID-19 infection (CDC, 2022b). Multi-organ effects or autoimmune conditions can result in diabetes, heart conditions, or neurological conditions (CDC, 2022a).

Another circumstance associated with PCC arises when an individual who exhibits symptoms does not have conclusive test results (CDC, 2022b). The symptoms in these hard to explain situations can be indicative of a condition such as myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS) and other chronic illnesses. The difficulty in diagnosing the cause of the symptoms can lead to a delay in the patient receiving proper care or treatment (CDC, 2022b).

Moreover, individuals suffering from severe illness, hospitalization, or treatment may also develop new health problems. Post-intensive care syndrome (PICS), although not unique to COVID-19 hospitalizations, can result in weakness, brain fog, and symptoms of post-traumatic stress disorder (PTSD) (CDC, 2022b). PTSD is a mental health condition associated with traumatic events and is characterized by severe anxiety or flashbacks (CDC, 2022b; Mayo Clinic, n.d.a). COVID-19 survivors who were hospitalized or placed in intensive care are at higher risk of developing PTSD (Giannopoulou et al., 2021). The myriad of both physical and mental health complications experienced by individuals as a result of COVID-19 pose significant considerations when encountered in the dental setting.

Unlike the tests available to diagnose COVID-19, there is no one test to determine if an individual has PCC. Some tests that may be utilized are routine blood tests, chest x-rays, and

electrocardiograms (CDC, 2022b). The wide variety of symptoms could also be associated with other health problems resulting in difficulty recognizing PCC. Currently, a diagnosis of PCC arises when a healthcare provider confirms a previous infection with SARS-CoV-2 along with an evaluation of the patient's current health for symptoms related to PCC (CDC, 2022b). Similar to COVID-19, PCC vary in presentation. Some individuals experience debilitating effects, while others report mild symptoms (WHO, 2022a). Furthermore, some people may not associate their current symptoms with COVID-19 (CDC 2022b).

The relative newness of PCC has revealed a void in assessment protocols and treatment guidelines in the dental setting. The dental hygiene process of care as outlined by the American Dental Hygienists' Association (ADHA), provides a framework to guide the practice of the dental hygienist in the provision of safe and effective care for a patient (2016b). The first standard of the dental hygiene process of care is assessment (ADHA, 2016b). The ADHA supports "comprehensive risk-based assessment of the patient's needs prior to and throughout the delivery of oral health services" (2020). Prior to treatment, a dental hygienist will conduct a health history assessment (ADHA, 2016b). The health assessment includes demographic information, vital signs, physical characteristics, social history, medical history, and pharmacologic history (ADHA, 2016b). The evaluation of vital signs and the medical history interview are opportunities to identify contraindications or limitations to treatment in the dental setting. Reviewing pharmacologic history similarly offers insight into recent changes in health. During the patient assessment phase, OHPs (including dental hygienists) have the opportunity to identify patients presenting with PCC. Along with the variety of symptoms and possible new health conditions, patients may also be taking different medications.

The variety and complexity of symptoms and disease associated with PCC can affect the safe delivery of oral health care. OHCP will benefit from a protocol to treat patients with PCC.

Statement of the Problem

Infections with SARS-CoV-2, the virus that causes COVID-19, have resulted in some people experiencing lingering symptoms after resolution of the primary infection. These symptoms range from mild to severe. The CDC has described symptoms which persist for four or more weeks after the primary SARS-CoV-2 infection as post-COVID conditions (PCC) or long COVID (CDC, 2022b). The relative newness of PCC revealed an absence of comprehensive assessment and treatment guidelines in the dental setting. To date, there is no protocol for the treatment of patients presenting with PCC in the dental setting.

Purpose of the Study

The purpose of this study was to test a protocol for assessing and treating patients with PCC in the dental practice setting.

Professional Significance of the Study

The professional significance of the study relates to the American Dental Hygienists' Association's National Dental Hygiene Research Agenda (NDHRA) objective one "to give visibility to research activities that enhance the profession's ability to promote the health and well-being of the public" (ADHA, 2016a). This study further supports the client level area of research focusing on basic research. The phase of research concerns clinical decision support tools that would provide an assessment and treatment protocol to facilitate the provision of appropriate treatment for patients presenting with PCC in the dental practice setting (ADHA, 2016a).

Research Questions

The following research questions guided the conduct of this study.

1. Is the assessment protocol for treating patients with PCC appropriate for a dental practice setting?
2. Is the treatment protocol for treating patients with PCC appropriate for a dental practice setting?
3. What are the barriers to using the assessment protocol?
4. What are the barriers to using the treatment protocol?

Conceptual Definitions

Appropriate. "Especially suitable or compatible" (Merriam-Webster, n.d.)

Assessment. "The collection and analysis of systematic and oral health data in order to identify client needs" (ADHA, 2020).

Assessment protocol. A detailed guideline used to evaluate/screen the medical condition of a patient to determine if treatment modifications are indicated.

Barrier. "Something immaterial that impedes or separates; an obstacle" (Merriam-Webster, n.d.)

Dental Practice Setting. A location or facility in which dental services are provided. This may include educational, public, private, institutional, community, or mobile facilities.

Post COVID Conditions. Long-term effects following infection with SARS-CoV-2; also referred to as long-COVID (CDC, 2022b)

Protocol. "a detailed plan of a scientific or medical experiment, treatment, or procedure" (Merriam-Webster, n.d.)

Treatment Protocol. "A written plan specifying the procedures to be followed when providing care for a particular condition" (Mosby, 2022).

Summary of Chapter 1

The COVID-19 pandemic has resulted in widespread death and serious illness. Nearly three years following the discovery of the SARS-CoV-2 virus it continues to mutate and spread. Some individuals who recover from the acute infection with COVID-19 report long-term symptoms. The term used to describe these lingering symptoms is PCC. PCC are another facet of the COVID-19 pandemic that continues to present challenges for both patients and OHCP in the provision of oral health care. Existing medical health questionnaires commonly used in the dental setting may not address the wide range of symptoms and health effects associated with PCC. Providing OHCPs with an assessment and treatment protocol could facilitate the delivery of comprehensive oral health care. This research was designed to determine if a protocol for treating patients with PCC in the dental setting would be both appropriate and useful.

Chapter 2: Review of the Literature

The purpose of this study was to test a protocol for assessing and treating patients with PCC in the dental setting. The databases utilized for the literature search included Google Scholar, PubMed, and Ebscohost, employing the following key terms: covid-19, long covid, sars-cov-2, dental care, and post covid. The search was limited to English, full text journal articles encompassing the years 2020-2022. The focus of the review of the literature included the signs, symptoms, and risk factors associated with PCC, current treatment options for PCC, and oral health protocols for patients with PCC.

Post-COVID Conditions – Signs, symptoms, risk factors

PCC are widely variable in both presentation, intensity, and duration. The lack of a universally accepted definition and a standardized nomenclature for PCC may impede the diagnosis and management (Akbarialiabad, 2021). Agreement on specific terminology will aid in more accurate reporting of PCC. Similarly, the prevalence of PCC is challenging to assess due to the aforementioned lack of standardized definitions, reporting methods, and diagnosis criteria (France & Glick, 2022). Despite these limitations, specific signs and symptoms have become associated with PCC and researchers have identified risk factors associated with the development of PCC.

Akbarialiabad et al., conducted research to discover what is known about PCC regarding nomenclature, diagnosis, risk factors, signs and symptoms, pathophysiology, and recommended management (2021). Incorporating a multi-step strategy, the authors searched Google Scholar, PubMed, Cochrane, Embase, Scopus, PsycINFO, and the Web of Sciences resulting in 120 research publications focused on PCC. The various types of research and reports were sourced from peer- reviewed journals and organizational reports. Furthermore, no language restrictions

were applied. The exclusion criteria eliminated research related to acute COVID-19, preprints, and unavailable full texts. These studies were then separated into five different sections; nomenclature, pathophysiology, signs and symptoms, management, and concluding comments and suggestions. The research method employed was a systematic scoping review utilizing Preferred Reporting Items for Systematic review and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) to avoid poor reporting. The research included publications from March 2020 to January 2021. Sixty-two percent of the publications originated in the United Kingdom, the United States of America, Italy, and China (Akbarialiabad et al., 2021).

Utilizing a systematic scoping review, Akbarialiabad et al. addressed nomenclature, diagnosis, pathophysiology, diagnosis, risk factors, signs and symptoms, and recommended management. A common theme of the research indicated that the failure to create and adhere to a defined nomenclature has limited the ability to provide appropriate diagnosis and management of PCC (2021). It was discovered that the varied pathophysiology of SARS-CoV-2 results in multi-organ and multisystem effects. The virus has been found to create inflammation, weakened immune response, may remain in the central nervous system resulting in new neurodegenerative conditions, and may affect the autonomic nervous system resulting in tachycardia, palpitation, orthostatic intolerance, breathlessness, and chest pain (Akbarialiabad et al., 2021).

Various risk factors for developing PCC have also been detected including the presence of anosmia, dysgeusia, a higher heart rate upon hospital admission, duration of oxygen supplementation, ICU admission, underlying medical conditions, higher white blood cell (WBC) count, and more (Akbarialiabad et al., 2021). Additional risk factors include age, hospital admission, severe COVID-19, and dyspnea. Reports from the research by Akbarialiabad et al., also indicate that patients experiencing five or more symptoms within the first week of acute

phase of COVID-19 were found to be four times more likely to develop long COVID (2021). The most predictive symptoms were noted as fatigue, headache, shortness of breath, hoarse voice, and myalgia (Akbarialiabad et al., 2021).

One of the symptoms associated with PCC is SARS-CoV-2-associated myocarditis (Akbarialiabad et al., 2021). This review suggested that the long-term effects of SARS-CoV-2-associated myocarditis would result in 25% developing chronic systolic dysfunction, 25% would require advanced treatment such as heart transplant, and 50% would recover in 6-12 months. This supposition is based on experience with other viral related myocarditis conditions. Recommendations included cardiac monitoring for 2-6 months post-recovery for patients who experience post-viral myocarditis or cardiac complications (Akbarialiabad et al., 2021).

Akbarialiabad et al., also identified long-term mental health conditions associated with PCC including PTSD and chronic psychological distress (2021). Risk for developing these conditions was related to the severity of the infection, loss of a loved one, isolation, financial stress, older age, and female gender. A previous psychiatric diagnosis and higher systemic immune-inflammatory index were also associated with higher post-COVID mental health conditions.

Akbarialiabad et al., further organized the signs and symptoms of PCC by dividing them into sections to address the complexity of the health consequences (2021). The sections included respiratory, cardiovascular, musculoskeletal, cutaneous, neurologic, mental health, pediatric, and thromboembolism. The most common symptoms noted were fatigue, breathlessness, arthralgia, sleep difficulties, and chest pain. Also noted was the risk of a continuation of symptoms involving multiple organ systems (Akbarialiabad et al., 2021). To improve reporting reliability, the authors recommended a “global consensus” for the nomenclature for PCC (long Covid)

including definitions of diagnostic criteria and established timelines for evaluating the symptoms. They also recommended continuing long-term follow up to identify additional risk factors (Akbarialiabad et al., 2021).

In another study, Cabrera Martinbianco et al., researched PCC (2021). The purpose of this study was to identify the frequency of PCC, its signs and symptoms, and diagnosis criteria. Utilizing a systematic review of clinical trials, observational longitudinal comparative and non-comparative studies, cross-sectional, and case series, Cabrera Martinbianco et al., evaluated 25 studies comprised of 5,440 participants to summarize the frequency, duration, symptoms, risk factors, and diagnosis of PCC (2021).

Cabrera Martinbianco et al., designed the research to follow the Cochrane Handbook for Systemic Reviews of Interventions utilizing the relevant sections to reference a systematic review of frequency (2021). The report was prepared following the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) statement. Conducted on February 1, 2021, the electronic search explored various databases such as: CINAHL, CENTRAL, EMBASE, Epistemonikos, Health Systems Evidence, LILACS, and MEDLINE. The research design included two phases for the study selection. Within the first phase, two independent reviewers assessed the search results by title and abstract for eligibility. During the second phase the full text of each selected research article was evaluated to verify inclusion in the study. The role of the third reviewer was to address any disagreements regarding inclusion. The data from the studies included general information, methods, and participant details. The risk of bias was evaluated using the Cochrane Risk of Bias Tool for randomized clinical trials, the ROBINS-I for cohort or case-controlled non-randomized trials, uncontrolled before-and-after studies, and controlled before-and-after studies, the Joanna Briggs Institute Checklist for

analytical cross-sectional studies and prevalence cross-sectional studies, and the National Institute of Health Quality Assessment Tool for Case Series Studies for case series of single-arm cohort studies.

Cabrera Martinbianco et al., found that the results of this study revealed the frequency of PCC in the range of 4.7% to 80% with the most common symptoms listed as chest pain, fatigue, dyspnea, and cough and sputum production. The risk factors identified included older age, female, severe clinical status, a high number of comorbidities, hospital admission, and oxygen supplementation during the acute phase of COVID-19. The included studies did not track the duration of the signs and symptoms (Cabrera Martinbianco et al., 2021). Cabrera Martinbianco et al., discuss the urgency to understand this new medical condition, of adopting standards for diagnostic criteria, terminology, and disease classification, to acknowledge that the frequency of PCC may not be accurate due to the dearth of established criteria, and that these research results can support health decisions and prompt new studies to evaluate the effects of interventions (2021).

Another study led by Healy et al., was conducted to identify the incidence of signs and symptoms associated with PCC and to determine if they were different from those associated with symptomatic SARS-CoV-2 infection (2022). After establishing a protocol based on preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P), Healy et al., investigated the signs and symptoms of PCC utilizing a rapid review and meta-analysis of longitudinal cohort studies from around the world (2022). The search focused on longitudinal cohort studies from Medline and Embase databases dated January 2020 to July 2021 which studied adults with PCC four weeks following the acute phase of COVID-19 (Healy et al., 2022). A single reviewer performed the study screening to assess eligibility based on title, abstract, and

ultimately full text articles. A second reviewer was available by request for guidance to clarify eligibility when needed. Additionally, the Joanna Briggs Institute checklist for cohort studies was utilized to assess risk of bias in each study (Healy et al., 2022).

Healy et al. included 19 studies with a total sample size of 10,643 patients and a follow up time ranging from 30 to 340 days (2022). The participants average age was 35-64 years and a median of 47% were female. Sixteen of the studies were assessed as having a low risk of bias and were included in the meta-analysis. The three remaining studies were identified as having a high or moderate risk of bias. The meta-analysis revealed the most common signs and symptoms of PCC as fatigue, dyspnea, olfactory dysfunction, myalgia, gustatory dysfunctions, and cough. Headache, diarrhea, and chest pain were identified as less commonly reported symptoms. The authors compared their findings with similar reviews and found that the same common symptoms of PCC were evident. Differences were attributed to subjects assessed at less than 4 weeks, different inclusion criteria, and inclusion of vaccinated or those with natural immunity. The authors asserted that these differences suggested a need for additional primary research to establish the features of PCC, identify its pathogenesis, and formulate treatments (Healy et al., 2022).

Another symptom associated with PCC is the incidence of diabetes following recovery from the acute phase of COVID-19. The purpose of the study conducted by Xie & Al-Aly was to examine the risk of the onset of diabetes in individuals who survived the first 30 days of infection with SARS-CoV-2 (2022).

Xie & Al-Aly designed a cohort study drawing participants from the national database of the US Department of Veterans Affairs (2022). The cohort was comprised of 181,280 individuals who had a positive COVID-19 test between March 1, 2020, and September 30, 2021, and

survived the first 30 days of the infection. This cohort was compared to a contemporary control (n= 4,118,441) from the same date range and an historical control (n= 4,286,911) selected from enrolled participants between March 1, 2018, and September 30, 2019. No evidence of SARS-CoV-2 infection was evident in either control group. Additionally, participants in all three groups did not have a diagnosis of diabetes. Follow up was conducted for a median of 352 days and ended on December 20, 2021, for the COVID-19 and contemporary control group, and December 20, 2019, for the historical control group. The COVID-19 cohort was subdivided into three categories for the acute phase of the infection: those who were not hospitalized (n=162,096), those who were hospitalized (n=15,078), and those admitted to an intensive care unit (n=4,106). Post-acute diabetes outcomes were assessed 30 days following a positive COVID-19 test and were based on medical codes or an HbA1c greater than 6.4. Use of antihyperglycemics was identified based on the presence of diabetes medication prescriptions for a duration in excess of 30 days (Xie & Al-Aly, 2022).

Xie & Al-Aly built a large national cohort, free from diabetes, to study the relationship between COVID-19 and the risk of diabetes (2022). The large size of the contemporary and historical controls allowed for a reliable result of an association between COVID-19 and diabetes not related to external factors. Applying multiple sensitivity analyses helped validate the approach with the use of 22 predefined variables and 100 algorithmically selected variables from diagnostic codes, prescription records, and laboratory test results. Despite the strengths of the study, several limitations were identified. First, the cohort was composed of predominantly white males which could limit the generalizability of the results. Secondly, misclassification bias could be a factor especially in reference to diabetes type. Another possibility is that individuals in the control group could have been infected with SARS-CoV-2 but not tested for it. Another

possibility which could limit the results of the study is participants who may have had undiagnosed diabetes prior to COVID-19 (Xie & Al-Aly, 2022).

Xie and Al-Aly discovered an elevated risk of diabetes and antihyperglycemic use in individuals following infection with SARS-CoV-2 (2022). Risk increased in a graded fashion directly proportional to the severity of the infection. The authors suggested that diabetes is an aspect of PCC that HCPs should be prepared to address in the post-acute care phase. These strategies should include evaluation for and management of diabetes (Xie & Al-Aly, 2022).

Ceban et al., narrowed the scope of their study to measure the proportion of individuals with fatigue and cognitive impairment 12 or more weeks following a diagnosis of COVID-19 and to connect the inflammatory processes with functional consequences associated with PCC (2022). Following PRISMA guidelines a systematic search was implemented utilizing PubMed/MEDLINE, Cochrane Library, PsycInfo, EMBASE, and Web of Science databases from their establishment up to June 8, 2021. Meta-analysis of Observational Studies in Epidemiology (MOOSE) reporting guidelines were followed in this study with the protocol registered on PROSPERO. With no language or publication date restrictions, the search terms associated with PCC were utilized to manually explore references of relevant articles. The titles and abstracts were evaluated for relevance by at least one reviewer and then full-text articles were evaluated by two independent reviewers (Ceban et al., 2022)

Ceban et al. targeted articles focused on the incidence of a primary outcome (i.e., fatigue) and a secondary outcome (inflammatory markers or quality of life) (2022). Specific inclusion and exclusion criteria were identified to determine eligibility. Inclusion criteria included at least one primary and one secondary outcome following a COVID-19 diagnosis, follow-up of at least 12 weeks, primary research, and full text articles. Some of the exclusion criteria included articles

with incomplete data, studies with less than a 12-week follow up, COVID-19 not confirmed, an unpublished study, and non-primary research. Two independent reviewers used a data extraction form to evaluate discrepancies. Risk of bias was gauged using the Newcastly-Ottowa Scale (NOS). Following data extraction, quality assessment, and synthesis and analysis, 81 studies were ultimately included and were comprised of prospective cohort studies (56), cross-sectional studies (14), retrospective cohort studies (10), and a retrospective case-control study (1) from countries around the world (Ceban et al., 2022).

Ceban et al. identified specific outcomes associated with PCC (2022). Data synthesized from this study through the meta-analysis of the primary outcomes revealed that fatigue was reported by 32% of the participants and cognitive impairment was reported by 22% in a time span of 12 or more weeks following a diagnosis of COVID-19. Additionally, research examining inflammatory parameters discovered elevations in proinflammatory markers. Functional impairment was also identified in the studies which investigated functional outcomes (Ceban et al., 2022).

The meta-analyses for the outcomes of fatigue and cognitive impairment were also described by Ceban et al. (2022). Pooled proportions showed that fatigue was more common in adults (.32) as compared to children (.07). The proportion of hospitalized and non-hospitalized individuals reporting fatigue was not statistically significant. Similarly, there was not a significant difference in proportions related to follow-up timing of evaluations. The pooled proportion was 0.22 for individuals exhibiting cognitive impairment. A trend was identified showing a larger proportion of females exhibiting cognitive impairment. Furthermore, there was no statistically significant difference in cognitive impairment between hospitalized and non-hospitalized individuals and the follow-up timing of evaluation. Additionally, nearly all the

studies reported at least one elevated measure of inflammation in post-COVID individuals (Ceban et al., 2022).

The outcome of the systematic review and meta-analysis conducted by Ceban et al. revealed that twelve or more weeks following a diagnosis of COVID-19 persistent fatigue was a symptom reported by approximately one third of individuals and cognitive impairment was reported by over a fifth of individuals in the studies (2022). Moreover, fatigue and cognitive impairment appeared to continue and could potentially worsen over time in individuals in a higher risk group. Persistent inflammation was reported and this along with the symptoms of PCC were related to functional impairment and lower quality of life reports (Ceban et al., 2022).

Ceban et al., discussed several limitations and cautioned that the study results should be carefully evaluated as to the type of study conducted, whether or not outcomes were present prior to the COVID-19 infection, and that most of the study participants were hospitalized so results may not be representative of the majority (2022). The strain of living through a pandemic could be the cause of the increase in symptoms of depression and anxiety rather than being related to infection with SARS-CoV-2. Additionally, most of the cohort studies examined did not include a non-exposed control group which limited comparison. Another limitation presented as selection bias which may show an overrepresentation of hospitalized cases and an underrepresentation for those who did not receive care for PCC. Additionally, the dementia screening tools used demonstrate limited sensitivity in younger individuals resulting in an underestimation of cognitive decline in that population. The level of heterogeneity in the meta-analyses could be the result of variations in data collection and assessment tools (Ceban et al., 2021).

The study by Ceban et al., indicated that a significant percentage of individuals experienced fatigue, cognitive impairment, displayed an elevation in proinflammatory markers, and experienced functional impairment (2022). Despite the study limitations, the authors encouraged continued research to characterize the underlying causes of PCC, to develop uniform diagnostic criteria, and to learn best treatment practices (Ceban et al., 2022).

Another study by de Oliviera et al. researched risk factors and health consequences associated with PCC (2022). The specific purposes of the study were to identify risk factors for developing PCC, assess quality of life, and to characterize the prevalence and health consequences following acute SARS-CoV-2 infection.

The study design incorporated an observational, cross-sectional study of COVID-19 positive patients admitted to a hospital in Belo Horizante, Brazil between July 1, 2020, and March 31, 2021, and discharged by April 30, 2021 (de Oliveira et al., 2022). The patients were 18 years and older, not vaccinated, and diagnosed with COVID-19 by a positive reverse transcriptase-polymerase chain reaction (RT-PCR) test utilizing a nasopharyngeal swab. Eligible study participants were contacted at least 4 weeks after the onset of symptoms with health outcomes recorded at only one follow-up. The procedures included telephone and virtual assessment, baseline assessment, outcomes, and statistical analysis. Patients were assessed within 2-12 months following the onset of COVID-19. Contact was initiated by telephone calls or text messages from doctors and nurses trained in recruitment. Participants were provided a link to complete an online questionnaire or a telephone interview using the same questionnaire. The questions addressed quality of life and post-COVID-19 persistent symptoms. The baseline assessment included demographics, comorbidity data, clinical data (including complications during the hospital stay), blood tests, and images. The outcomes measured included the

prevalence of PCC (persistence of one or more symptoms 4 or more weeks following onset of SAR-CoV-2 infection), the type of PCC symptoms, and quality of life measures. Potential risk factors for PCC were also evaluated. Within the statistical analysis, descriptive analysis of the variables and frequency of PCC was completed (de Oliveira et al., 2022).

De Oliveira et al., gathered an initial sample size which included 748 eligible participants of which 309 were excluded for various reasons (2022). The remaining 439 patients were included in the study. The median age of the participants was 58 years with a near even distribution of men and women. Seventy-five percent of patients had an existing comorbidity with the most frequent being arterial hypertension, obesity, and diabetes mellitus. The most frequently reported symptoms at time of hospitalization included dyspnea, cough, and fatigue. Fifty-eight percent of patients who received chest CT scans had alterations noted of which pulmonary involvement was the most common. Eighteen percent of patients were admitted to the intensive care unit and 18% required mechanical ventilation. Nearly every patient received dexamethasone as a corticosteroid treatment (de Oliveira et al., 2022).

De Oliveira et al. discovered that at least one symptom of PCC was reported by 84% of the study participants with fatigue, arthralgia, depression and anxiety, dyspnea, and myalgia being the most common (2022). Some of the factors associated with developing PCC included the following: the patients were generally younger, had longer times from symptom onset to hospitalization, and had longer stays in the hospital. The multivariate analysis revealed the presence of dysgeusia and ICU admission during the acute phase of COVID-19 as variables associated with the presence of PCC. The quality-of-life assessments demonstrated that from the pool of 357 patients who reported PCC, 50.1% reported health condition(s) worse than prior to

COVID-19. The conditions included mobility, usual activities, anxiety/depression, and pain/discomfort (de Oliveira et al., 2022).

De Oliveira et al., reported various limitations of the study (2022). One limitation was related to generalizability due to the nature of the single center study and the high rate of unreachable patients. Additional limitations were described as being related to the accuracy of clinical information and a lack of consistent definitions in medical records. Moreover, the authors could not rule out reinfection with COVID-19 or separate health effects related to PCC from those related to comorbidities (de Oliveira et al., 2022).

De Oliveira et al., reported ICU admission for COVID-19 as a risk factor associated with PCC along with dysgeusia as a possible predictor of PCC (2022). PCC were also more prevalent in the first 180 days after the acute phase of COVID-19 with fatigue being the most reported symptom. Identifying risk factors or predictors of PCC can aid HCP in the recognition and diagnosis of this new syndrome (de Oliveira et al., 2022).

Daugherty et al., also evaluated the risks for adults aged 18-65 to develop PCC (incident clinical sequelae) following the acute phase of SARS-CoV-2 infection from January 1, 2020, to October 31, 2020 (2021). Utilizing a retrospective cohort study the participants were identified from a pool of individuals enrolled in a United States health plan. From this pool, the study population and three comparator groups were generated. The study population included adults aged 18-65 with a diagnosis of SARS-CoV-2 infection. Continuous enrollment in the health plan from January 2019 up to the diagnosis of COVID-19 was established as an inclusion requirement. The index date for the study population was defined as the first date of diagnosis of COVID-19 by test result, insurance claim number, or hospital admission with a COVID-19 diagnosis. Three comparator groups were also created with index dates being randomly assigned.

The 2020 comparator group consisted of individuals ages 18-65 with continuous enrollment in the health plan from January 1, 2019, and who did not have a diagnosis of COVID-19. The 2019 comparator group was created to identify bias due to health access changes during the COVID-19 pandemic. The individuals in this group were also required to have continuous enrollment in the health plan from January 1, 2018, to a randomly assigned index date in 2019 and were drawn from the SARS-CoV-2 infection group. The third historical comparator group was comprised of individuals also with continuous enrollment in the health plan from January 1, 2016, January 1, 2017, or January 1, 2018. These individuals had infections with a viral lower respiratory tract illness in January to October of either 2017, 2018, or 2019. The purpose of this historical comparator group was to evaluate the clinical signs and symptoms specific to SARS-CoV-2 infection (Daugherty et al., 2021).

To evaluate this large study population, Daugherty et al. employed statistical methods which included propensity score matching, data analysis, subgroup analysis, and sensitivity analysis (2021). The propensity score matching was based on 108 variables which were used to create three balanced cohort groups from matching individuals with SARS-CoV-2 with individuals from each comparator group. The data analysis calculated the risk for specific symptoms 21+ days following the index date. The proportion of the matched populations with or without symptoms 21 days after the index date were also calculated. A secondary analysis estimated the hazard ratios and confidence intervals by forming seven-month long time intervals to evaluate the matched pairs at risk for diagnosis of COVID-19 at the start of each interval. The subgroup analysis included four groupings from the SARS-CoV-2 and 2020 comparator group by age (18-34, 34-50, >50), sex, pre-existing comorbidity, and admitted to hospital for COVID-19. Finally, the sensitivity analysis addressed the strength of how the post-acute phase is defined

by evaluating the differences in the cut-off points of 14 and 28 days after the index date (Daugherty et al., 2021).

The results of this study demonstrated that of the 9,247,505 individuals qualifying for the study criteria, 2.9% (266,586) were diagnosed with SARS-CoV-2 infection (Daugherty et al., 2021). Drawing from a United States health plan, the researchers identified 50 clinical sequelae and found that 14% of adults displayed at minimum one new symptom associated with PCC. These symptoms included chronic respiratory failure, cardiac arrhythmia, hypercoagulability, encephalopathy, peripheral neuropathy, memory difficulty, diabetes, liver abnormalities, myocarditis, anxiety, and fatigue. Furthermore, an increased risk of developing PCC was associated with older individuals, those with pre-existing conditions, or those who required hospital admission for COVID-19. In women, fatigue and anosmia were more commonly diagnosed whereas men experienced myocarditis, hypercoagulability, deep vein thrombosis, kidney injury, and sleep apnea more commonly. The risk for mental health symptoms increased regardless of age or the presence of pre-existing conditions. This study also determined that the index date plus 21 days is an appropriate start time to evaluate the post-acute phase of COVID-19 (Daugherty et al., 2021). Daugherty et al., asserted that assessing the risk for developing PCC is important for healthcare planning and that more research will help determine risk over time (2021).

Subranian et al., investigated symptoms and risk factors associated with PCC in non-hospitalized individuals with COVID-19 (2022). The purpose of the study was to better understand the risk factors and the wide range of symptoms associated with long COVID. This information can help health care providers identify higher risk groups. This study evaluated symptoms in non-hospitalized individuals at least 12 weeks after a confirmed SARS-CoV-2

infection. Subranian et al., specifically noted that many of the previous studies focused on populations that were hospitalized with COVID-19 which may not reflect an accurate portrayal of the full scope of the symptoms and risk factors for PCC (2022).

Subranian et al. drew from a study population which included a cohort of 486,149 COVID-19 positive patients and a comparator cohort of 8,030,224 that had no suspected or confirmed diagnosis of COVID-19 during the study period between January 31, 2020, and April 15, 2021. Female participants with a mean age of 43.8 comprised 55.3% of the study population. Of the study participants, 22.5% were current smokers, 53.8% were obese, 64.7% were white, 12.2% were Asian, 4% were black, and 16.2% had missing ethnicity data. The most common comorbidities were depression, anxiety, asthma, eczema, and hay fever. The most common symptoms noted at the 12-week minimum follow up were anosmia, hair loss, sneezing, ejaculation difficulty, reduced libido, shortness of breath, fatigue, pleuritic chest pain, hoarse voice, and fever. It is notable that this study revealed symptoms such as hair loss, sneezing, and sexual dysfunction that have not been commonly reported in previous research (Subranian et al., 2022).

The risk factor analysis demonstrated higher risk for long COVID in females, ethnic minority groups, lower socioeconomic groups, smokers and former smokers, individuals with high basal metabolic rate, and a gradient of decreasing age. As with other studies, there are various strengths and weaknesses identified. The large sample size and well-matched comparator group provided adequate statistical power. Another strength was the large number of symptoms that were included as they were based on previous systematic reviews, a scoping review, long COVID questionnaires, and consultations with both patients and clinicians. A limitation of the study was associated with the use of coded healthcare data. Limited access to healthcare early in

the pandemic, individuals not reporting symptoms, and symptoms being recorded in free text could result in an underrepresentation of symptoms. Another limitation of the study was a possible misclassification bias as testing for SARS-CoV-2 was limited in the beginning of the pandemic and positive COVID cases may have been missed. As some of the findings contradict those in other studies, the authors suggested that the difference may lie in the composition of the sample group (Subranian et al., 2022).

Subramanian et al., discovered symptoms such as hair loss, sneezing, and sexual dysfunction that have not commonly been reported and also identified a younger age as a risk factor for developing PCC (2022). As this study evaluated non-hospitalized individuals, it was suggested that the younger patients might be better represented in this study than in those whose participants have been hospitalized. Further research was recommended to identify the health and social impacts associated with the persistent symptoms associated with long COVID (Subramanian et al., 2022).

Based on the above studies the commonalities of the symptoms of PCC included fatigue, malaise, cough, dyspnea, tachycardia, chest pain, brain fog, headache, peripheral neuropathy, depression, anxiety, PTSD, muscle or joint pain, abdominal pain, nausea, diarrhea, loss of taste/smell, tinnitus, fever, or rashes. Other incidences of systemic disease affecting multiple organ systems have also been identified. The common risk factors for developing PCC included those who experienced more severe COVID-19 illness, those who had existing health conditions, unvaccinated individuals, and those hospitalized or admitted to ICU during the acute phase of COVID-19. Additionally, some individuals experienced new health conditions following a COVID-19 infection. Multi-organ effects or autoimmune conditions from COVID-19 resulted in diabetes, heart conditions, or neurological conditions. The significant number of studies

conducted to evaluate the signs, symptoms, and risk factors associated with PCC have produced a considerable amount of information. Despite the lack of universal definitions and diagnostic criteria, the literature has shown commonalities amongst the symptoms and risk factors associated with PCC. The variety and intensity of symptoms affecting multiple organ symptoms contribute to the complexity of the identification and management of this new disease process. The need for further research and consistent reporting criteria was a sentiment consistently echoed by the authors.

Diagnostic and Treatment Considerations for Post-COVID Conditions

A sound medical approach requires a structured diagnostic assessment to determine appropriate treatment (Paris, 1975). Yet, in the absence of specific diagnostic criteria, identifying PCC has become a diagnosis of exclusion when the symptoms cannot be attributed to another cause. Once a diagnosis of PCC is determined, the appropriate treatment can be rendered. The efforts to characterize the diverse collection of symptoms as PCC contributes to the body of evidence necessary to help support the diagnosis and treatment efforts of this new disease process.

The trifold purpose of the literature review conducted by Oronsky et al., was to examine the relationship of the overexpression of transforming growth factor beta (TGF-β) with PCC, to summarize the clinical symptoms of PCC, and to identify possible strategies for the diagnosis and management of PCC (2021). Relating the clinical manifestations of PCC to those associated with post-sepsis syndrome and post-ICU syndrome, the authors emphasized the importance of addressing postinfectious care following acute infection (Oronsky et al., 2021).

The initial stimulation of the immune system by an infectious disease (COVID-19) is followed by a post-infectious immunosuppression during which the body attempts to rebalance

its systems (Oronsky, et al., 2021). It is during this time that the pro- and anti-inflammatory responses determine the outcome whether it be protracted immunosuppression, injury, or healing. Post-COVID patients demonstrate a vulnerability to developing pulmonary fibrosis which may be mediated by TGF- β. Associated with immunosuppression and fibrosis, TGF- β can provide a mechanism for targeted treatment (Oronsky et al., 2021)

Oronsky et al., suggested a screening and diagnostic framework to identify PCC (2021). The four screening categories were listed as laboratory investigation, radiologic pathology, decline of functional status, and symptomatic and quality of life measures. Various post-COVID diseases were explored including pulmonary fibrosis and dysfunction, cardiac fibrosis and dysfunction, neurological fibrosis and dysfunction, and coagulopathy (Oronsky et al., 2021).

Approximately 5-8% of COVID-19 patients developed adult respiratory distress syndrome (ARDS) which is characterized by three phases (exudative, proliferative, and fibrotic) (Oronsky et al., 2021). A subset of ARDS survivors presented with pulmonary fibrosis which was marked by chronic dry cough and exercise induced breathlessness. The treatment medications for these conditions are nintebanib and pirfenidone which work to slow the progression of the fibrosis (Oronsky et al., 2021).

Cardiac fibrosis and dysfunction can arise because of myocardial injury resulting from the acute phase of COVID-19 (Oronsky et al., 2021). The mechanism of the injuries ranges from viral invasion resulting in myocarditis, overstimulation of the renin-angiotensin system causing hypokalemia and cardiac arrhythmias, cardiotoxicity from anti-COVID agents (azithromycin, chloroquine/hydroxychloroquine, tocilizumab, etc.) leading to conduction defects and increased cholesterol. TGF- β is indicated as the main profibrotic cytokine which functions as a mediator of hypertrophy and fibrosis of the left ventricular wall. Based on long term cardiovascular

abnormalities associated with SARS-CoV-1, Oronsky et al., extrapolated that SAR-CoV-2 patients may also experience protracted cardiovascular consequences of which TGF- β may provide a therapeutic target (2021).

Oronsky et al., referenced a retrospective case series study (n=214) in Wuhan, China which noted a high rate of neurologic symptoms (2021). Two of the common symptoms were dizziness and headache with acute cerebrovascular disease, ataxia, epilepsy, and impaired consciousness also reported. Neurological fibrosis and dysfunction arise because of tissue fibrosis in response to cytokine activity. As TGF- β is also linked to neurologic disorders such as anxiety, depression, schizophrenia, Parkinson's disease, and more; it presents as a potential therapeutic target for neuropsychiatric symptoms associated with COVID-19 (Oronsky et al., 2021).

Coagulopathy has also been associated with severe COVID-19 infections which is characterized by delayed clotting times, low platelet count, and decreased fibrinogen levels (Oronsky et al., 2021). These effects are associated with pulmonary embolism and stroke. The long-term consequences of thrombotic effects are associated with the potential for recurrence, need for anti-coagulation medications which increase the risk of hemorrhage, cerebrovascular accident resulting in physical impairment, myocardial infarction, pulmonary embolism, and behavioral and emotional changes (Oronsky et al., 2021).

The increase and range of both physical and psychological disabilities experienced in post-COVID patients makes diagnosis of PCC challenging. Yet, many of the health consequences can be associated with fibrotic remodeling in the lungs, heart, and brain as a result of chronic inflammation. To this end, inhibition of TGF-β may provide a treatment strategy to mitigate the effects of PCC (Oronsky et al., 2021).

Another review conducted by Yong and Liu aimed to highlight the likelihood of multiple pathophysiology and subtypes of PCC that are characteristic of this syndrome (2021). The purpose of this review was to categorize PCC into six subtypes and describe the associated manifestations, pathophysiology, and treatments. The characterization of these subtypes may help to promote medical and public health efforts to better recognize and treat the health effects associated with PCC (Yong & Liu, 2021).

Yong and Liu designed a semi-systematic narrative review to propose multiple subtypes of PCC (2021). The eligibility criteria included primary studies reporting persistent symptoms associated with PCC. The scope of the search was further narrowed to focus on PCC studies which specifically reported information about non-severe COVID-19 multi-organ sequelae (NCS-MOS), pulmonary fibrosis sequelae (PFS), myalgic encephalomyelitis/chronic fatigue syndrome (ME/CFS), postural orthostatic hypotension (POTS), post-intensive care syndrome (PICS), and medical or clinical sequelae (MCS). Non-English studies, those with inaccessible full texts, those with insufficient information, case studies, those with low sample sizes, and studies that were not original were excluded. Using keywords associated with PCC and its associated symptoms, PubMed, SCOPUS, and Web of Science were searched from January 1, 2020, to August 14, 2021. Additionally, a review of reference lists from the relevant articles were screened for supplemental sources. Forty-three of the 1,439 articles met the eligibility criteria. The majority of the articles included in the review were retrospective or prospective cohort studies with several cross-sectional studies and only one case series.

Although COVID-19 is primarily considered a respiratory disease, it can affect other organ systems via diverse mechanisms (Yong & Liu, 2021). NSC-MOS resulting from damage during the acute phase of COVID-19 may lead to PCC. Multi-organ impairment and symptoms

of PCC have been identified in individuals that have recovered from mild COVID-19. Treatment for NSC-MOS is dependent upon specific pathophysiology. Rehabilitation programs based on the organ system affected are proposed as the indicated approach to treatment. Regardless of hospitalization status or disease severity, survivors of COVID-19 can develop MOS. Ten of the studies demonstrated that non-severe COVID-19 can result in PCC with MOS which supports the subtype category of NSC-MOS (Yong & Liu, 2021).

Another subtype suggested by Yong & Liu (2021) is PFS. Multi-organ failure and acute respiratory distress syndrome (ARDS) are common in individuals who experience severe or critical COVID-19 (2021). These individuals may also be hospitalized for longer periods of time, be admitted to the intensive care unit (ICU) and require mechanical ventilation. Pulmonary fibrosis was associated with more severe COVID-19 infection and interventions. Individuals experiencing PFS may benefit from treatment with antifibrinolytic agents such as nitedanib and pirfenidone to minimize lung injury in mechanically ventilated patients. Ongoing clinical trials are evaluating other medications, medication combinations, Chinese medicines, and interventions such as hyperbaric oxygen treatment to determine therapeutic effects for PFS. Additionally, several studies have supported non-drug pulmonary rehabilitation as an effective treatment to improve exercise and lung function capabilities, reduce fatigue, dyspnea, and improve mental health following COVID-19 infection. Pulmonary rehabilitation may include breathing and aerobic exercises, airway clearance techniques, and oxygen and nutritional support. Unlike NSC-MOS, PFS is dependent on the severity of acute COVID-19 and thus arises as a separate subtype of PCC (Yong & Liu, 2021).

Commonly known as chronic fatigue syndrome, diagnosis of ME/CFS utilizes frequently used diagnostic criteria from the Centers for Disease Control and Prevention (CDC), the

Canadian Consensus Criteria (CCC), and the Institute of Medicine (IOM) (Carruthers, et al., 2003; Clayton et al., 2015; Fukada et al., 1994). These three criteria base diagnosis on clinical manifestations such as severe fatigue, cognitive impairments, and immune manifestations lasting six months or longer (Carruthers, et al., 2003; Clayton et al., 2015; Fukada et al., 1994). Although the etiology of ME/CFS is undetermined, risk factors include female sex, major stress events, and viral infections such as SARS-CoV-1 and SARS-CoV-2. The commonality of the symptoms and mechanisms suggest that PCC may result in ME/CFS. In the studies reviewed by Yong & Liu, a significant percentage of COVID-19 survivors exhibited symptoms of ME/CFS at 6 months post-infection (2021). This PCC subtype may benefit from the existing non-drug treatments or pharmaceutical treatments for ME/CFS. Cognitive behavioral therapy (CBT), graded-exercise therapy (GET), rehabilitation, acupuncture, and abdominal tuina are the current non-drug treatments. The Staphypan Berna vaccine, rintatolimod, and coenzyme Q10 + NADH are the drug treatment options used to improve the symptoms of ME/CFS. Sleep medications, pain medications, and antidepressants are also indicated to treat specific symptoms. The effectiveness of CBT and GET are being debated for their efficacy and potential for harm as these therapies are to be used with caution (Yong & Liu, 2021).

Another subtype of PCC identified by Yong & Liu is POTS which is an autonomic disorder lasting for six months or more (2021). Diagnostic criteria for POTS are an increased heart rate (>30 beats/minute) within 5-10 minutes of standing or upright tilt without orthostatic hypotension. Dizziness, palpitations, blurred vision, weakness, exercise intolerance and fatigue are all hallmarks of POTS (Agarwal et al., 2007; Sheldon et al., 2015; Bryarly et al., 2019). Stress and gastrointestinal or respiratory infection are possible triggers for POTS. As COVID-19 is a respiratory infection, Yong & Liu asserted that it may trigger POTS (2021). The authors

noted a significant percentage of individuals with COVID-19 were diagnosed with POTS following the acute phase of infection. Pharmaceutical treatment with medications such as propranolol, midodrine, ivabradine, fludrocortisone and antihistamine have been effective with symptomatic relief. Non-drug treatments such as increased fluid and salt intake, compression stockings, and non-upright exercises are also reported to be effective to treat POTS and are recommended as the first approach for treatment. POTS arises as a subtype of PCC due to its prevalence in COVID-19 survivors (Yong & Liu, 2021).

Prolonged ICE care for severe cases of COVID-19 can result in PICS (Yong & Liu, 2021). PICS is characterized by the presence of cognitive, mental, and physical sequelae that significantly affect quality of life. Yong & Liu found in their review that a significant percentage of severe COVID-19 survivors experience PICS (2021). It was proposed within three of the studies that statin, dabigatran renin-angiotensin-aldosterone system inhibitors, sodium-glucose contransporter-2 inhibitors, glucagon-like peptide-1 receptor agonist, metformin and B-adrenoceptor blocker medications may deter the pathological processes associated with PICS (Bangash, et al., 2021; Hariyanto, & Kurniawan, 2020; Hariyanto et al., 2020). Therapies such as neuromuscular stimulation and virtual reality are non-drug options for the treatment of PICS. The relationship of PICS as a subtype of PCC is supported in survivors of severe COVID-19 disease.

The final subtype described by Yong and Liu is MCS (2021). MCS is the result of a deterioration of health in COVID-19 survivors which results in new disease processes. In contrast to the aforementioned PCC subtypes, MCS involves a wide variety of diseases. One cohort study reviewed by Yong & Liu (2021) reported that MCS may be an exacerbation of pre-existing and new onset of medical conditions (Maestre-Muniz, 2021). The outcome of the

reviews indicates that COVID-19 either exacerbates existing conditions, induces new health conditions, or both (Al-Aly et al., 2021; Ayoubkhani et al., 2021; Chevinsky et al., 2021; Daugherty et al., 2021; Hernandez-Romieu et al., 2021; Lund et al., 2021; Maestre-Muniz et al., 2021; and Taquet, et al., 2021). It was also determined that COVID-19 is associated with MCS which supports its designation as a PCC subtype (Yong & Liu, 2021).

The studies reviewed by Yong and Liu helped describe the six distinct subtypes of PCC (2021). Limitations of this review involved the lack of standardized case definitions, different symptoms screening methods, recruitment criteria, and the lack of non-COVID-19 control groups. The lack of control groups complicates cause and effect and influence of confounding factors. Although there is overlap among the six subtypes described by Yong and Liu, each subtype is unique in its symptoms, pathophysiological mechanisms, and treatment interventions (2021). This categorization of subtypes is helpful in the creation of an assessment and treatment protocol for patients with PCC.

A diagnostic model which may prove helpful for HCPs was proposed by Raveendran (2021). Collectively referred to as PCC, four clinical groupings arise to categorize the symptoms as post-intensive care syndrome, post-viral fatigue syndrome, permanent organ damage, and long-term COVID-19 syndrome. Additionally, drug-related side effects, cardiovascular complications of COVID-19, psychological effects, and infection can be associated with PCC. Raveendran cautions careful evaluation to rule out diseases/symptoms unrelated to COVID-19 (2021).

Drawing from research and governmental reports from around the world, Raveendran proposed three sectors to diagnose PCC: essential criteria, clinical criteria, and duration criteria (2021). The essential criteria included evidence of a preceding SARS-CoV-2 infection. The

clinical criteria evaluated symptoms of PCC (new or persistent) which could not be ascribed to another cause. These symptoms were described as fatigue, breathlessness, cough, joint pain, chest pain, muscle aches, and headaches (Raveendran, 2021). The duration criteria were based on the severity of disease ranging from 2-6 weeks following the acute phase of COVID-19. When considered as a whole, the results of the evaluation of each of the three sectors yielded four PCC diagnoses: confirmed, probable, possible, or doubtful (Raveendran, 2021). This diagnostic model can be beneficial for HCP as they evaluate their patients for the presence of PCC.

Using a qualitative study design, Ladds et al., documented patient experiences accessing and receiving healthcare for PCC in an effort to improve services (2020). Three questions provided the focus of the study. The first question was how do individuals with PCC experience the disease over time? The second was what services were accessed, or attempted to access, and what was the experience? The final question was what are the ideas for improving the health care and delivery of services? Using a qualitative design, participants from the United Kingdom (UK) had the option of completing an individual narrative interview or joining an online focus group between May and December 2020 (Ladds, et al., 2020). Participants were recruited from PCC support groups and social media sites. Inclusion criteria included individuals who developed symptoms between February and July of 2020 at least 3 weeks after acute COVID-19.

The study included 114 participants ranging in age from 27-73 years old (Ladds, et al., 2020). Of these, 80 were female. Fifty-five individual interviews and eight focus groups were held. The design of the individual narrative interview allowed 30-40 minutes for the interviewees to share an uninterrupted account of their experiences with general prompts as needed from the interview. These interviews were conducted by phone, video, or email. In contrast, the focus

groups lasted 90 minutes and consisted of 3-12 participants. The interviews revealed that many individuals had not received emergency assessment or treatment. Prolonged untreated hypoxia was suggested to be a precursor to the development of PCC. Reported symptoms such as fatigue and brain fog limited the ability to return to work. There were also reports of symptoms being dismissed as anxiety. Participants also had difficulty accessing care. Along with the challenges of diagnosing PCC, patient health services can be improved with the adoption of consistent standards and protocols. Ladds et al., summarized six categories of patient services developed from the feedback of individuals with PCC (2020). The six categories include access, burden of illness, clinical responsibility and continuity of care, multi-disciplinary rehabilitation services, evidenced-based standards, and continued development of the knowledge base and clinical services (Ladds et al., 2020).

The key findings from this study were that PCC is a confusing illness with intermittent symptoms and severity of symptoms, and that health care services can be challenging to navigate (Ladds, et al., 2020). Two limitations of the study resulted from the study population being limited to individuals residing in the UK and the failure to include viewpoints of minority individuals. Ladds et al., also suggested that primary care physicians require improved knowledge and guidance along with more time and resources to support the needs of patients with PCC (2020). Additionally, every patient with PCC should have access to health care, and the burden of accessing, navigating, and coordinating care should shift from the patient to the HCP. Continuity of care is achieved when the clinician provides complete care with clear clinical responsibility. Furthermore, patients with PCC should be assessed by a multidisciplinary team including rehabilitation, respiratory and cardiac consultation, physiotherapist, occupational

therapist, psychologist, and neurologist. Standards and protocols should be universally consistent in health care settings and additional data should be collected and analyzed (Ladds et al., 2020).

The common themes in the research studies presented reveal that diagnostic and treatment considerations for PCC involve general care, pharmacological options, and physical and mental rehabilitation. Current treatments for PCC are based on the symptoms the patient is experiencing. Equipping HCP with the knowledge, tools, and time to treat patients with PCC is important for providing safe and effective oral health care.

Oral Health Symptoms and Treatment Considerations for PCC

Oral symptoms, such as taste and smell dysfunction, are closely associated with COVID-19 infection and can be considered definitive symptoms of infection with SARS-CoV-2 (Callejon-Leblic et al., 2021; Menni et al., 2020). Yet, these symptoms, along with others, can persist beyond the active infection and be associated with PCC. This situation presents a challenge for the OHCP to determine if treatment should be deferred. Treatment guidelines dictate deferral of dental treatment for individuals with COVID-19 symptoms (D'Amico et al., 2020). In an individual with PCC, oral symptoms such as taste, or smell dysfunction, or dysesthesia can persist well beyond the infectious stage of COVID-19 resulting in impractical delays in oral health care. Persistent symptoms can be worrisome to the patient who may consider it a sign of a continuation of the contagious stage of COVID 19 (Catton & Gardner, 2022).

Catton & Gardner (2022) explored the relationship of smell and taste dysfunction along with the influence of oral health behaviors on the duration of symptoms following the acute phase of COVID-19. The purpose of the study was to evaluate the loss and recovery of taste function in individuals with COVID-19. The intensity and duration of taste loss relative to smell

loss was evaluated using a granular analysis. Additionally, the intensity of loss of individual taste qualities and an analysis of external factors such as lifestyle and oral health factors may be associated with extended (>28 days) taste loss (Catton & Gardner, 2022). Utilizing a cross-sectional survey, 222 study participants were evaluated for rapid taste recovery (n=182) or prolonged taste recovery (n=47) via a hosted online Reddit survey from March to August of 2020. Participant criteria included individuals who were 18 years or older with a positive PCR test for COVID-19 or a physician or self-diagnosis which included symptoms of acute changes to smell and/or taste. Catton and Gardner found that taste and smell dysfunction persisted for more than 28 days in approximately 25% of individuals with COVID-19 (2022).

The study suggested a close correlation between taste and smell dysfunction with smell loss occurring more commonly in the absence of taste loss. Older participants and those who did not use floss regularly demonstrated a higher incidence of extended taste loss. Additional factors that were evaluated were sex, diet, basal metabolic rate (BMI), vitamin D, antibiotic, and alcohol use, smoking, brushing frequency, missing teeth, appliances, and number of restorations. Considering a mechanistic action of taste receptors on the tongue via ACE-2 receptors facilitating viral entry of SARS-CoV-2 as well as salivary glands and olfactory and gustatory neurons mediating the entry of the virus, oral health can be a factor in taste recovery following COVID-19. Catton and Gardner found a correlation between flossing and rapid taste recovery which they suggested may improve oral health by reducing inflammation which could facilitate viral entry. The results of the study contribute to the body of evidence that taste and smell dysfunction can extend for >28 days. A limitation of this study was the reliance on self-reported information rather than objective data. Also, causative associations such as flossing being protective against long term taste recovery could be associated with overall health protective

behaviors. The authors suggested that future prospective studies with larger sample sizes would be beneficial. Additionally, COVID-19 guidelines should be provided to health care professionals (Catton & Gardner, 2022).

The purpose of the study by Alfaifi et al., was to explore long-term post-COVID-19 oral inflammatory sequelae and to provide insight to the risks for oral opportunistic infections and mucosal inflammatory conditions (2022). The discovery of SARS-CoV-2 within salivary epithelial cells indicates a strong relationship between the virus and the resulting inflammation and atrophy of salivary glands. As saliva is an important component of oral health, its reduction can contribute to oral disease. Alfaifi et al., found that SARS-CoV-2 destroyed salivary gland tissue where histatin-5 is produced (2022). Histatin-5 has a role in innate immunity and is active against candida albicans. The reduction of histatin-5 may be responsible for oral opportunistic infections and mucosal inflammatory conditions post COVID-19 (Alfafi et al., 2022).

Employing a case presentation Alfafi, et al., compared the saliva from a healthy individual to that of a patient diagnosed with PCC marked by dysesthesia and dysgeusia (2022). The patient is a 48-year-old woman who was healthy prior to her initial infection with COVID-19 in January of 2021. In March of 2021 she began experiencing taste changes, oral dysesthesia, and pins and needles sensations in her fingertips. The dysesthesia worsened after she received her first COVID-19 vaccination in April 2021. The patient sought treatment at the Oral Medicine Clinic at the University of Maryland School of Dentistry in June 2021. She exhibited normal saliva flow and no evidence of oral pathology. She was prescribed a mouth rinse with lidocaine and diphenhydramine for symptom relief. She was then diagnosed with PCC. Saliva samples were collected from the patient and the control and were tested for histatin-5 and other cytokines.

Two saliva samples were collected from the patient in June 2021 and September 2021 (Alfafi et al., 2022). Each sample included an unstimulated whole saliva sample for microbial culturing and Salivette collection systems for salivary histatin-5 and cytokine measurement. Saliva samples were collected from the control subject on two equitably spaced occasions to align with the samples taken from the patient. The results demonstrated the patient's histatin-5 levels were approximately 92% lower than the control. Although all saliva samples were negative for fungal culture, the patient's saliva samples showed reduced anti-candidal effects as compared to the control sample. The salivary cytokine levels taken from the patient demonstrated an increase in inflammatory cytokines.

Alfafi et al, hypothesized that COVID-19 patients may have reduced levels of histatin-5 in the saliva due to salivary gland damage mediated by SARS-CoV-2 (2022). This reduction may be a risk factor for patients to develop long term opportunistic infections and mucosal inflammatory conditions following resolution of the acute phase of COVID-19. The authors recommend larger scale studies to explore the connection between SARS-CoV-2 and oral disorders. Additional information may provide guidance to help HCP evaluate the risk for oral opportunistic infections and mucosal inflammatory processes in COVID-19 patients.

Gherlone et al., designed a retrospective and prospective cohort study to investigate the association between COVID-19 and oral disease and to determine whether the oral symptoms persist after resolution of the primary infection (2021). The study participants included all patients 18 years of age or older admitted to the Emergency Department of San Raffaele University from February 25, 2020, who tested positive for COVID-19. After resolution of the primary infection, patients received a follow-up evaluation from July 23, 2020, to September 7, 2020 (Gherlone et al., 2021).

The study included 122 patients with 75% male and a median age of 62.5 years (Gherlone et al., 2021). The follow-up evaluation was a direct patient interview and was performed at a median of 104 days following discharge. An assessment of intraoral and extraoral structures was conducted by an experienced dental specialist. There was no patient reported oral cavity disorders prior to COVID-19. The follow-up evaluation revealed 83.6% of COVID-19 study participants demonstrated oral cavity and facial abnormalities. Frequently identified abnormalities were identified as salivary gland ectasia, dry mouth, temporomandibular joint (TMJ) abnormalities and masticatory muscle weakness. The most common finding was salivary gland ectasia which was noted in 38% of the study population with a male prevalence. Older patients and those with more severe COVID-19 also developed salivary gland ectasia. Additionally, 93% of patients who received antibiotics during hospital admission developed salivary gland ectasia. Dry mouth was identified in 30% of patients and 13 patients presented with both dry mouth and salivary gland ectasia. Additional findings include dysgeusia (17%), anosmia (14%), facial tingling (3%), trigeminal neuralgia, and one patient had facial asymmetry.

Gherlone et al., discussed limitations of the study being related to an inability to determine whether the oral manifestations were related to viral persistence or sequalae of infection (2021). Although the results suggested the oral cavity is a target of COVID-19 and oral manifestations persist after resolution of the primary infection, the authors recommended additional studies to clarify the relationship between SARS-CoV-2 infection and oral disorders. The authors cautioned that the impact of treatments for COVID-19, such as antibiotic therapy, should be considered in the evaluation of a patient. The oral involvement is theorized to be a consequence of the host inflammatory response due to a strong relationship between salivary

gland ectasia and the levels of C reactive protein (CRP) and lactate dehydrogenase (Gherlone et al., 2021).

In another study, France and Glick conducted a literature review to compile information about PCC and the resulting oral health care considerations (2022). The information was evaluated to determine how long COVID-19 might impede or alter the delivery of oral health care. PubMed and LitCovid (National Library of Medicine COVID repository) were searched for original research, case reports, case series, review, and editorials. The PubMed search yielded 254 articles, and the LitCOVID search produced 246 articles. France and Glick found the prevalence of PCC can be challenging to determine given the wide range of symptoms and the lack of a universal definition of the disorder. PCC are estimated to occur in a range from 10% to 87% with patients having at least one symptom. Older adults with comorbidities showed a higher frequency of PCC, severity, and number of symptoms. Underlying respiratory disease and obesity were also related conditions. France and Glick also found that most cases of PCC were associated with patients who were otherwise healthy and not hospitalized for COVID-19. Approximately 13% of children were affected by PCC marked by symptoms such as fatigue, dyspnea, chest pain, headache, weakness, and changes in taste and smell. PCC affect many body systems with the most common respiratory symptom presenting as shortness of breath or difficulty breathing. Cardiac dysfunction, neurologic symptoms, chronic pain, and organ impairment are some of the body systems affected by PCC. Additionally, oral manifestations such as salivary gland ectasia, white tongue, dry mouth, facial muscle weakness, dysesthesia, oral ulcers, temporomandibular joint disorder, and smell and taste changes have been reported (France & Glick, 2022).

The authors suggested that providing oral health care to patients with PCC is not substantially different from providing care to a medically compromised patient (France & Glick, 2022). Collaboration with the patients' health care team can be beneficial for providing safe oral health care. Patients with PCC may require modifications to oral health care interventions and OHCP should be prepared to treat patients with PCC (France & Glick, 2022).

Summary of Chapter 2

Individuals with PCC can be difficult to assess due to the wide range of signs and symptoms and a lack of specific diagnostic criteria. The primary risk factors for developing PCC are age, presence of comorbidities (especially respiratory disease and obesity), and hospitalization for acute COVID-19. Individuals with PCC may be prescribed medications to manage new health conditions which may affect the safe delivery of oral health care. The medical conditions and therapeutics associated with PCC may require modifications to treatment to ensure the comprehensive delivery of oral health care. Patients presenting in the dental setting with PCC may also be considered as a medically complex patient and will benefit from careful assessment and modification of oral health care (France & Glick, 2022). Upon discovery of a patient presenting with PCC in the dental setting, identification of the symptoms can aid in the provision of thorough and effective oral health care.

Chapter 3: Methodology

The purpose of this investigation was to test a protocol designed to provide guidance to dental professionals in the assessment and treatment of patients presenting with post-COVID conditions (PCC) in the dental setting. The following sections will describe the methodology of the research study.

Research Design

A qualitative exploratory research design was selected to evaluate the usefulness of an assessment and treatment protocol and to identify any barriers to its use. An exploratory design is an approach used to investigate research questions that have yet to be studied or when little research exists on a topic (Jacobsen, 2021; USC Libraries, 2022). As there is little available information about this topic, the exploratory design provides the appropriate framework.

Research Questions

The following research questions guided the conduct of this study.

1. In what ways is the assessment protocol for treating patients with PCC appropriate for a dental practice setting?
2. In what ways is the treatment protocol for treating patients with PCC appropriate for a dental practice setting?
3. What are the barriers to using the assessment protocol?
4. What are the barriers to using the treatment protocol?

Research Context

A sample of registered dental hygienists engaged in clinical practice in the state of California were invited to participate in the study. In the context of this study, clinical practice describes the activities of a dental hygienist as a clinician who is providing all forms of health

care including patient consultation (Law Insider, n.d.). The state of California was selected as the source of study participants due to the historic support from the local and regional dental hygiene associations in the dissemination of requests for research assistance. Additionally, California is a large state reporting over 11 million cases of COVID-19 which is the highest number of cases in the United States (Worldometer, 2022b). This substantial number of COVID-19 cases may be associated with higher numbers of patients experiencing PCC. Furthermore, California boasts the second highest number of dental hygienists in the United States (Statista, n.d.). The support of California dental hygiene professional organizations, the high rate of COVID-19, and the high number of registered dental hygienists in California established good prospects for a sample population of study participants.

Research Participants

Sample Description

The sample consisted of registered dental hygienists engaged in clinical practice in the state of California. The California Dental Hygienists' Association, local dental hygiene components, and online dental hygiene groups were resources utilized to announce the study to interested participants. Inclusion criteria for this study were registered dental hygienists in the state of California who were engaged in clinical patient care for a minimum of 2 days per week. Exclusion criteria included registered dental hygienists in the state of California who were engaged in clinical patient care less than two days per week.

Study participants were sourced from a random sample of dental hygienists in California who met the inclusion criteria. Participants received an invitation to participate in the study (see Appendix A) which included a link to complete an online survey to verify eligibility (see Appendix B). Upon determining eligibility, participants received the study consent (see

Appendix C) and study materials (see Appendices D-I). A six-week time frame was established to allow participants sufficient time to test the assessment and treatment protocol in their daily practice. Following the six-week time frame in which the participants used the PCC assessment and treatment protocol, they were invited to participate in an individual interview (see Appendix J). Confidentiality and anonymity were preserved using pseudonyms within the Zoom platform. An encrypted account housed the Zoom recordings and transcriptions.

Human Subjects Protection

Prior to conducting the study, an application was submitted to the Idaho State University Human Subjects Committee (HSC) for permission to conduct the research study. Following receipt of approval from the Idaho State University Human Subjects Committee, potential participants received a screening survey to identify if they met the study criteria, (see Appendix B). Participants confirmed consent via a Google Forms survey (Appendix C). The anonymity and confidentiality of the study participants was preserved via the use of pseudonyms. Participants were advised that participation is voluntary, and they may withdraw from the study at any time.

Data Collection

A cohort of 20 participants were included in the study. During a six-week period, participants were asked to incorporate an assessment and treatment protocol (ATP) to evaluate its usefulness in identifying and providing appropriate treatment for patients with PCC in the dental setting as well as identifying any barriers to its use. The participants first completed a brief screening survey to determine eligibility aligned with the stated inclusion criteria (see Appendix B). Eligible participants were provided a Human Subjects Informed Consent Form (see Appendix C) and indicated consent via a Google Forms survey. Upon notification of

consent, participants received instructions for use of the ATP (see Appendix D) and the assessment and treatment protocol instruments and resources (see Appendices E-I). Participants were also offered the opportunity to ask any questions. Participants were instructed to incorporate the ATP into their regular clinical practice for each patient seen during the six-week study period. At the end of the six-week period, participants received a second invitation (see Appendix J) to participate in a final online screening survey (see Appendix K) to determine eligibility for participation in the individual interview. Eligible participants received an invitation to select a day and time to participate in an online Zoom interview and the interview guidelines (see Appendix L). The interview was designed to obtain feedback from their experience with use of the ATP. The interview followed a questioning route (see Appendix M) which included five elements: an opening question, introductory questions, transition questions, key questions, and an ending question (Krueger & Casey, 2015). The questioning route was designed to spark conversation with clear, open-ended questions. The qualitative responses were coded and grouped into themes related to the participants' feedback using the qualitative research analytic platform Dedoose (Dedoose, n.d.).

Instruments

The instruments designed for this research study included participant eligibility screening surveys, participant instructions, an assessment protocol, a treatment protocol (including treatment considerations and referral sources), a notes page, and Zoom facilitated individual interviews. The study participants used the assessment protocol, treatment protocol, and notes page to test the usefulness of these tools and whether they are appropriate for the dental setting. The Zoom interviews provided the PI with the data to evaluate the research.

Assessment protocol

The assessment protocol as shown in Appendix E, was designed to enhance the standard medical history form with supplemental questions addressing the patient's experience with COVID-19. These questions were crafted to assess the likelihood of the patient having PCC and the potential need for treatment modifications. The assessment protocol was given to each study participant to use in their clinical practice.

Treatment protocol

Clinical practice guidelines are statements utilized to aid patient and provider decisions by creating standards of care supported by scientific research (Steinberg, et al., 2011). In this study, clinical practice guidelines were compiled from existing information to guide the practitioner. The treatment protocol quick reference guide as shown in Appendix F lists common signs and symptoms associated with PCC, the associated therapeutics, clinical implications, treatment modifications, and referral sources. The treatment protocol was given to each study participant. Treatment considerations should be applied when caring for patients with certain conditions. General recommendations for clinicians to consider as they treat patients with health conditions associated with PCC were included with the study materials (see Appendix H). Additionally, both patients and clinicians may benefit from a listing of resources for their patients and included with the study materials was a list of resources for people with PCC (see Appendix I).

Notes Page

The notes page (see Appendix G), provided along with the study materials, served as a repository for the study participants to memorialize any thoughts or experiences to be shared at the interview.

Individual Interviews

Upon approval from the Idaho State University Human Subjects Committee, online interviews were conducted via the Zoom platform. Twenty interviews that were comprised of one study participant, a moderator (PI), and a co-investigator were utilized. The interviews lasted for 20-30 minutes. The participants were asked questions as described in the interview guide (Appendix M). The interview began with an opening question asking how long they have been practicing dental hygiene. The subsequent questions were open-ended and focused on the participant's experience with COVID-19 and then moved to questions regarding use of the assessment and treatment protocols. The interviews were recorded via Zoom and with an iPhone to provide a back-up recording. The recordings were transcribed and once completed were evaluated by the PI and co-investigators. The statistical software Dedoose (Dedoose, n.d.) was used to identify themes and subthemes using the classic analysis strategy.

Validity and Reliability

The strength of a qualitative research study is supported by its validity and reliability. Researchers use various strategies to ensure validity and reliability such as pilot-testing questions, triangulation, member checks, ensuring saturation, assessing trustworthiness, and addressing researcher bias (Krueger & Casey, 2015). This study utilized pilot-testing, triangulation, saturation, and member checks to ensure validity and reliability.

The assessment and treatment protocols were designed from the literature and reviewed by the co-investigators. The interview guide was reviewed for content validity by two content experts. Modifications, as recommended by the content experts, were incorporated into the interview guide prior to the initiation of the study.

Another aspect of ensuring validity and reliability is disclosing the bias of the PI. The PI initiated this research based on a perceived need for protocols to better assess and treat patients with PCC.

Incorporating a triangulation method serves to increase the credibility of the research (Merriam & Tisdell, 2016; Guion, et al., 2011). Triangulation occurs when the results from several investigators are compared and result in the same conclusion. Analysis is considered verifiable if another researcher can achieve similar findings using the same data (Krueger & Casey, 2015). In this study, the PI and co-investigators ensured validity and reliability by separately evaluating the transcripts using Dedoose qualitative analysis software to compare codes and themes.

Additional methods of verifying validity are by achieving saturation and incorporating member checks. Saturation occurs when researchers encounter repeated similar responses from participants (Merriam & Tisdell, 2016). Member checks included two phases which allow opportunities for participants to provide feedback. The first occurred when participants confirmed the accuracy of their responses from the transcripts. The second occurred when study participants received the opportunity to review the quotes and themes being used to ensure that their ideas are being correctly represented. Incorporating member checks allowed the PI to confirm that the responses were recorded as intended and without researcher bias. Merriam and Tisdell (2016) suggest that member checks prevent misunderstandings in data collection and interpretation.

Limitations

The primary limitation of the study related to the purposive sampling which limits generalizability to all oral health care providers. According to Kruger & Casey (2015),

Qualitative studies are not intended to generalize but rather to delve deeper into a topic. Qualitative research methods can provide insight into perceptions and opinions which may not be revealed in a quantitative research design.

Another limitation can occur when the PI acts as the moderator. There is a potential for bias when the PI is involved in the data collection. However, certain strategies such as pilot-testing, member checks, and the presence of a co-investigator were utilized to control bias.

Procedure and Protocols

Following the receipt of approval from the Idaho State University Human Subjects Committee, the principal investigator contacted the California Dental Hygienists' Association to request assistance to disseminate the request for study participants to registered dental hygienists in the state of California. Contacts for local dental hygiene associations were requested to ensure additional outreach. The dental hygiene organizations received an email describing the purpose of the study and requirements for participation. Those interested in participating were provided the option to scan a QR code or click on a link to access the screening survey. The letter also mentioned the drawing for an opportunity to win a $50 Amazon gift card to eligible study participants. Krueger & Casey (2015) promote the use of a monetary incentive to increase the chances of recruiting participants for the study. The screening survey accessed in the letter was designed to identify participants who met the inclusion criteria.

Study participants who met the inclusion criteria were provided a link to the informed consent (Appendix B). An email was sent to each participant which included participant instructions (Appendix C), and the study instruments (Appendix D-I). Participants were instructed to test the assessment and treatment protocols in their clinical practice for six weeks. Upon completion of the six-week period, participants were emailed a second screening survey

(Appendix K) to determine eligibility for participation in an individual interview. Once eligibility was determined, participants received an invitation to select from several dates and times for an individual interview and were prompted to enter a pseudonym to maintain anonymity and confidentiality. Participants were emailed their assigned date and time for the interview with an invitation to join the Zoom meeting and interview guidelines (see Appendix L). Participants were instructed to download the Zoom application prior to the scheduled interview.

The individual interviews were conducted utilizing the Zoom platform with the PI serving as the moderator and a co-investigator participated in the interview as an observer. The study design included twenty individual interviews comprised of one participant, the PI, and a co-investigator. Participants were instructed to log on 10-15 minutes prior to the meeting time to allow time to address any technical difficulties. Participants were also instructed to log in with their chosen pseudonym and their cameras off. The Zoom meeting was recorded with access limited to the PI. The moderator asked each participant the same questions allowing sufficient time for each answer. The moderator remained unbiased throughout the interview. Participants were asked to share any general comments or feedback at the end of the interview. To maintain confidentiality, the PI used pseudonyms when addressing the participants. Following each interview, the recordings were evaluated to determine saturation or if questions needed adjustment or clarification. Upon completion of the interview, the recordings were transcribed and organized. The PI and co-investigators reviewed each transcript to verify the accuracy.

The PI and co-investigators reviewed the transcripts and the results were analyzed using Dedoose (Dedoose, n.d.) a web-based research program designed to perform qualitative data analysis. This program was used to create parent and child codes. The classic analysis strategy

was used to identify themes. Themes were identified based upon the frequency and specificity of responses (Krueger & Casey, 2015). The qualitative data analysis was interpreted and reported at the conclusion of the research interviews.

Summary of Chapter 3

This chapter describes the methodology for a qualitative exploratory research design to evaluate the usefulness of an assessment and treatment protocol and to identify any barriers to its use. The results of this study established the usefulness of a protocol to provide guidance to dental professionals as they assess and treat patients with PCC and also encouraged further research into this topic.

The results and discussion of the study will be reported in the form of a manuscript to be submitted for publication in the *Journal of Dental Hygiene*. The remaining sections of the thesis reflect the manuscript specifications outlined in the author guidelines located at https://jdh.adha.org/content/author-guidelines.

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Appendix A - Email to send to California Dental Hygienists via CDHA

Hello _____,

My name is Peggy Lelesi, and I am a graduate dental hygiene student at Idaho State University. Along with my thesis advisors Leciel Bono and Dr. JoAnn Gurenlian, I am conducting a study on the usefulness of an assessment and treatment protocol for patients with post-COVID conditions (PCC) in the dental setting, along with identifying any barriers to its use. I am specifically looking to recruit dental hygienists who engage in clinical practice a minimum of two days per week.

Participation in this study would involve:

1. Completing a brief online survey to screen for participation eligibility
2. Read and sign an informed consent.
3. Use an assessment and treatment protocol in clinical practice for six weeks.
4. In preparation for an individual interview, you will be asked to download the Zoom app onto your personal computer or tablet (2 minutes) and login at the designated time.
5. The individual interview will last approximately 20-30 minutes and will include a moderator, and an investigator(s). You will be asked to keep the discussion private and be identified using a pseudonym to preserve confidentiality and anonymity.

Please scan the QR code or click here to access the screening survey.

I appreciate if you would please forward this email to your colleagues.
If you or any of your colleagues would be willing to participate in the study, please complete the screening survey. Each study participant will be entered in a drawing to win a $50 Amazon gift card.

Thank you for helping me further our profession!

Peggy Lelesi, RDH, BS
plelesi@isu.edu

Appendix B - Research Study Participant Screening Survey I

https://forms.gle/Zf6oLf6u6VSX322GA

Research Study Participant Survey

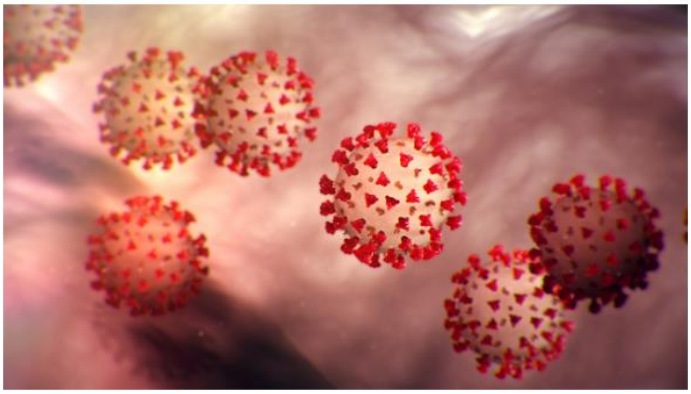
Please answer the brief survey to meet the qualifications to participate in this research study.

peggylelesi@isu.edu Switch account

* Required

Email *

Your email



How many days per week do you practice clinical dental hygiene?

- 0 I do not practice clinical dental hygiene
- 1 day
- 2 or more days

Would you be willing to use an assessment and treatment protocol in your practice for six weeks?

- Yes
- No

Submit

Clear form

Appendix C - Human Subjects Informed Consent Form

Idaho State University Department of Dental Hygiene

A Protocol for Treating Post-COVID Condition Patients in Dental Settings

Peggy Lelesi, RDH, BS

What is the Research?

You have been asked to participate in a research study about the usefulness of an assessment and treatment protocol for patients with post-COVID conditions in the dental setting. The Human Subjects Committee at Idaho State University has approved this research project. Your experience with treating patients with post-COVID conditions in the dental setting will help us discern if a protocol is useful in the delivery of oral health care.

Procedures

If you agree to participate in this study, you agree to the following procedures

- Before formally agreeing to participate in this study, a written informed consent will be sent to you via email on a password protected, private e-mail account. Upon agreeing to participate, the informed consent document will be signed and returned to the investigator via email.
- To protect your confidentiality, a pseudonym will be chosen by you and be used throughout the course of the interview, and for transcription or documentation. You will be asked to download the Zoom app on your personal computer or tablet. An email will be sent that is linked to a calendar and you will be asked to identify your availability to meet for the individual interview. A Zoom invitation will be sent out with the selected interview time .
- You will participate in an individual interview consisting of you, a moderator, and investigator(s). The interview will last approximately 30 minutes, and questions will pertain to your experience with and opinion on using a protocol to assess and treat patients with post-COVID conditions. The Zoom platform will be used to record the discussion along with a backup recording on an iPhone. The recording will then be downloaded to a password protected computer. Only the primary investigator, the thesis committee members, and the professional transcriptionist will have access to the recording.
- Participants will use only pseudonyms on the audio recording, and every effort will be made to keep the recordings confidential. You will be asked not to use personal identifying information such as names or employers. Instead, you can say “my office” or “my practice”. The Zoom transcription feature will make a word for word transcription of the recording. The transcription will identify the participants by their pseudonyms. At the completion of the study, all transcripts and recordings will be sent to Idaho State University, to be held in the Idaho State University secured storage for seven years. At

that point, all materials related to the study will be destroyed by Idaho State University following established university protocol.
- A summary of your statements will be sent to you to review. A copy of the results of the study will be sent to participants upon request.

Why Have I Been Asked to Take Part?

You have been asked to participate because you have a valuable perspective as a clinical dental hygienist.

Voluntary Participation

Participation in this research study including the testing of the assessment and treatment protocol and the interview is voluntary. You do not have to take part if you do not want to. If you choose not to participate it will have no effect on your dental hygiene career. If any questions make you feel uncomfortable, you do not have to answer them. You may leave the Zoom group at any time for any reason.

Risks and Benefits

Despite all attempts to preserve privacy and anonymity, there may be a slight risk of your voice being recognized by a colleague(s) during the interview. Participation in this research study will not afford you any personal benefits. Your experience and opinions may be helpful to researchers as they seek insights on this topic.

Privacy and Confidentiality

This discussion will be audio and audiovisual recorded to ensure that we have accurately captured the comments of each individual. The recording will only be available to the research team and a transcriptionist. The recordings will be stored in a secure location and will be erased when the analysis is complete. Your privacy will be protected using a pseudonym. Pseudonyms will be used in the focus group and on all reports, and the discussions will be kept strictly confidential.

In an effort to maintain confidentiality, you are asked to keep the interview discussion private and during the discussion be in a private location where others cannot hear. Nonetheless, each person will only be identified through use of his or her pseudonym and the video camera will be turned off during the interview.

Questions

If any questions arise about the study, the primary investigator or faculty thesis co-chairpersons may be contacted.

Investigator

Peggy Lelesi, RDH, BS
(562) 225-9229
peggylelesi@isu.edu

Faculty Thesis Co-Chairpersons

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I have read the information in the consent form. I have been given an opportunity to ask questions, and any questions I had have been answered to my satisfaction. I have been given a copy of the informed consent form.

I give my consent for the results of the research to be published or discussed using my pseudonym. No information will be included that will reveal my identity.

I HAVE REVIEWED THIS CONSENT FORM AND UNDERSTAND AND AGREE TO ITS CONTENTS.

Printed Name Date

Signature

Appendix D - Participant Review & Instructions

Idaho State University Department of Dental Hygiene

A Protocol for Treating Post-COVID Condition Patients in Dental Settings

Peggy Lelesi, RDH, BS

Thank you for participating in this research study to test an assessment and treatment protocol to identify and treat patients with post-COVID conditions (PCC or long-COVID). Your participation will help determine if these protocols are useful when treating patients in the dental setting. If you have any colleagues that would like to participate, please contact Peggy Lelesi at (562) 225-9229.

Background

The challenges of the COVID-19 pandemic have been further complicated by prolonged health consequences experienced after resolution of the acute phase of infection with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). These symptoms range from mild to severe. The CDC has described symptoms which persist for four or more weeks after the primary SARS-CoV-2 infection as post-COVID conditions (PCC) or long COVID. Symptoms associated with PCC include fatigue, malaise, cough, dyspnea, tachycardia, chest pain, brain fog, headache, peripheral neuropathy, depression, anxiety, PTSD, muscle or joint pain, abdominal pain, nausea, diarrhea, loss of taste/smell, tinnitus, fever, or rashes. The variety and complexity of symptoms and disease associated with PCC can affect the safe delivery of oral health care. The relative newness of PCC revealed a lack of comprehensive assessment and treatment guidelines in the dental setting. To date, there is limited guidance for the treatment of patients presenting with PCC in the dental setting.

Instructions

Attached, you will find a copy of an assessment protocol, a treatment protocol, and a notes page to document your experience. Please use these protocols in your daily clinical practice for the next six weeks. The *assessment protocol* is a short series of questions crafted to supplement your medical history review. The *treatment protocol* is designed as a "quick reference" to guide your patient care as you encounter patients who may be experiencing PCC. Patients with PCC may require treatment modifications to ensure the safe delivery of oral health care. As you use these instruments, please make note of any barriers you encounter or any recommendations to improve the protocols.

At the conclusion of the six-week test period, you will receive a link to complete a brief online survey. This survey will be followed by an invitation to selected study participants to join an online (Zoom) interview to share your experiences.

Study participation is voluntary, and you may leave the study at any time. If you have any questions regarding the study or instructions, please contact Peggy Lelesi at 562-225-9229.

Thank you for your time and willingness to participate,

Peggy Lelesi, RDH, BS

peggylelesi@isu.edu

Appendix E - Assessment Protocol

Supplemental Medical History Questions		
Have you had COVID-19? If yes, how was it diagnosed? ☐ At home (COVID-19 rapid test) ☐ Doctor's office (PCC test)	☐ yes	☐ no
Were you hospitalized for COVID-19? ● If yes, how long? _____	☐ yes	☐ no
Were you admitted to intensive care for COVID-19 treatment?	☐ yes	☐ no
Were you intubated?	☐ yes	☐ no
Are you experiencing any post-COVID-19 symptoms which have lasted longer than 4 weeks?	☐ yes	☐ no

Please mark any that apply:		
☐ Fatigue	☐ Shortness of breath	☐ Loss of smell or taste
☐ *cough	☐ Muscle and/or body aches	☐ Brain fog (difficulty concentrating)
☐ Chest pain	☐ Blood clots	☐ Anxiety or depression

☐ Other (please describe)

_____

_____

_____

_____

* Patients with a chronic cough may need to provide a negative COVID-19 test prior to treatment.

Appendix F - Treatment Protocol

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
Chronic fatigue	N/A		Shorter appointments	Primary care provider
Shortness of breath	Oxygen, bronchodilators, systemic corticosteroids	Decrease in physical activity	Semi-supine position Pulse oximetry monitor Shorter appointments	Respiratory therapist Pulmonologist
Chronic cough	Antitussives	Drowsiness, shakiness, slowed breathing	Rapid COVID test Semi-supine position	Respiratory therapist Pulmonologist
Venous thromboembolism	Antiplatelet medications Anticoagulant medications	Potential for prolonged bleeding	Frequent breaks, shorter appointments	
Chest pain	Nitroglycerin tablets	Chest pain	Discontinue treatment if present Monitor symptoms	Cardiologist
Seizures	Anti-seizure medications	Gingival enlargement Increase risk for periodontal disease and caries Orofacial trauma Central nervous system depression Gastrointestinal distress Drug interactions	Fixed prosthesis May interact with certain antibiotics or antifungals Knowledge of seizure triggers Morning appointments Shorter appointments Reduce stimuli (noise and lights) Use caution with NSAIDs Frequent oral prophylaxis Thorough oral hygiene instruction	Neurologist
Cognitive changes (brain fog)	N/A	Inability to make decisions	May need to include another decision maker, ensure consent prior to treatment	Primary care provider
Postural orthostatic tachycardia (POTS)	Increase fluids, add salt to diet	Lightheadedness, brain fog, fatigue, headache,	Slow raising and lowering of dental chair	Primary care provider Neurologist

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
	Medications (beta-blockers)	palpitations, tremor, intolerance of exercise		Cardiologist
Chronic headache	Analgesics		Shorter appointments	Primary care provider Neurologist
Chronic pain	Analgesics, opioids	Difficulty with extended appointments Pain in certain positions	Shorter appointments Adjust anesthesia dose and type as needed	Primary care provider
Kidney impairment	Lifestyle modifications Diuretics ACE inhibitors Statins Vitamin Supplements Dialysis	Decreased renal metabolism	Shorter appointments Adjust anesthesia dose and type as needed Avoid NSAIDs	Nephrologist
Liver impairment	Lifestyle modifications Medications	Decreased hepatic metabolism Jaundice	Adjust anesthesia dose and type (amides) as needed. Avoid hepatic-metabolized medications Avoid NSAIDs	Gastroenterologist Hepatologist
Anxiety/depression	Antianxiety or antidepressant medications	Increased risk of periodontal disease and caries Xerostomia CNS depression	Salivary replacement, topical fluoride Iatrosedation Avoid epinephrine with tricyclic antidepressant	Primary care provider

Note. Information has been condensed and modified from Aragon, C.E. & Burneo, J.G. (2007, February). Understanding the patient with epilepsy and seizures in the dental practice. *Journal of the Canadian Dental Association 73*(1): 71-6.; Blue, C. M. (2017). *Darby's comprehensive review of dental hygiene* (8th ed.). Elsevier.; France, K., & Glick, M. (2022). Long COVID and oral health care considerations. *Journal of the American Dental Association (JADA), 153*(2), 167–174. https://doi.org/10.1016/j.adaj.2021.08.007; Haveles, E. B. (2020). *Applied pharmacology for the dental hygienist* (8th ed.). Elsevier.; Karolyhazy, K., Kivovics, P., Fejerdy, P., & Aranyi, Z. (2005, February). Prosthodontic status and recommended care of patients with epilepsy. *Journal of Prosthetic Dentistry 93*(2): 177-82. doi: 10.1016/j.prosdent.2004.11.008; Malamed, S. F. (2019). *Handbook of local anesthesia* (7th ed.). Mosby.; Mattson, R.H. & Gidal, B.E. (2004). Fractures, epilepsy, and antiepileptic drugs. *Epilepsy & Behavior.* 2004; 5(2): 236-

40; Mayo Clinic (n.d.b). Tachycardia. Retrieved September 9, 2022, from /www.mayoclinic.org/diseases-conditions/tachycardia/diagnosis-treatment/drc-20355133

Appendix G – Notes

Please use this page to record any notes, suggestions, or recommendations.	
ASSESSMENT PROTOCOL	**TREATMENT PROTOCOL**

Appendix H - Treatment Considerations

Treatment Considerations

- Special care should be taken with patients who indicate that they have experienced "brain fog" or difficulty concentrating as this may affect their ability to provide consent.
- Patients experiencing fatigue should be scheduled for appointments earlier in the day.
- Patients with difficulty breathing should be reclined to a semi-supine position.
- Patients hospitalized in intensive care may present with post-intensive care symptoms.
- *Patients presenting with symptoms associated with PCC should be referred to their primary care provider or specialist for evaluation.
- *Advise patients of post-COVID multidisciplinary care centers
  https://www.survivorcorps.com/pccc
  https://www.hhs.gov/civil-rights/for-providers/civil-rights-covid19/guidance-long-covid-disability/index.html#footnote10_0ac8mdc

Appendix I - Resources for People with Post-COVID Conditions

Type of Resource	Contact
Post-COVID multidisciplinary care centers (Survivor Corps, 2022)	https://www.survivorcorps.com/pccc
Guidance on "Long COVID" as a Disability Under the ADA, Section 504, and Section 1557 (U.S. Department of Health and Human Services, 2021)	https://www.hhs.gov/civil-rights/for-providers/civil-rights-covid19/guidance-long-covid-disability/index.html#footnote10_0ac8mdc
Volunteer to participate in a research study (NIH, 2022a)	https://recovercovid.org/
Information from the National Institutes of Health RECOVER program. "What is Long-COVID?" (NIH, 2022b)	https://recovercovid.org/long-covid
Resources from the Administration for Community Living to connect individuals classified as disabled due to PCC to assistance to live in own home, go to school or work, or participate in the community (Administration for Community Living, 2021)	https://acl.gov/sites/default/files/COVID19/ACL_LongCOVID.pdf

Appendix J - Email to Study Participants at the Conclusion of the Six-Week Test Period

Dear _____,

Thank you for your participation over the past six weeks to test the usefulness of an assessment and treatment protocol in your clinical practice. You are invited to participate in a final screening for inclusion in the individual interview portion of the study.

Participation in the interview would involve:

1. Completing a brief online survey to screen for participation eligibility
2. In preparation for the interview, you will be asked to download the Zoom app onto your personal computer or tablet and login at the designated time.
3. The interview will last approximately 30 minutes and will include you, a moderator, and an investigator(s). You will be asked to keep the discussion private and be identified using a pseudonym to preserve confidentiality and anonymity.

Please scan the QR code or click here to access the screening survey.

Procedures

If you agree to participate in the interview portion of the study, you agree to the following procedures:

- Completion of the attached survey indicates your interest in participating in the interview portion of the research study.
- To protect your confidentiality, a pseudonym will be chosen by you and be used throughout the course of the interview, and during any further transcripts or documentation. You will be asked to download the Zoom app on your personal computer or tablet. An email will be sent that is linked to a calendar and you will be asked to identify your availability. A Zoom invitation will be sent out with the designated interview time and a specific meeting link to join the discussion.
- You will participate in an interview consisting of you, a moderator, and investigator(s). The interview will last approximately 30 minutes, and questions will pertain to your experience with and opinion on using a protocol to assess and treat patients with post-COVID conditions. The Zoom platform will be used to record the discussion along with a backup recording on an iPhone. The recording will then be downloaded to a password protected computer. Only the primary investigator and the thesis committee members will have access to the recording.

- Participants will use only pseudonyms on the audio recording, and every effort will be taken to keep the recordings confidential. You will be asked to avoid the use of personal identifying information such as names or employers. Instead, you may say “my office” or “my practice”. The Zoom transcription feature will make a word for word transcription of the recording. The transcription will only identify the participants by their pseudonyms. At the completion of the study, all transcripts and recordings will be sent to Idaho State University, to be held in the Idaho State University secured storage for seven years. At that point, all materials related to the study will be destroyed by Idaho State University following established university protocol.
- A summary of your statements will be sent to you to review. A copy of the results of the study will be sent to participants upon request.

Voluntary Participation

Participation in this research study including the testing of the assessment and treatment protocol and the interview is voluntary. You do not have to take part if you do not want to. If you choose not to participate, it will have no effect on your dental hygiene career. If any questions make you feel uncomfortable, you do not have to answer them. You may leave the Zoom group at any time for any reason.

Risks and Benefits

Despite all attempts to preserve privacy and anonymity, there may be a slight risk of your voice being recognized by a colleague(s) during the interview. Participation in this research study will not afford you any personal benefits. Your experience and opinions will be helpful to researchers as they seek insights on this topic.

Privacy and Confidentiality

This discussion will be audio and audiovisual recorded to ensure that the comments of each participant are accurately recorded. The recording will only be available to the research team. The recordings will be stored in a secure location and will be erased when the analysis is complete. Your privacy will be protected using a pseudonym. Pseudonyms will be used in the interview and on all reports, and the discussion will be kept strictly confidential.

Questions

If any questions arise about the study, the primary investigator or faculty thesis co-chairpersons may be contacted.

Investigator

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Thank you for helping me further our profession!

Peggy Lelesi, RDH, BS
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Appendix K - Research Study Participant Screening Survey II

https://forms.gle/CuujgzzEb41d4Ka6

Research Study Participant Screening Survey II

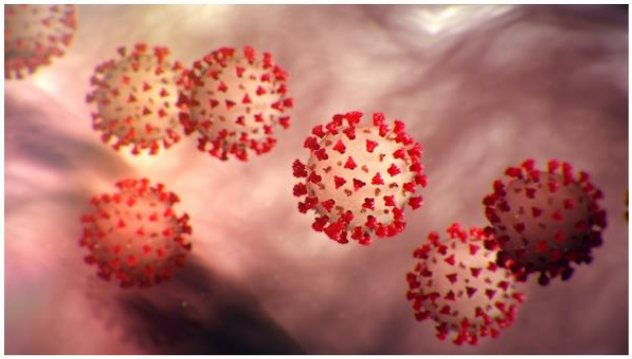
Please answer the brief survey to meet the qualifications to participate in this research study.

peggylelesi@isu.edu Switch account

* Required

Email *

Your email



Did you use the assessment and treatment protocol in your practice for a minimum of six weeks?

- Yes
- No

Are you willing to participate in an online focus group interview to share your experience?

- Yes
- No

Please enter a pseudonym to be used in the focus group interview.

Your answer

Appendix L - Interview Guidelines

Thank you for participating in this online Zoom interview. If you are unable to attend, please call or text Peggy Lelesi at 562-225-9229 as soon as possible so that an alternate time may be selected. To ensure a well-organized session, please follow the guidelines.

1. Select a computer or tablet with a camera, keep your camera turned off, and type in a pseudonym.
2. Please use a reliable internet connection
3. An invitation with a link to join a Zoom meeting will be provided three days prior to the interview. To allow adequate time to address any technical issues, please click the link to join the meeting 10 minutes prior to the start time.
4. When asked what name you would like to be identified as, use your pseudonym.
5. Please focus your responses and discussion to the topic. The moderator will facilitate the conversation to return to the topic if needed.

Please help us ensure the privacy of the participants by maintaining confidentiality at the conclusion of the interview. Do not share any of the information with your colleagues. To ensure your privacy, do not say the name of your office or dental practice. You may leave the meeting at any time for any reason. Simply select the red “leave meeting” button at any time.

Appendix M - Interview Guide

Questions for Participants	
Opening	1. Please tell us your pseudonym. How long have you been a dental hygienist?
Introduction	2. How has your practice been impacted by COVID-19?
Transition	3. What is your understanding of PCC?
	4. How has treating patients with post-COVID conditions affected your delivery of dental hygiene care?
	5. How prepared have you felt in identifying and treating patients with PCC in your dental practice setting. Would you tell me more about that?
Key	6. What was your experience using the assessment protocol?
	7. What was your experience using the treatment protocol?
	8. What barriers, if any, did you encounter when using the assessment protocol? How did you manage those barriers?
	9. What barriers, if any, did you encounter when using the treatment protocol? How did you manage those barriers?
	10. What if anything would you like to add to the assessment protocol?
	11. What if anything would you like to add to the treatment protocol?
Ending	12. What are your final thoughts related to the use of the assessment and treatment protocol? Is there anything else you would like the researchers to know about the assessment and treatment protocol?

Title Page of Manuscript

A Protocol for Treating Post-COVID Condition Patients in Dental Settings

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Manuscript Abstract

A Protocol for Treating Post-COVID Condition Patients in Dental Settings

Abstract

Purpose The relative newness of Post-COVID Conditions (PCC) has revealed a void in assessment protocols and treatment guidelines in the dental setting. Providing oral health care providers with an assessment and treatment protocol could facilitate the delivery of comprehensive oral health care. The purpose of this study was to test a protocol for assessing and treating patients with PCC in the dental practice setting.

Methods A qualitative exploratory research design was used to conduct the study. A PCC assessment and treatment protocol (ATP) was developed and used by dental hygienists in clinical practice in California for a period of 6 weeks. Following the use of the PCC ATP practitioners were invited to participate in individual interviews; online individual interviews were comprised of 20 dental hygienists recruited via purposive sampling. Participant anonymity was preserved using pseudonyms. A qualitative analysis software program was used to identify codes and themes. Investigator triangulation, member checks, and saturation were used to validate responses.

Results Fifty-six participants completed the six-week PCC ATP protocol and twenty participants were interviewed. Four themes were identified: awareness, accessibility, resources, and complications. Within the theme of accessibility, the subthemes of ease of use and guidance emerged. The theme complications yielded three subthemes: time, clinician hesitation, and patient lack of cooperation.

Conclusion This study demonstrated a PCC ATP created awareness of the varied symptoms of PCC and is a useful resource for clinical practitioners. Providing dental hygienists with a protocol supports efforts to provide person-centered evidence-based care.

Key Words: covid-19, sars-cov-2, dental care, long covid, post covid

A Protocol for Treating Post-COVID Condition Patients in Dental Settings

Introduction

First identified in 2019 in Wuhan, China, severe acute respiratory syndrome coronavirus 2 (SARS-Co-V-2) emerged as the coronavirus strain responsible for the coronavirus disease 2019 (COVID-19) pandemic.[1] Although the pandemic has ended, the disease persists. The World Health Organization reports that as of September 2023, there have been over 770 million confirmed cases of COVID-19 and 6.9 million deaths worldwide, while the United States has experienced over 103 million cases of COVID-19 and over 1.1 million deaths.[2] The challenges of the COVID-19 pandemic have been further complicated by prolonged health consequences experienced after resolution of the acute phase of infection with SARS-CoV-2. The Centers for Disease Control and Prevention (CDC) uses the term Post-COVID Conditions (PCC) or long COVID to describe the variety of physical and mental health symptoms which persist 4 or more weeks after infection with SARS-CoV-2.[3] Some of the symptoms associated with PCC include fatigue, malaise, cough, dyspnea, tachycardia, chest pain, brain fog, headache, peripheral neuropathy, depression, anxiety, post-traumatic stress disorder (PTSD), muscle or joint pain, abdominal pain, nausea, diarrhea, loss of taste/smell, tinnitus, fever, or rashes.[4-11]

A person previously infected with SARS-CoV-2, whether the disease is mild or severe, can develop PCC.[4] Certain individuals may be at higher risk for developing PCC which include those who experienced more severe COVID-19 illness, those who had existing health conditions (prior to their COVID-19 diagnosis), unvaccinated individuals, and those who developed multisystem inflammatory syndrome (MIS) during or after COVID-19 infection.[6,7,9-13] Multi-organ effects or autoimmune conditions can result in diabetes, heart conditions, or neurological conditions.[12,14] Moreover, individuals suffering from severe illness or hospitalization may also develop new health problems. Post-intensive care syndrome (PICS), although not unique to COVID-19 hospitalizations, can result in weakness, brain fog, and

symptoms of PTSD.[4] COVID-19 survivors who were hospitalized or placed in intensive care are at higher risk of developing PTSD.[12,15] The myriad of both physical and mental health complications experienced by individuals as a result of COVID-19 pose significant considerations when encountered in the dental setting.

Another challenge associated with PCC arises when an individual who exhibits symptoms does not have conclusive test results.[4] The difficulty in diagnosing the cause of the symptoms can lead to a delay in the patient receiving proper care or treatment.[4] The wide variety of symptoms could also be associated with other health problems resulting in difficulty recognizing PCC.[16-17] Currently, a diagnosis of PCC arises when a healthcare provider confirms a previous infection with SARS-CoV-2 along with an evaluation of the patient's current health for symptoms related to PCC.[4] Some individuals experience debilitating effects, while others report mild symptoms.[1] Furthermore, some people may not associate their current symptoms with COVID-19.[4,18]

The relative newness of PCC has revealed limited guidance for oral health professionals in the form of assessment protocols and treatment guidelines. France and Glick[16] compiled a table outlining signs and symptoms of PCC, routine medications, oral health interventions, and treatment modifications for dental professionals to use when providing care to patients with PCC. In addition, comprehensive physician clinical practice guidelines have been and continue to be published by The American Academy of Physical Medicine and Rehabilitation (AAPM&R) to support the needs of the millions of patients affected by PCC.[19] AAPM&R offers medical guidance for some of the symptoms of PCC including fatigue, neurological symptoms, cardiovascular complications, cognitive symptoms, autonomic dysfunction, and breathing discomfort.[20-25] AAPM&R provides links to research and guidance tables.[19] Furthermore, the dental hygiene process of care as outlined by the American Dental Hygienists' Association (ADHA), provides a framework to guide the practice of the dental hygienist in the provision of safe and effective patient care.[26] The ADHA supports "comprehensive risk-based assessment

of the patient's needs prior to and throughout the delivery of oral health services".[27] Prior to treatment, a dental hygienist will conduct a health history assessment which includes demographic information, vital signs, physical characteristics, social history, medical history, and pharmacologic history.[26] The evaluation of vital signs and the medical history interview are opportunities to identify contraindications or limitations to treatment in the clinical setting. Reviewing pharmacologic history similarly offers insight to recent changes in health. During the patient assessment phase, dental hygienists have the opportunity to identify patients presenting with PCC and can make referrals to specialists as needed.

Given the limited availability of resources addressing rural health clinical practice guidelines for managing patients with PCC, the purpose of this investigation was to test a protocol designed to provide guidance to dental hygienists in the assessment and treatment of patients presenting with Post-COVID Conditions (PCC) in the dental setting. The following research questions guided the conduct of this study: In what ways is the assessment protocol for treating patients with PCC appropriate for a dental practice setting?; In what ways is the treatment protocol for treating patients with PCC appropriate for a dental practice setting?; What are the barriers to using the assessment protocol?; and, What are the barriers to using the treatment protocol?

Methods

A qualitative exploratory research design was selected to evaluate the usefulness of an assessment and treatment protocol (ATP) for PCC and to identify any barriers to its use (IRB**:** FY2023-106). The COREQ Checklist was utilized in formulating and evaluating the study design.[28]

A purposive sample of registered dental hygienists engaged in clinical practice in the state of California were invited to participate in the study. The support of California dental hygiene professional organizations, the high rate of COVID-19, and the high number of

registered dental hygienists in California established good prospects for a sample population of study participants. Inclusion criteria for this study were registered dental hygienists in the state of California who were engaged in clinical patient care for a minimum of two days per week. Participants were invited to complete a screening survey to determine eligibility for the study.

The PCC ATP was developed based on the literature related to the assessment and management of PCC and other systemic health conditions.[16,29-38] A cohort of 5 dental hygiene educators and clinicians reviewed the PCC ATP to establish content validity and usability. Comments provided were positive and no changes were recommended to improve the protocols.

A six-week time frame was established to allow participants sufficient time to test the PCC ATP (Tables I and II) in their daily practice. Participants were invited to participate in an individual interview following the six-week time frame. Confidentiality and anonymity were preserved using pseudonyms within the Zoom platform.

The interview guide (Table III) was designed to obtain feedback regarding the participants' experience with the use of the ATP. The interview followed a semi-structured questioning route which included five elements: an opening question, introductory questions, transition questions, key questions, and an ending question asking participants if there was anything they would like the researchers to know about this topic.[39] The interview guide was validated by two experts in qualitative research.

The individual interviews lasted approximately thirty minutes. The principal investigator conducted each interview and followed the interview protocol to ensure no biases were introduced to enhance methodological rigor. The PI evaluated each transcript to make sure the key concepts were represented and that participants were allowed to restate main ideas to establish non-bias.[40]

The interviews and closed caption transcripts were recorded via Zoom and saved to a Zoom encrypted password protected account. Access to the recordings was limited to the PI

and the PI verified each transcript for accuracy. Each participant also reviewed their responses in the transcripts for accuracy. Interviews were conducted until saturation was reached with twenty participants.

The qualitative responses were coded and grouped into parent and child codes related to the participants' feedback using the qualitative research analytic platform Dedoose (Dedoose; Los Angeles, CA, USA).[41] The co-investigators systematically reviewed the codes using the classic analysis strategy to identify themes and subthemes.[39] Validity was established by pilot testing the interview, triangulation, saturation, and member checks to ensure validity and reliability and that researchers interpretation of the data was accurate.[39]

Results

Eighty-nine participants completed the screening questionnaire. Fifty-six participants qualified for the study and completed the six-week PCC ATP protocol. Of those individuals, twenty participants were interviewed. The majority of respondents were female (95%, n=19) and one participant was male (5%, n=1). Participants' years of practice ranged from 1 to 50 years with an average of 16 years. Quotes from the participants were condensed into seven parent codes and 33 child codes. Four themes were identified: Awareness, Accessibility, Resources, and Complications.

Awareness

Participants were asked about their experience in using the PCC ATP. The responses included having a better understanding of PCC and awareness of associated conditions that are related to PCC. Runner Girl stated, "It has made me more mindful about associating different signs and symptoms potentially caused by COVID. Before, I might have thought it was due to some other condition". Marie added,

> I am more aware when I am asking health history questions. We have not had anything related to post COVID on our medical history update for the last two months that I have

> been doing it [participating in the study]. It has been eye opening that patients are checking “yes” to some of the symptoms that I had not [asked] in the past.

Participants also noted the ATP facilitated open communication with patients. Flossy Posse expressed, “I think that the questions evoked good conversations. I would find out from people who knew people who had long covid symptoms and I would give them the information that you gave to all of us.” However, Kay noticed that there was sometimes a lack of awareness with patients about PCC and stated, “Patients were kind of wondering why we’re still going into details about COVID, because they feel like that is behind them”.

Accessibility

Participants reported the PPC ATP was very thorough and allowed them to show concern for their patients. Patients also appreciated that questions focused on mental and physical health and not just oral health. Most notably there were two subthemes that emerged including Ease of Use and Guidance.

Ease of Use

> Most participants described the protocols as quick and simple to follow. SY expressed, “I thought the assessment protocol was clear and very easy to navigate. The questions are laid out very clearly and the questions were simple. It was a very easy thing to implement while I had my patient in front of me”.

Other participants incorporated the protocols into the health history as evidenced by Flossy Posse who stated, “It wasn’t part of my medical history review and now it is. Mary Jo expressed,

> I would say that the treatment protocol was very helpful. It was thorough which I liked and it was easy to follow. I liked how it was in a chart form and you could easily look up if that patient is having that symptom. Just follow the column to see how you could treat them or what referral to give, or clinical applications they might be. It was clear and easy to read, and then a nice chair side tool to quickly reference.

Guidance

Helping clinicians understand the complexities of PCC and adapting to new conditions as they arise provided opportunities to use the PCC ATP as a framework for patient care. Irish Ufloss stated,

> I really like this treatment protocol because I feel like we've kind of been navigating this completely blind, not really having something to guide us with, how to talk to our patients about COVID, what we should be looking for and how we can change the appointment to really help them. It made me a better clinician. I felt like I was more knowledgeable about it.

Mary Jo noted,

> It really helped me identify modifications and where to direct patients when they are having issues. As a new hygienist, this was a life saver for me and it just made me feel a lot more prepared and confident, using this chairside with the patients.

Resources

Participants recognized the value of the PCC ATP as subject matter information that had multiple applications. For example, Carol reported,

> I'm going to be keeping these protocols handy and will continue to use them for my patients. It opened my eyes to the not so obvious long COVID symptoms. I can continue to help my patients and the people in my life, my own family. I realized that COVID has really affected myself and my child in ways that I didn't really connect the dots before. Now I realize that maybe we are having some long COVID symptoms or some post-COVID complications. Now I know I have a resource to help me look into that as well. It's going to help us not only in our practice but in our personal lives as well.

Mary Jo noted that these protocols would be important as chairside tools.

> They were great tools, and I would personally use them. I could laminate them and keep them chairside, if I come across a patient with PCC. You can easily pull it out during the appointment, and then make sure you're getting the patient the correct and best advice.

> Both the assessment and the treatment protocol would be great to have chairside; they're very helpful and resourceful references.

Finally, Irish Ufloss indicated the value of addressing mental health conditions as part of the PCC ATP.

> I had a patient who was hospitalized for Covid in December 2021. He was a 43-year-old, male, healthy, no meds. He was so sick he had to be in the hospital for 3 days and he's the only patient who said that he had anxiety and depression. I really like that you had that in the treatment protocol, because I never would have thought to ask about mental health when it comes to anxiety and depression. He wasn't taking any meds for anxiety or depression. He was choosing to handle it on his own. The one thing that he said that broke my heart was “when I entered the hospital, I had to leave my wife and 2 young boys, I got scared and thought, what if this is the last time that I'll ever see them”. It was so bad that he thought he might die. He's pretty young to have these thoughts. It affected his mental health, thinking that he could have died from Covid.

Complications

Participants were asked to describe barriers they encountered using the PCC ATP. Although half of the interviewees indicated they did not experience any obstacles using either the assessment or treatment protocol, others reported complications. Three subthemes emerged including Time, Clinician hesitation, and Patient lack of Cooperation.

Time

Participants indicated that time is a factor when being asked to add another element to an already crowded dental hygiene appointment. As Flower declared,

> I feel like an hour is never enough. I am always running behind. It's not enough to do blood pressure. It's just a lot. Having frequent breaks sometimes is tough. I'll talk to a

> patient and say “let's tough it through” or having to hand scale more. It's a barrier in regard to treatment protocol.

Danielle concurred with Flower describing,

> Lack of time, really. I want more time sometimes because I feel like it's a lot of the medical review. Really typically in a normal dental hygiene appointment I don’t have a lot of time for that. I felt like I wanted to spend more time discussing that with the patient than just doing their general hygiene services. It felt more important. That's my biggest barrier.

Clinician Hesitation

Some participants appeared to have concerns about aspects of their practice either in relation to scope of practice or the manner in which they provided care. Runner Girl, expressed, “When referring them to their physician, I couldn’t really follow up and say, ‘did you go see them?’ I couldn’t make the appointment for them. It was out of my hands. Irish Ufloss stated,

> I didn't want to make the patient feel like I'm being too invasive. Just because I am newer to them, and they were rarely being asked about their medical history to all of a sudden being asked a little bit more. That was my barrier. Trying to guide it and ease it in and not feel like I'm trying to step over any boundary.

Flower also reported reluctance to provide referrals and reported,

> I think for me the one thing that I didn’t utilize with the treatment protocol is the referral column. I think my lack of confidence in being able to have that conversation with patients about referrals. I say, “oh, you should probably go” instead of “you should go”.

Patient Lack of Cooperation

Participants reported there were some patients who had strong feelings about COVID-19 or were reluctant to answer health history questions that pertained to this disease or PCC. As Andi indicated,

> Early on, I could tell who was very anti covid, or vaccine, or doesn't believe in what's going on, because when you ask if you can ask them these questions, they'd flip out so I did have a couple of patients who don't believe that any of this actually occurred. That was very interesting to come up against that, because I didn't expect it.

Carol had a similar experience stating**,**

> I work in South Orange County and a lot of my patients think that COVID wasn't a thing and they're a little resistant to talk about it or if they had it, they get offended if you ask them about it, or they blow it off like it was no big deal. I had to beat around the bush almost to determine if they had any symptoms or issues. If they mentioned anything about symptoms, I would ask if they had COVID. They would answer “no, of course I didn’t have COVID”. I'm convinced a lot of my patients weren't even testing for it.

Additional supplemental quotes related to the themes and subthemes are shown in Table IV.

Discussion

The outcomes of this study establish the usefulness of the PCC ATP for utilization in clinical practice settings. Qualitative responses from research participants revealed themes associated with both facilitators and barriers to implementation. This data is beneficial in the further development of the protocol as a living document. Information from this research study can be used to develop clinical practice guidelines (CPG) to aid in the assessment and treatment of patients with PCC.

The American Dental Association (ADA) describes CPG as “the strongest resources to aid dental professionals in clinical decision making”.[42] Both facilitators and barriers of CPGs must be evaluated to ensure adoption. In this study, there were four themes (*Awareness, Accessibility, Resources, and Complications*) which emerged from the research participant interviews that relate to the framework of CPG.

Awareness was a recurring topic associated with the use of the PCC ATP. In a systematic meta review of facilitators and barriers of CPG, Correa et al. found that leadership

and administrative support were strong facilitators.[43] When there is an expectation of application of a clinical standard, clinicians are more likely to comply and have awareness of the expectation. De Vleminck et al. explored barriers and facilitators for patient interventions in a systematic review and found that accumulated skills to respond to a patient's needs were a strong facilitator.[44] Conversely, research conducted by Guncu et al. found a lack of awareness led to clinician hesitation in implementing CPG.[45]

The second theme of *Accessibility* was supported by subthemes of *ease of use* and *guidance*. Participant responses were favorable in describing the ease of use of the PCC ATP as well as showing regard for its value as a clinical guide. Research from Lau et al. established the presence of evidence-based practice and patient centered care as strong facilitators of implementation of CPG.[46]

The value of a protocol or CPG can be diminished if the barriers to implementation are not addressed. The barriers in this research study were related to the theme of *Complications* with subthemes of *time, clinician hesitation, and patient lack of cooperation*. Overwhelmingly, *time* was named as a barrier to implementing the PCC ATP. This finding echoes what has been found in the literature in regard to the implementation of CPG. Stewart et al. conducted a scoping review of "theories used to investigate clinician adherence to clinical practice guidelines" which revealed busy schedules as a barrier.[47] Likewise, Lau et al. in a systematic review of reviews noted clinician perception of time as a barrier.[46] Additionally, in a systematic meta review of the literature Correa et al. noted lack of time as a relevant barrier to the implementation of CPG.[43] Further, Spolarich explored the challenges in applying evidence-based research to clinical practice and noted lack of time identified as a barrier.[48]

Another barrier in implementing the PCC ATP was evidenced by the subtheme *of clinician hesitation*. Research participants mentioned hesitation regarding initiating referrals, explaining that it may be out of the scope of their practice or uncertainty regarding incorporating the ATP within the dental setting. Correspondingly, Spolarich and Correa et al. revealed lack of

knowledge on the part of the clinician as a barrier.[43,48] Furthermore, Spolarich and Lau et al. both noted confusion about clinician roles and responsibilities as barriers to implementing CPG, while Lau et al. cited additional workload as a barrier.[46,48]

The subtheme of *patient lack of cooperation* arose as a barrier to implementation of the PCC ATP. Research participants shared experiences of patients' attitudes and beliefs regarding COVID-19 and PCC as no longer being relevant. This relates to the finding of Correa et al. regarding patients' negative attitudes towards implementation of CPG, a lack of knowledge, and sociocultural beliefs.[43]

This study suggests that providing clinicians with evidence-based guidelines for assessing and treating patients with PCC in the dental setting is a useful resource. Providing training to oral health care providers to clarify roles and responsibilities, scope of practice, timesaving or efficiency strategies can address the barriers noted in the research study as well as the literature. Modifying the assessment and treatment protocol to be accessible as a chairside resource may also increase compliance.

Limitations and Future Research

Despite the efforts of the researchers, there were limitations to this study. The primary limitation of the study is related to the purposive sampling which limits generalizability to all oral health care providers. In qualitative research, interviews are not intended to generalize but rather to delve deeper into a topic.[39] Qualitative research methods can provide insight into perceptions and opinions which may not be revealed in a quantitative research design. Another limitation can occur when the PI acts as the moderator. There is a potential for bias when the PI is involved in the data collection. However, strategies such as pilot-testing, member checks, and the presence of a co-investigator were utilized to control bias.

Suggestions for further research include implementing the PCC ATP guidelines among dental hygiene education programs to prepare students to provide appropriate care for patients

with PCC. In addition, it is recommended the ADHA use the PCC ATP as a framework to develop consensus guidelines for dental hygiene practice.

Conclusion

California dental hygienists engaged in clinical practice 2 or more days per week were recruited to test an assessment and treatment protocol for patients with PCC for 6 weeks and then share their experiences in an online interview. Four themes emerged regarding the use of protocols in the dental setting. Findings revealed that participants found the protocols created awareness of the varied symptoms of PCC and that they were accessible in regard to ease of use and helpful as a guide or resource. Complications in the use of the protocols were related to time, clinician hesitation, and patient lack of cooperation. Providing dental hygienists with these resources supports efforts to provide person-centered evidenced-based care.

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Tables

Table I. Assessment Protocol

Supplemental Medical History Questions		
Have you had COVID-19? If yes, how was it diagnosed? ▢ At home (COVID-19 rapid test) ▢ Doctor's office (PCC test)	▢ yes	▢ no
Were you hospitalized for COVID-19? If yes, how long? _____	▢ yes	▢ no
Were you admitted to intensive care for COVID-19 treatment?	▢ yes	▢no
Were you intubated?	▢ yes	▢ no
Are you experiencing any post-COVID-19 symptoms which have lasted longer than 4 weeks?	▢ yes	▢ no

Please mark any that apply:		
▢ Fatigue	▢ Shortness of breath	▢ Loss of smell or taste
▢ *Cough	▢ Muscle and/or body aches	▢ Brain fog (difficulty concentrating)
▢ Chest pain	▢ Blood clots	▢ Anxiety or depression
▢ Other (please describe) _____ _____ _____ _____ _____ * Patients with a chronic cough may need to provide a negative COVID-19 test prior to treatment.		

Table II. Treatment Protocol[16,29-38]

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
Chronic fatigue	N/A		Shorter appointments	Primary care provider
Shortness of breath	Oxygen, bronchodilators, systemic corticosteroids	Decrease in physical activity	Semi-supine position Pulse oximetry monitor Shorter appointments	Respiratory therapist Pulmonologist
Chronic cough	Antitussives	Drowsiness, shakiness, slowed breathing	Rapid COVID test Semi-supine position	Respiratory therapist Pulmonologist
Venous thromboembolism	Antiplatelet medications Anticoagulant medications	Potential for prolonged bleeding	Frequent breaks, shorter appointments	
Chest pain	Nitroglycerin tablets	Chest pain	Discontinue treatment if present Monitor symptoms	Cardiologist

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
Seizures	Anti-seizure medications	Gingival enlargement Increase risk for periodontal disease and caries Orofacial trauma Central nervous system depression Gastrointestinal distress Drug interactions	Fixed prosthesis May interact with certain antibiotics or antifungals Knowledge of seizure triggers Morning appointments Shorter appointments Reduce stimuli (noise and lights) Use caution with NSAIDs Frequent oral prophylaxis Thorough oral hygiene instruction	Neurologist
Cognitive changes (brain fog)	N/A	Inability to make decisions	May need to include another decision maker, ensure consent prior to treatment	Primary care provider

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
Postural orthostatic tachycardia (POTS)	Increase fluids, add salt to diet Medications (beta-blockers)	Lightheadedness, brain fog, fatigue, headache, palpitations, tremor, intolerance of exercise	Slow raising and lowering of dental chair	Primary care provider Neurologist Cardiologist
Chronic headache	Analgesics		Shorter appointments	Primary care provider Neurologist
Chronic pain	Analgesics, opioids	Difficulty with extended appointments Pain in certain positions	Shorter appointments Adjust anesthesia dose and type as needed	Primary care provider
Kidney impairment	Lifestyle modifications Diuretics ACE inhibitors Statins Vitamin Supplements Dialysis	Decreased renal metabolism	Shorter appointments Adjust anesthesia dose and type as needed Avoid NSAIDs	Nephrologist
Liver impairment	Lifestyle modifications Medications	Decreased hepatic metabolism Jaundice	Adjust anesthesia dose and type (amides) as needed. Avoid hepatic-metabolized medications Avoid NSAIDs	Gastroenterologist Hepatologist

SIGNS & SYMPTOMS	THERAPEUTICS	CLINICAL IMPLICATIONS	TREATMENT MODIFICATION	REFERRAL
Anxiety/depression	Antianxiety or antidepressant medications	Increased risk of periodontal disease and caries Xerostomia CNS depression	Salivary replacement, topical fluoride Iatrosedation Avoid epinephrine with tricyclic antidepressant	Primary care provider

Table III. Interview Guide

Interview Guide		
Opening	1,	Please tell us your pseudonym for this research focus group. How long have you been a dental hygienist?
Introduction	2.	How has your practice been impacted by COVID-19?
Transition	3.	What is your understanding of PCC?
	4.	How has treating patients with post-COVID conditions affected your delivery of dental hygiene care?
	5.	How prepared have you felt in identifying and treating patients with PCC in your dental practice setting.
Key	6.	What was your experience using the assessment protocol?
	7.	What was your experience using the treatment protocol?
	8.	What barriers, if any, did you encounter when using the assessment protocol? How did you manage those barriers?
	9.	What barriers, if any, did you encounter when using the treatment protocol? How did you manage those barriers?
	10.	What if anything would you like to add to the assessment protocol?
	11.	What if anything would you like to add to the treatment protocol?
Ending	12.	What are your final thoughts related to the use of the assessment and treatment protocol? Is there anything else you would like the researchers to know about the assessment and treatment protocol?

Table IV. Supporting Quotes Related to Themes and Subthemes

Theme/ Subthemes	Supporting Quotes
Awareness	My experience was shocking for me that I found out so many people either didn't have it or didn't know they had it. I figured at this point everyone had it. Also, I think that the questions evoked good conversations. Flossy Posse I found a lot of them were not really aware that some of their symptoms could be related to Post Covid. Marie There's so many more conditions that develop with COVID that we don't know about. So I really liked that at the end of the assessment you could add in any extra conditions that weren't listed. It really helps us as hygienist(s) to associate these with ongoing COVID and just helps us build a better understanding. Ellie Mack Basically, it was educating patients about possible symptoms that they could have, and that might need to be addressed. It created awareness! Jenn
Accessibility: Ease of Use	It was excellent. I thought the questions you had in the assessment were right on and it was very clear cut, easy to answer, easy to respond to and I thought it was great. The treatment protocol, overall, I felt was very well designed and executed. Rose I liked it because it was very short and condensed, straight to the point. SY The assessment protocol, it's a great tool to go through and ask patients, and to have at hand like this. It's very helpful. Fangs The treatment protocol makes sense as a lot of it is what we normally would do with the patient with similar symptoms. It was very good. Kay
Accessibility: Guidance	It actually was quite helpful in order to make sure that you were getting all of the questions asked that they needed to have done that we had to have and just to make sure that we did all of it, that we asked all of the questions. Monty It also helps me to consider taking some precautions or accommodations for patients with certain symptoms. Isa

	It helped guide me. Maybe, as we learn a little bit more and have the ability to do more in an office that we could add to it as we learn. Runner Girl
Resources	Having a tangible, like a link, or being able to show them something that they would have access to, or they could share with a medical provider. Or find a medical provider for something specific. I've only had a few people that were like, I'm not getting answers, and I'm struggling. I was able to give them more information that they were getting from their medical team. Danielle I appreciate that this was available for me to be able to use and implement into my office just because I never really had a resource like that, or I'd never really sought out resources for PCC. Jenn But what I really did like with the treatment protocol was having those referrals, because I haven't done that before. Marie Overall, it was helpful and just because it helped me know right away what to do and in the sense of not having to fidget around in my operatory to try to find a modification. To use it as a reference to make a modification if needed. Flower
Complications: Time	I was not able to ask every single patient, because we're so stressed for time. And I just know some patients. Once they start talking about Covid, it gets into a I'm going to go down a rabbit hole with them that I just don't have time for. Anita When you got someone in your chair and they had Covid. Then they wanted to tell you the whole story, and sometimes that was a disadvantage because we don't have time for a 15 min conversation about Covid when we're trying to get our treatment taken care of. Andi Mainly time. I tried to ask all my patients, but sometimes because of the many tasks we have at the office. Isa
Complications: Clinician Hesitation	There were a couple of people that were like, “Oh, I really don't want to answer those questions”, and I didn't really force the issue. Runner Girl That is one of the hardest things for dental hygienists right now is that we're very knowledgeable about many different things. But it's really not in our scope to say you should talk to a neurologist, or you should talk to so and so. So that's not really appropriate. It

	might not even be appropriate for a dentist to do that. But I have no qualms for suggesting someone talk to their primary care about these issues. Andi At first I was a little hesitant because I had a hard time formatting how I would ask patients and if it would be too invasive. I found that some patients are not super happy about being asked about their medical history. Flower
Complications: Patient Lack of Cooperation	Only maybe one person started asking me questions, saying that it is a bureaucratic questionnaire. Why, even ask and he started arguing about that. Isa I had quite a few that would push back. Patients stating that Covid doesn't matter anymore. It's just the flu. Ellie Mack